

**CULTURALLY MODIFIED PICTURES IN
PRINTED MEDIA AS AN ADJUVANT TO
EDUCATION IN DEVELOPING COMMUNITIES**

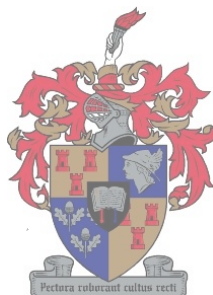
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Dissertation submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy
in higher education at the University of Stellenbosch

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December 1999



DECLARATION

I, the undersigned, hereby declare that the work contained in this dissertation is my original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

SUMMARY

Instructional pictures can significantly facilitate recall, comprehension and problem-solving skills. This learning effect is robust and can be achieved with a variety of learners, text, pictures, media, and learning conditions. Pictures can also distract from the learning process and interfere with the process of learning how to read. People can experience difficulty in utilising pictures in picture-text learning material due to unfamiliar graphic conventions and inadequate visual and verbal literacy skills.

The aim of this study was to investigate the use of pictures in picture-text learning material, and in particular the value of culturally modifying pictures in such material to increase the learning facilitation effect. The focus was on learners from developing communities.

The study consisted of four phases: the development of a theoretical foundation through a literature study; an empirical component that investigated the effect of culturally modified pictures when they are combined with printed educational text; recommendations for the design and development of picture-text learning material; and the development of a model that explains and predicts pictorial learning facilitation.

The literature study isolated twenty-two general factors that influence the learning effect of pictures and a further ten factors applicable to learners from developing communities. Nineteen principles were identified that can improve pictorial material that is used in educational material, health education and development programmes. Culture was shown as a filter through which people receive, interpret and transmit messages. The literature study concluded with a model that projected the picture-text-communication process in education as an open system, which takes place within a cultural environment.

More than seven hundred subjects participated in eight experiments. The results have shown that culturally modified pictures do not necessarily increase recall, comprehension or problem-solving abilities more than instructional pictures that are not culturally sensitised or modified to their audience. Subjects have shown that they prefer pictures that are modified to their own culture. Culturally appropriate and relevant graphic elements and conventions might not necessarily reveal measurable cognitive value, but are important elements in instructional picture-text learning materials that are specifically aimed at developing and undeveloped communities.

The study proposed a learner-centred theory for pictorial learning facilitation, seven principles for the design and development of picture-text learning material, and an

analytical model that instructional designers can use during a formative and evaluative process of pictures in picture-text learning material.

The main contribution of the study is a model for the explanation and prediction of pictorial learning facilitation in picture-text learning material. This model provides the means to use existing and anticipated data to predict the effect of picture-text learning material in a specific learning situation with specific learners. It also provides a means to explain the results of a picture-text learning occurrence.

Sociocultural variables in text and pictures play an important role in picture-text learning material when such material is aimed at learners from developing communities. These variables become less important when the subjects move towards an urbanised, developed and heterogeneous community. Cultural appropriateness in pictures can affect the congeniality of picture-text learning material, but does not necessarily contribute on a cognitive level to the value of picture-text learning material. Inappropriate cultural conventions in text and pictures can, however, create a barrier in communication and thereby affect the cognitive value of such learning material.

OPSOMMING

Onderrigbeelde kan herroeping-, begrip- en probleemoplossingsvaardighede betekenisvol fasiliteer. Hierdie leereffek is kragtig en kan met 'n verskeidenheid leerders, tekste, beelde, media en in verskillende leeromstandighede bereik word. Beelde kan ook aandag van die leerproses aftrek en met die proses inmeng waar geleer word hoe om te lees. Mense kan probleme ondervind met die gebruik van beelde in beeld-tekstleermateriaal as gevolg van onbekende grafiese konvensies en onvoldoende visuele en verbale geletterdheidsvaardighede.

Die doel van hierdie studie was om die gebruik van beelde in beeld-tekstleermateriaal te ondersoek, met spesifieke klem op die waarde van kultuuraangepaste beelde in sodanige materiaal om die leerfasiliteringseffek te verhoog. Die fokus was op leerders vanuit ontwikkelende gemeenskappe.

Die studie het uit vier fases bestaan: die ontwikkeling van 'n teoretiese grondslag deur 'n literatuurstudie; 'n empiriese komponent wat die effek ondersoek het van kultuuraangepaste beelde wanneer dit met gedrukte onderrigtekste kombineer word; aanbevelings vir die ontwerp en ontwikkeling van beeld-tekstleermateriaal; en die ontwikkeling van 'n model wat onderrigbeeldleerfasilitering verduidelik en voorspel.

Die literatuurstudie het twee en twintig algemene faktore geïsoleer wat die leereffek van beelde beïnvloed, sowel as 'n verdere tien faktore wat van toepassing is op leerders vanuit ontwikkelende gemeenskappe. Negentien beginsels is geïdentifiseer vir die verbetering van onderrigbeeldmateriaal wat in onderrigmateriaal, gesondheidsopvoeding en ontwikkelingsprogramme gebruik word. Kultuur het na vore gekom as 'n filter waardeur mense boodskappe ontvang, interpreteer en oordra. Die literatuurstudie het afgesluit met 'n model wat die beeld-tekstkommunikasieproses in onderwys geprojekteer het as 'n oop stelsel wat binne 'n kulturele omgewing plaasvind.

Meer as sewe honderd proefpersone het aan agt eksperimente deelgeneem. Die resultate het getoon dat kultuuraangepaste beelde nie noodwendig herroepings, begrip- of probleemoplossingsvaardighede meer verhoog as onderrigbeelde wat nie kultureel vir sy teikengroep vatbaar gemaak of aangepas is nie. Proefpersone het egter getoon dat hulle beelde verkies wat by hul eie kultuur aangepas is. Kultuurtoepaslike en -relevante grafiese elemente en konvensies sal nie noodwendig meetbare kognitiewe waarde openbaar nie, maar is belangrike elemente in onderrigbeeld-tekstleermateriaal wat spesifiek gerig is op die ontwikkelende gemeenskappe.

Die studie het 'n leerdergesentreerde teorie voorgestel vir onderrigbeeldleerfasilitering, asook sewe beginsels vir die ontwerp en ontwikkeling van beeld-tekstleermateriaal, en 'n

analitiese model wat onderrigontwerpers kan gebruik gedurende 'n formatiewe en evaluerende proses van beelde in beeld-teksteleermateriaal.

Die vernaamste bydrae van die studie is 'n model vir die verduideliking en voorspelling van onderrigbeeldleerfasilitering in beeld-teksteleermateriaal. Hierdie model maak dit moontlik om bestaande en verwagte data te gebruik om die effek van beeld-teksteleermateriaal in 'n spesifieke leersituasie met spesifieke leerders te voorspel. Dit voorsien ook 'n metode om die resultate van 'n beeld-teksteleergebeurtenis te verduidelik.

Sosiokulturele veranderlikes in teks en in beelde vervul 'n belangrike rol in beeld-teksteleermateriaal wanneer sodanige materiaal gerig is op leerders uit ontwikkelende gemeenskappe. Hierdie veranderlikes vervul 'n minder belangrike rol wanneer die proefpersone na 'n verstedelike, ontwikkelde en heterogene gemeenskap beweeg. Kulturele toepaslikheid in beelde kan die geskiktheid van beeld-teksteleermateriaal affekteer, maar dra nie noodwendig op 'n kognitiewe vlak tot die waarde van beeld-teksteleermateriaal by nie. Ontoepaslike kulturele konvensies in teks en beelde kan egter 'n hindernis in kommunikasie veroorsaak en daardeur die kognitiewe waarde van sodanige leermateriaal affekteer.

ACKNOWLEDGEMENTS

I hereby acknowledge the assistance and support of the following persons and institutions who made the completion of this research project possible:

- Professor Chris Kapp, my promoter, for his supervision and encouragement during my period of study.
- Dr Johann Hugo, my co-promoter, whose specialist knowledge and advice on particular matters pertaining to the contribution made by this project.
- The Technikon Free State, which provided me with 11 months' study leave to complete the empirical work and the thesis.

- The Free State Department of Education, for granting me permission to use pupils from schools under their control as subjects in the empirical work.
- The Centre for Science Development (part of the National Research Foundation) for their financial support in the form of a scholarship. Opinions expressed and conclusions arrived are those of the author and are not to be attributed to the Centre for Science Development.
- The Commonwealth Commission for a scholarship to study for a period at The University of Reading.
- The Harry Crossley Trust for a bursary.
- Dr. Cay van der Merwe who assisted me with the statistical analyses.
- Robert M. Branch who gave supporting comments on my thesis proposal at the beginning stages of the project, Rune Pettersson for his valuable comments on one of my experiments, and Mary Dyson for her constructive criticism.
- The principals, teachers and pupils at the schools who willingly gave their co-operation during the empirical work.
- My colleagues at the Technikon Free State - Lukas van Vuuren, Nic Esterhuizen, Marietjie van Deventer, Chris van Rensburg, Thomas Vermeulen and Johan Verster - for their constructive and implied moral support.
- My wife, Meryl de Lange, who supported me throughout the study.

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CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND

This study investigates the learning effect of culturally modified pictures when combined with printed educational text. The research focuses on the subjects' ability to recall, problem-solving skills, and to comprehend the information that is presented in the picture-text material. The study consists of empirical work within a theoretical framework resulting in recommendations and a proposed model. This study takes place within the broad field of educational technology and focuses particular on the facilitating effect of pictures within a developing community.

Past studies have found sufficient evidence that pictures, under certain conditions, can significantly facilitate the comprehension and recall of prose and instructional text when they are combined with prose and text (Levin and Lesgold, 1978; Levie and Lentz, 1982; Goldsmith, 1984; Moore and Skinner, 1985; Pettersson, 1993; Mayer, Bove, Bryman, Mars and Tapangco, 1996). Researchers have also reported that some pictures do not assist with comprehension and recall, and that they can even have a negative effect when beginner readers learn how to read (Samuels, 1970; Concannon, 1975; Solman, Singh and Kehoe, 1992; Wu and Solman, 1993; Solman and Wu, 1995). The conditions under which pictures facilitate learning, the magnitude of these facilitating effects, and the type of pictures in picture-text material that can produce these learning effects are known (Dwyer, 1978; Levie, 1987; Mayer, 1989; Mayer and Gallini, 1990; Mayer, 1993). This knowledge is unfortunately not always applied by publishers (Woodward, 1993), which can result in less-effective picture-text learning material.

Researchers and development workers have reported that subjects from developing communities and those with little exposure to visual media have difficulty in the perception and the utilisation of pictorial information (Hudson, 1960 and 1967; Schwitzgebel, 1962; Winter, 1963; Ajayi-Dopemu, 1982; Bentley, 1986). It is theorised that some of these difficulties in understanding pictures and messages represented by pictures are due to unfamiliar cultural conventions depicted in the pictures (Ajayi-Dopemu, 1982; Tzeng and Trung, 1990). It is also believed that Western-oriented

pictures and graphic conventions are less effective in education if they are not culturally modified for specific audiences in developing communities (Ajayi-Dopemu, 1982; Stacy, 1991; Kalsi, 1990; Stedler, 1992; Linney, 1995). One example of an inappropriate Western-oriented graphic convention referred to by Hugo and Smit (1998:89-90) is where a huge cockroach was shown alongside a recommended insecticide product. Subjects from the target audience were not able to interpret the message correctly and refused to use the product, as they assumed that the cockroach would grow to the depicted size if they were to use the insecticide.

Limited empirical research results, in the South African context, are available on the efficacy of culturally modified pictures when they are used in combination with instructional text and as an adjunct to the instructional text. Hugo and Skibbe (1991:49), with reference to health education, remarked that although studies of different communication media have been completed, no previous research results are available on patients' ability to read instructional pictures. The patients referred to by Hugo are illiterate patients. The Human Sciences Research Council published scientific papers related to the subject, but these did not address the effect of making pictures indigenous to a specific audience (Jordaan, Steyn, Van Aswegen, Rossouw and Swanepoel, 1986; Van Aswegen and Steyn, 1987). In related work, Hugo and Skibbe (1991) and Hugo (1994 and 1995) published research results on the appropriateness of simple line drawings with text captions, a picture card game, and the ability of illiterate patients to interpret instructional pictures. Other reported studies used either illiterate subjects (Zimmerman and Perkin, 1982) or subjects with a different culture (Patel, Eisemon and Arocha, 1990) to those in Southern Africa.

It is difficult to generalise the results of pictorial studies completed in the West, or studies that used illiterate subjects, to the newly urbanised and developing communities in South Africa, as these subjects have different value systems, traditions and social structures. Different cultural backgrounds and home languages contribute to heterogeneous developing communities in South Africa make the generalising of reported research to these communities difficult.

An AIDS prevention photonovella, "Roxy", a photographic based comic book, published by the *Story Circle* (1993), comic narratives with social messages by *The Storyteller Group* (1991a; 1991b; 1991c), and a publication by Soul City (n.a.) on using energy in the home attest to the belief of publishers that pictures must reflect the people for whom they are developed, as well as their environment and culture. Research reports on these publications (Bahr and Rifkin, 1992; Mathews, Everett, Reddy and Lombard, 1994; Mathews, Everett, Binedell and Steinberg, 1995) noted that even subjects who

had little experience with comics were able to follow the visual narratives, that the material was popular, that it was accepted by the community, and that the readers had a sense of identification with the characters in the stories.

Social and cultural appropriateness in pictures are crucial factors that could influence the effectiveness of a comic in extension and development work (Gillman, 1994). The importance of social-cultural sensitivity, within the context of accepting health messages and learning materials by specific target audiences, is also emphasised by Hugo (1997:262). In a follow-up article, Hugo and Smit (1998:91) stated that health learning material and messages should, if so required, be modified. This modification process signifies the inclusion of *“cultural identification cues”* such as clothing, familiar objects and body language gestures, to name but a few.

Three concepts are introduced in the introductory paragraphs, namely that pictures under certain conditions can significantly facilitate recall and comprehension of information presented in picture-text learning material; that some subjects have difficulty in utilising pictures effectively; and that unfamiliar graphic conventions, amongst other factors, contribute to this difficulty.

Pictures that are culture specific and which are socially sensitive appear to be a recognised method whereby communicators attempt to improve the efficacy of their printed material. Efficacy in this context comprises the popularity of the material, the acceptance of the material by the target audience, and the identification or association that the audience has with the material.

Making a picture that is used as an adjunct to picture-text learning material, culture specific, however, does not necessarily imply that the picture will increase a person's recall and comprehension of the information that is presented in the instructional text.

1.2 DEMARCATION

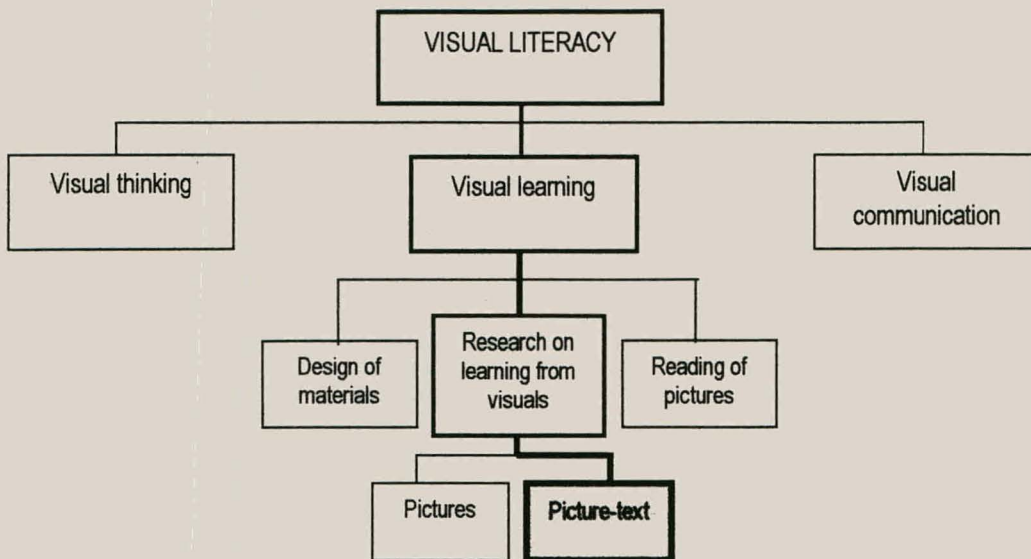
Seels (1994:105), in her a discussion on visual communication, visual learning and visual thinking, proposed these three constructs as the main components that contribute towards the wider field of visual literacy. Research on visual learning, which is a smaller component of learning, refers to research that is related to the effect of visual

stimuli on the outcome of specific learning objectives. She (*Ibid.*, 1994:107) further suggests that the terms “message design” and “instructional design” are synonymous and are current terms to describe research related to the design of visuals for learning.

The position of this study in relation to visual literacy is graphically presented in Figure 1.1. This figure is adapted from Seels (1994:105), who depicted relationship of areas of study in visual literacy.

FIGURE 1.1

The position of this study in relation to visual literacy.

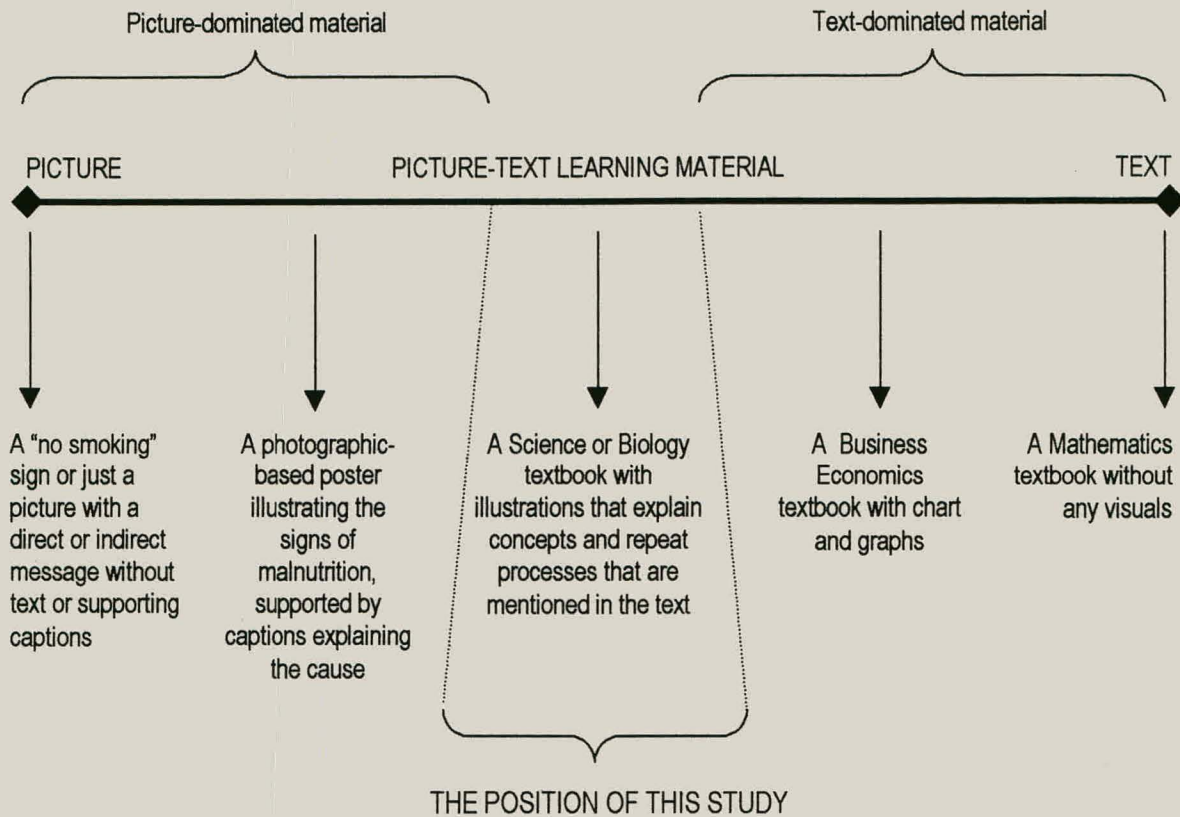


This study investigated the effect of culturally modified pictures when combined with printed educational text. The emphasis is not on learning primarily from the pictures, but on the effect that modified pictures have when they play a supporting role to the text, as is found in school textbooks.

The position of this study, in relation to learning just from text and learning solely from pictures, is demarcated in the simplified figure on the next page. Printed material that is composed just of picture items is placed on the left, whilst text-only material is placed on the right of the continuum.

FIGURE 1.2

The position of this study in relation to text-only and picture-only instructional material.



The above figure placed the position of the study in an area where learning takes place with the aid of text supported by pictures. Learning in its broadest sense can be defined as a relative permanent change in a person. This change can be the person's behaviour, insight, perception or motivation, or a combination of these (Houston, 1991:21, Bigge and Shermis, 1992:1; Hergenhahn and Olson, 1993). Learning in the context of this study has taken the approach of the researchers who publish in this field and is confined to a learner's recall, comprehension and problem-solving abilities. Learning theories of the 20th century appear to be classified into the cognitive or interactionist theories, the S-R (stimulus-response) conditioning theories or behaviouristic theories (Bigge and Shermis, 1992; Hergenhahn and Olson, 1993) and a constructivist view of learning (West, 1988:58-62). Learning from pictures and text would fall in the domain of the S-R theorists where pictures, colour in the pictures, labels next to the pictures, and instructions, for example to attend to the pictures, are all agents of stimuli.

1.3 CLARIFICATION OF TERMS

Researchers from diverse academic fields contribute to the science of picture-text communication within an educational context. The terms and concepts in this thesis consequently come from education, educational psychology, visual communication (graphic design), educational technology, health communication, and development communication.

There are four concepts in this study that are reflected in the title, namely “*pictures*”, “*culturally modified*”, “*developing communities*” and “*education*”. These four main concepts are explained. The rest of the terms are discussed in Addendum 1 at the end of this chapter.

Pictures

Braden (1994:194), in a discussion on visual - verbal relationships, states that the word “visual” is synonymous with image, picture and illustration. He further comments that within the art and educational fraternity the noun “visual” is meant to convey visual aids, or the images of several kinds that are used to communicate. The word “visual” has further been used to describe paintings, charts, diagrams, graphs or sketches. Pettersson (1993:143-145) also uses the term “visual” as a general reference to symbols and pictures within the context of learning from verbo-visual messages. Wileman’s (1993:19) typology of the relationship between verbal messages and visual images/messages places pure verbal content at the one end of a figure and a pure graphic or pictorial symbol, devoid of typographic additions, at the other end of a figure. In the middle of the two extremes are variations of visual/verbal messages with dominance going either to the verbal or visual side. An “*Icon-Digital Continuum*” (Braden 1994:201) places pictorial symbols, represented by a photograph, at the one end of a scale and verbal symbols, represented by a noun, at the other end. Further classification systems and a discussion of classification are provided by Hunter, Crismore and Pearson (1987) and Pettersson (1993:201-224). These systems classify visuals according to their function, and from realistic or concrete to abstract.

From the above it appears that the word “*picture*” is sometimes synonymous with the word “*visual*”; picture is regarded as a separate concept in the visual-verbal continuum; pictures can be classified as being symbolic, schematic, suggestive or realistic; pictures can be further sub-classified according to their function; and pictures can be placed in a continuum ranging from abstract to realistic. The variation of the classification and description of pictures is extendable by including picture styles, colour, degree of realism, size, media usage, and the function that they fulfil in relation to the text they accompany. Pictures, within the context of visuals and the variation of

classification systems referred to above, are defined for this study as a general term to refer to *unambiguous realistic images*. These images can be represented by photographs, line illustrations or shaded illustrations. The shaded and line illustrations that are used for the empirical work are examples of “*pictures*”.

Culturally modified

Culture in its widest sense is defined by Samovar and Porter (1995:101) as that which designates what a person pays attention to or ignores, i.e. it acts as a selective screen between the person and his/her outside world or environment. Groenewald (1996:13-23) cites perception, values, beliefs, attitudes and a person’s world view as elements that make up an individual’s culture. He furthermore states that culture is not only a screen but that it might affect someone’s interpretation of reality in such a way that his/her understanding of the reality may be different from that of another person. Pictures, the recognition of pictures and the meaning attached to pictures and elements of pictures are influenced by culture and are thus but a small element in the wider field of culture. The concept of culture, in the context of pictures and this study, refers to the food, clothing, symbols, environment, physical features and other familiar items of the people to whom the visual message is directed. “Culturally modified” therefore signifies the *visual transforming or translating of a picture so that the picture reflects the visual dialect of the end-user of the learning material*. The words “*visually translating*” are used by Schiffman (1996:67) to describe a process of visually translating pictorial components of educational material for ethnic minorities in the United States. This translating process entails the changing of cross-culturally inappropriate health learning material to become more appropriate through the use of appropriate colour, symbols, cultural norms and the depiction of lifestyle. Schiffman (1995:273) also describes the depiction of these visual symbols and images as “*sociovisual*” and “*ethnovisual*” elements. These elements combine to provide a culturally influenced language or a visual dialect appropriate for a specific ethnic group. Hugo (1997:265) uses the term “*media acculturation*” in the context of appropriate message design in a multi cultural situation.

Developing communities

Researchers who work in the field of visual-verbal learning describe their experimental subjects by listing demographic details, level of schooling, literacy ability and/or the socio-economic condition and cultural/ethnic background. Preliterate, illiterate and low-literate are some terms used to describe the subjects’ verbal or visual competencies in dealing with verbal and visual messages.

Developing and developed countries are popular mass media terms (radio, television and newspapers) that are used to describe industrialised countries, for example those in

North America and Western Europe, and to describe less-affluent countries, for example those in Africa.

South Africa is in the position where segments of the population are affluent and have access to medical care, education and social benefits services, whilst populations from rural areas have insufficient resources and more often than not have low levels of verbal literacy. In between the developing rural and developed urban areas are populations that have limited resources and unsatisfactory access to education, medical care, and social and public services. A migration of people from rural and farming areas into these peri-urban areas, or township areas, gave rise to informal settlements or shantytowns. Developing communities, in the context of South Africa and this study, refers to *communities living in peri-urban areas and informal settlements* in the process of growth and change.

Other terms that are used for this dissertation are given in Addendum 1 at the end of this chapter.

Education

The term education is a wide concept and can, according to Griesel, Louw and Swart (1993:16), denote everything from the science of education to the educative practice. It can also imply concepts such as moulding, guidance and disciplining. Griesel *et al.* (1993) further projects the concept of education as educative actions where the educator uses encouragement, commendations and rewards so that the educand can assimilate certain criteria and try to act in accordance with the criteria. Griesel and Oberholzer (1994:16) further defines education as a purposeful act where one person influences another with a specific purpose to affect change. However, the final result of education cannot be guaranteed. Pictures when used in conjunction with instructional text can assist the learner or educand to assimilate knowledge or guide them on how to comprehend difficult text. The term education in the context of this study denotes the educative practice that is supported by pictures and where the outcome of the practice is to improve recall, comprehension and problem solving skills.

1.4 STATEMENT OF THE PROBLEM

Researchers found intercultural differences between the meaning of colour (Jacobs, Keown and Worthley, 1991), the preference of colour (Hugo, 1994), visual instructional media (Beentjes, 1989), response to pictorial stimuli (Bentley, 1986; Deregowski and Bentley, 1986), picture interpretation skills (Liddell, 1997), and the preference for and interpretation of graphics (Pettersson, 1982; Tzeng and Trung, 1990). Zeuschner

(1992:393) believes that filters and screens operate when senders and receivers are from different cultures and concludes that: "... *these barriers can actually reverse the meaning, or ignore the content of, an incoming message*". Although he was discussing aspects of intercultural communication, it would not be improper to generalise the application of his statement to visual material as well.

A mismatch between a communicator's intentions and the receivers' understanding of a message can occur, especially when the designer of the message and the recipients are from differing socio-cultural backgrounds (Hugo, 1994; De Lange, 1995). This disagreement between message and recipient is aptly illustrated by Hugo and Smit (1998:88), who cite several examples of health communication messages in Africa where the intended message was misunderstood by the target market or where there were moral objections to the visuals in the message.

This difficulty is also highlighted by Garforth (1982 and [n.a.]), who attributes this misinterpretation to differences in culture, unfamiliar terminology, incorrect interpretation of the visuals and inadequate research on the intended audience's information needs. A similar opinion is also expressed by Melkote (1991), who found that those who develop messages that are aimed at subjects with a low level of literacy are biased towards literacy. Messaris (1994) notes that the argument about barriers in cross-cultural communication and difficulty in pictorial interpretation across cultures becomes viable when one deals with the subject matter of the visual images. Such a barrier was found in a study by Griffin, Pettersson, Semali and Takakuwa (1995), where the aim was to measure how well people from different countries would interpret symbols that would be used in international business presentations. Three hundred and two subjects from Sweden, the United States, Tanzania and Japan participated in a survey where they had to classify a series of clip art symbols. The main conclusions of the study are that there are many ways to interpret a symbol and that there are strong cultural differences in the way that people interpret symbols.

A mismatch between a message and an audience is possible not only where there is a difference in culture or literacy levels between communicator and receiver, but also within homogeneous and literate communities.

In a study using literate subjects, Zwaga and Boersema (1983) reported that only 15 of 29 symbols met a criterion of sixty-seven percent correct responses from a sample of 11600 railway passengers in the Netherlands. If a large homogeneous sample from a visually literate society in the Netherlands had difficulty in correctly interpreting their own symbols, then it is also probable that developing communities will find it difficult to benefit educationally even from images that are designed for them. It must be noted,

however, that symbols are abstract and that symbolic images rely on recognition and correct interpretation for their use. Pictures rely not only on their recognition and correct interpretation to assist recall and comprehension of text, but are dependent on text-picture combinations, the function that they fulfil in the text, picture characteristics and even the learners that use the text, before a facilitating effect becomes evident.

The phenomenon of misunderstood visually based messages is also reported by researchers in the advertising and marketing industry. Mody (1991:186), for example, refers to a thirty percent misunderstanding of American television and print advertisements by Americans, and a twenty-one percent misunderstanding of magazine articles in the same country. This incongruence between the intended message and the perceived message within the advertising field is noted in South Africa by Stacy (1991 and 1992), and is reflected in various popular marketing articles (*Marketing Mix*: October 1992:6-7; March 1992:32-33; September 1993:25-28; May 1991:40-41). In another popular marketing article, Stedler (1992:28), discussing Third World marketing, believes that "...culturally unique imagery could improve the effectiveness of communication strategies." Although there is a perception in the advertising arena that cultural imagery could be helpful for specific audiences, it might not be easy to measure this benefit in experimental conditions.

Fullagar and Barling (1983), for example, found that different genders and races responded differently towards visuals in an advertisement, but that "... racial similarities to the model did not necessarily facilitate recall or a desire to imitate the modeled behaviour" (*Ibid.* 1983:21). In this study, a culturally modified visual (racial similarities) did not facilitate the recall of an advertisement. Suffice it to say that the process of transforming commercial messages, like advertisements, to the visual culture of a specific target market is known and appears to be an established practice.

It appears reasonable to assume that visuals will be more effective in instructional material if they are culturally modified for a particular subgroup. It is a recognised practice when communication material with a visual content is designed for specific audiences (Zimmerman and Perkin, 1982). Some previously cited examples are "Roxy", a photonovella (Story Circle, 1993), a publication by Soul City (n.a.) and comic narratives produced by The Storyteller Group (1991a and 1991b). Two examples are given in Plate 1.1 on the next page.

This modification or "translating process" is stated by Schiffman (1996:67) as a critical factor to the success of communication efforts, especially when health education materials must be developed for ethnic minorities and less-developed countries.

PLATE 1.1

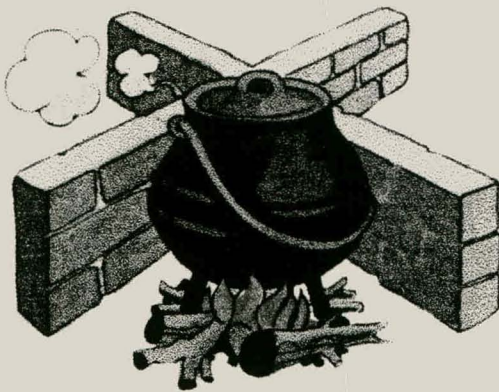
A section of a culture-sensitive photonovella, "Roxy" (Story Circle, 1993:13), aimed at a specific target audience (Plate a) and a section from a culturally modified booklet by Soul City (n.a., 28) aimed at rural and developing communities (Plate B).



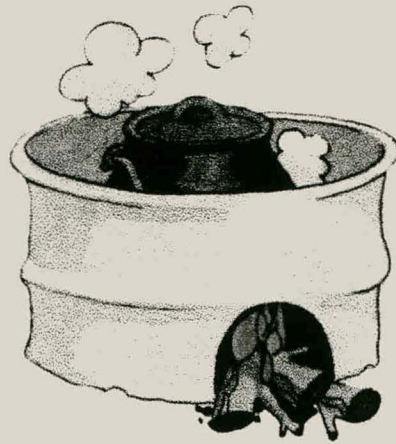
Plate A

How can we save wood?

Wind makes a fire burn more wood. You should protect your fire from wind.



- Build low walls in the shape of a cross. Then make the fire in the place most protected from wind.



- Use part of a metal drum to protect your fire.

Always use dry wood for your fire. Burning wet wood wastes a LOT of heat AND makes more smoke.

Plate B

In an earlier paper Schiffman (1995:278) also describes this translation process as “... *meeting the viewer on the viewer’s turf*” and maintains that if this process is done correctly then “... *vital health and safety educational materials, especially for special populations, should present no challenge for the viewer to comprehend*”.

The concept of modification, translating, or meeting the viewer on the viewer’s turf, is similarly described by Hugo (1995:12) in terms of “... *learning materials must match the learners*”. Hugo and Smit (1998:88) furthermore use the term “socio-cultural sensitivity” to imply an awareness of sociocultural variables that play a role in the acceptance of health messages and educational material for specific audiences.

Whilst familiar images and graphic and pictorial conventions from a group’s own culture (Cripwell, 1989; Patel *et al.*, 1990) can assist in interpreting images, assist in a marketing campaign, and motivate, interest and create popular appeal with the reader (Bahr and Rifkin, 1992), there appears to be little empirical evidence that these types of pictures facilitate recall and comprehension of instructional text within an educational setting. A similar need was also expressed by Schiffman (1996:77) who, at the end of her paper, stated that there is a need for comparative empirical tests between visually untranslated [unmodified pictures] and visually translated [modified pictures] educational materials (square brackets mine). She also aptly remarked that although researchers highlight the need for cultural sensitivity, this emphasis is mainly for low-literate subjects, and the emphasis is on oversimplification rather than adaptation.

The advertising industry normally gains attention with pictures and headlines and then persuades the customer to purchase the product by stimulating the senses and sometimes exaggerating the benefits of the product (Lucas, 1986:401; Kember, 1996:233). The function of pictures in educational material, in contrast to the use of pictures in advertising, is not to exaggerate or just to gain attention, but rather to help the students’ long- and short-term memory and to assist in the accurate recall and comprehension of relevant information.

The preceding paragraphs argued that misinterpretations could occur between the sender of a message presented in a visual-verbal format, and the recipient. These recipients can be from developing to developed communities, and the misinterpretation can occur with educational material, health communication messages and advertisements. This misinterpretation could partially be due to visually insensitive cultural and graphic conventions. Culturally modifying or translating the visual and text material for it to become more appropriate for the learner appears to be a suggested process to solve this dilemma. Advertisements aimed at a literate target market, health care messages on

posters aimed at low-literate patients, and learning material designed for school children are different message-media systems. Each system would require different development and research procedures and will produce differing results.

It appears that researchers and authors are confident that culturally modified pictures in picture-text material can aid the acceptance, congeniality and appeal of the material and message, and that culturally insensitive visuals will be a hindrance. It is, however, not evident from the empirical literature whether such visuals can produce a measurable increase in recall, comprehension and problem-solving skills when culturally modified visuals are used in conjunction with educational text aimed at developing communities. This question also leads to additional questions, namely:

- If culturally modified pictures are useful, what is the extent of this usefulness?
- What are the conditions under which pictures are helpful when they are combined with educational text?
- Which factors could assist in or distract from the potential increase in learning when modified pictures are used?
- Can the effect of a modified picture on a learner's recall or comprehension be predicted?

1.5 THE GENERAL HYPOTHESIS OF THIS STUDY

The hypotheses are based on the notion of perceptual dominance, which states that subjects will more readily perceive pictures from their own sociocultural environment than visual imagery that is unfamiliar. The viewers' cultural and geographic environment affects their perception and interpretation of a picture (Mangan, 1978:246). Making a picture indigenous, or culturally modifying a picture, could possibly assist subjects in their recall and comprehension of instructional text and improve their problem-solving skills based on the text.

It is, therefore, hypothesised that scholars will prefer culturally modified pictures to pictures that are not modified to their culture, and that modified pictures in printed educational text will facilitate recall, problem-solving skills and comprehension more than text with pictures that are not modified.

The hypothesis stated in this section is the general research hypothesis for the study. Eight different experiments were conducted. Each experiment in the empirical part of the study has its own hypothesis and is given with the report of each experiment in Chapter 3. The manner in which the hypotheses are stated for each experiment are comparable to the style and method that are used by researchers that publish in this field (Beck, 1990:146; Mayer and Anderson, 1991:486; Newton, 1994:222; Mayer, *et al.*, 1996:68).

1.6 THE AIM AND PROPOSED RELEVANCE OF THE STUDY

There are four components of this study that are applicable to the aims of the study, namely (a) the literature study to provide the theoretical foundation and framework, (b) the empirical work, (c) the contribution of theory to the field of study by means of a model and the accompanying theoretical explanations, and (d) the conclusions and recommendations.

The aim of the study is therefore fourfold: to develop a theoretical foundation and framework for the study through a literature study; to investigate the effect of culturally modified pictures when combined with printed educational text through a series of experiments; to make a theoretical contribution with a model that would explain and predict the picture facilitating effect; and to make practical and applicable recommendations for the design and development of picture-text learning material.

1.6.1 The aim of the study

The specific objectives related to the four components of this study are as follows:

1.6.1.(a) The literature study or the theoretical background

Research data on the use of pictures in educational material are distributed in psychological, educational, educational technology, visual literacy, design, medical, and communication publications. Researchers use diverse paradigms, models, theories and research methods to explain their results and to predict human behaviour in this field. The results presented in these publications are used for the theoretical basis of the study in order to:

- Isolate variables and regularities that influence the facilitating effect of pictures when these pictures are used together with instructional text material aimed at subjects from developed and developing communities.

- Present these variables and regularities as factors with generalisable possibilities that are applicable to subjects from developed and developing communities.
- Recommend variables that instructional designers must consider when designing picture-text material aimed at developing communities.
- Isolate existing theories that explain the picture facilitating effect.

1.6.1.(b) The empirical work

Multiple known and unknown variables are responsible for the divergent interpretation and usage of visuals by different cultural groups. The aim of the empirical work is to investigate whether the process of culturally modifying pictures would increase the general facilitating effect that pictures have when they are combined with instructional text. This is done by gathering primary data through a series of experiments. The aims of the experiments are:

- To determine if the subjects prefer pictures that are culturally modified for them more than pictures that are not modified.
- To determine if culturally modified pictures facilitate recall, problem-solving skills and comprehension more than pictures that are not modified, when they are used to support instructional text.

1.6.1.(c) The contribution of theory to the field of study by means of a model and the accompanying theoretical explanations

Inductive and deductive processes based on the results of the literature study and the results of the empirical work will be used to contribute to theory building in this field. The aim is to present these outcomes as:

- A model that can be used to explain and predict pictorial learning facilitation in picture-text learning material.
- Theoretical propositions in support of the model.

1.6.1.(d) The recommendations

The empirical work, the literature study and the contribution of theory to the field of picture-text learning should result in practical guidelines founded on scientific principles. The aim of this component is to:

- Propose guidelines for the design and development of picture-text learning material for subjects from developed and developing communities.

1.6.2 The proposed relevance of the study

Sauthoff (1986:110) and De Lange (1995) have previously expressed the need for research in South Africa on the use and effectiveness of pictorial and graphic elements in education and communication. A demand for more research on visual imagery with a cultural characteristic for a particular group is also implied by Craig (1992:177), who calls for more culturally based studies of advertising and consumption, and Tomaselli (1993:40) who, writing from a cinematic and television perspective, states that the real question is how to reach African audiences. With reference to health education, Hugo and Skibbe (1991:50) called for priority to be given to research that will identify guidelines and principles that can be used to design suitable medical and health education media. In a recent article, Hugo and Smit (1998: 93) reiterated this need by calling for more resources for research and development in the field of culture-directed health message design. Although the focus of this study is not on health message design or on film production, it will address culture-related issues in picture-text learning material.

The results of the empirical work will have implications for scientists and practitioners who must solve problems primarily in the field of visual communication, educational technology and graphic design.

Graphic designers and educators can use the regularities established in the theoretical study for extrapolation and prediction when developing educational materials of a visual nature.

The outcomes of the study will assist designers of picture-text information material to decrease trial and error design practices when aiming their messages at target groups in developing communities.

1.7 DELIMITATIONS

Experimental work is normally confined by self-imposed delimitations and externally influenced limitations. The experimental conditions of the empirical work for this study are affected by regulations laid down by the Free State Department of Education (the subjects for the experiments are school children), whilst the types of pictures and the dependent variables are limited by the researcher to keep the experiments within the focus of the study. Permission from the Free State Department of Education to conduct research at schools under their control and their conditions are given in an Addendum 4 at the end of this thesis.

1.7.1 Experimental conditions

The conditions and time restrictions imposed by the Free State Department of Education, the school principals and the conditions at the schools limited the empirical work in terms of the length of the experiments, the pupils that could be used, and the type of sampling procedures that could be employed. These limitations were not the same at each school and are fully described with each experiment in Chapter 3. The researcher further limited the experiments to subjects who are between Grade 6 and Grade 11. The focus of the experiments is on developing communities and the study is therefore delimited to schools with subjects that are from peri-urban and rural areas in the greater Bloemfontein region. Experiments were conducted at some urban schools, as a large proportion of the subjects at these schools come from developing communities. Urban and peri-urban are terms that the Free State Department of Education uses to designate schools in suburban areas and schools in township areas.

1.7.2 Picture delimitations

The experiments are delimited to the use of realistic and unambiguous pictures that have a representative and explanative function and which play a supportive role to instructional text. The use of full-colour pictures in conjunction with the text is excluded from the experiments. Colour is a separate communication code and is a known variable that can have a positive effect on learning, but which can also have a negative effect if used incorrectly, especially in cross-cultural communication. Colour as a cueing agent, however, has been used in the last experiment. The use and value of colour in picture-text learning material is discussed in Chapter 2, and the use of colour

as a cueing agent is discussed with the experiment where it was used in Chapter 3. Pictures that are self-explanatory and which can be used without instructional text, and other visuals such as charts, graphs, flow charts and symbols are excluded from the experiments.

1.7.3 Dependent variables

The dependent variables are delimited to the subjects' recall and comprehension scores with regard to information or the facts that are represented in picture-text experimental material, as well as their problem-solving skills.

Subjects from different schools and different geographic regions were used in the experiments and are fully discussed with each experiment. Comparisons between experimental and control groups, in order to arrive at experimental conclusions, were performed with the groups from each individual school. No comparisons are made between the achievement scores of subjects from the different schools and the different regions as the experimental material and procedures changed with each school. The educational, visual literacy and socio-economic backgrounds of subjects from different schools and different regions in South Africa differ widely. Comparisons between schools and subjects from urban and peri-urban schools will invariably show differences in achievement scores due to socio-economic and educational differences, but will not provide information on the effectuation of modified pictures. Comparing the recall and comprehension achievement scores of children from suburban (urban) schools and those from township (peri-urban) schools could show a difference due to better infrastructures that are generally available in suburban schools. Such a comparison can project children from township schools, who are mainly from an African cultural background, as lower achievers than those who are from urban schools. Such comparisons can be viewed as derogatory and do not fall within the scope of this project.

1.7.4 Other limitations of the study

The above paragraphs provided the delimitations for the empirical work with regard to the pictures that are used in the experimental material, the types of achievement (dependent variables) scores that are measured, and the conditions surrounding the experiments. There are several limitations to the study, which could have an affect on

the generalisability of the results of each experiment. These limitations are due to the infrastructure of the schools, which limited the subjects available for individual experiments and affected the randomisation process of allocating subjects to the various experimental and control groups. These are discussed with each experiment.

1.8 THE METHOD

The aim of the study was given in a preceding section as a fourfold objective, namely to develop a theoretical foundation and framework for the study through a literature study; to investigate the facilitating effect of culturally modified pictures through empirical work (a series of experiments); to develop a model towards theory building; and to recommend steps for the design and development of picture-text learning material. Each of these four aims warrants a brief description of the methods that were used to achieve these aims. The following subsections contain brief discussions of the methods used. A detailed description of the methods is given with each particular section in subsequent chapters in the thesis.

1.8.1 Method for the theoretical foundation and framework

An extensive review of relevant literature provided the theoretical foundation of the study and the framework within which the experiments were conducted and the outcomes were reached.

The data for this study consist of three kinds, namely primary, secondary and tertiary data. The primary data were collected through the empirical work. Secondary information in academic journals formed the basis for the theoretical foundation and the framework of the study. This information was supplemented by tertiary data from scholarly books and reviews of research related to the field of study in journals. Online and CD-ROM databases were surveyed for relevant published research. Contact was established with members of the *International Visual Literacy Association* from where directives were obtained for additional sources of information. The journals that provided the most information were from the fields of audiovisual communication, educational technology, psychology and education.

1.8.2 Method for the empirical work

The population and sample

The samples for the experiments were taken from the population of scholars in the greater Bloemfontein area between Grade 6 and Grade 11. An official at the Free State Department of Education requested that no Grade 12 and Grade 7 subjects be used as they are in their final year of secondary and primary school. Grade 6 subjects and subjects between Grade 8 and Grade 11 were therefore used. Subjects in Grade 5 and subjects below Grade 5 were considered to be too young, possibly with poor reading skills. The sample, the random sampling procedures and the limitations of each experiment are discussed with the report of each experiment in Chapter 3.

The instruments

The researcher adapted existing printed educational picture-text materials and developed new educational picture-text learning materials as the test instruments. Examples of all the materials are given in addenda that are associated with each experiment.

Gathering of the information and analyses of the data

The researcher gathered the primary data through the empirical work. Measuring recall, comprehension and problem-solving skills provided the data to determine the facilitating effect of culturally modified pictures. These achievement scores were obtained through open-ended, cued-recall and multiple-choice questions in immediate and delayed testing procedures. The researcher tested the research hypotheses by comparing and measuring central tendencies and the variability of the data with analyses of variance (ANOVA). Post-hoc tests were done with Tukey's HSD test. Each experiment and its corresponding statistical procedure is discussed in Chapter 3.

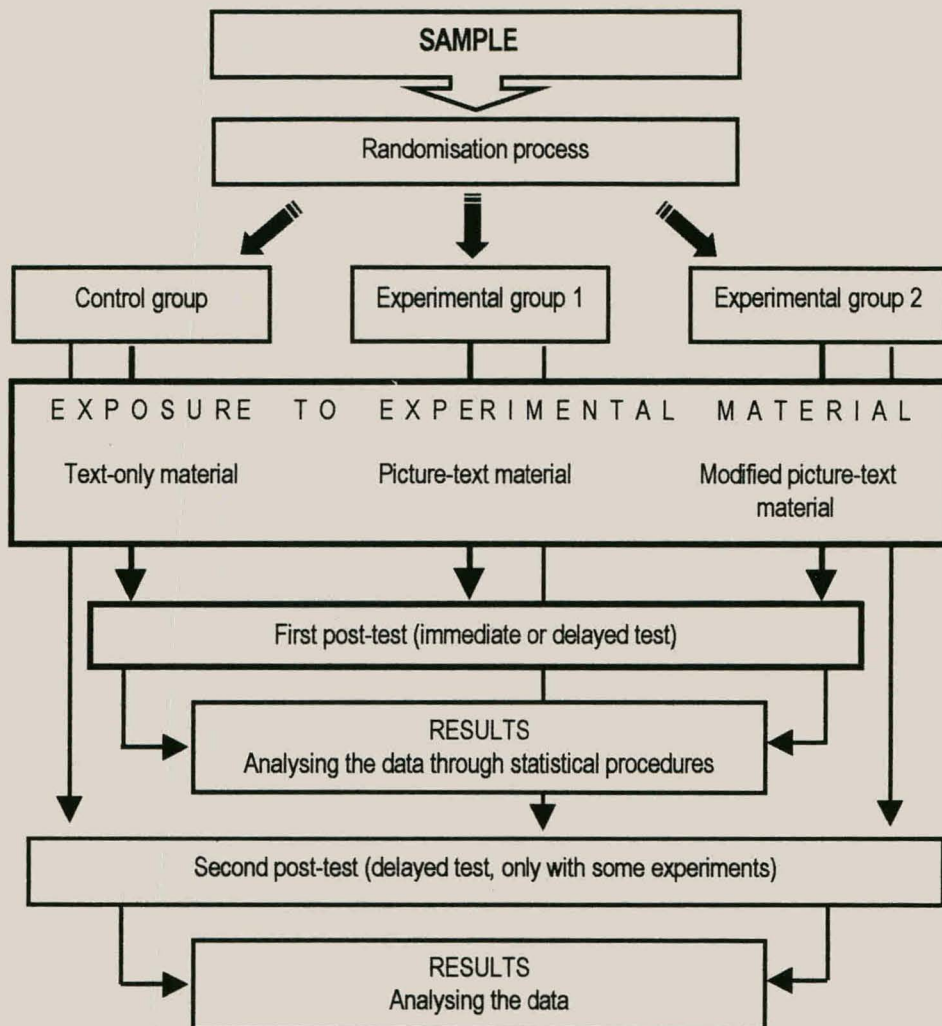
The experimental design

The researcher used a *post-test control group* experimental design for the experiments. Post-test-only control group design is described by Leedy (1989:224) as a true experimental design that can be used in a situation where pretesting is difficult. This appears to be a preferred experimental design by researchers who publish in this field (Peeck, 1974, 1994; Sewell and Moore, 1980; Lamberski and Dwyer, 1983; Mayer and Anderson, 1991; Mayer *et al.*, 1996). The variations in the experimental design and randomisation process for each experiment and the reasons therefore are discussed with each experiment. A typical experiment, for example, used three randomised groups of subjects. One group acted as the control group whilst the other two groups were

experimental groups. The control group received text-only material, one experimental group received picture-text material where the pictures were modified for them, and the second experimental group received picture-text material that had not been modified for them. The conditions under which the experiments were permitted and the time that the researcher received from respective principals at the schools where the experiments were conducted, determined the length of the experimental material for each experiment. A graphic representation of a typical experimental design and procedure during an experiment is given in Figure 1.3.

FIGURE 1.3

A diagrammatic representation of a typical experimental design and the procedure.



1.8.3 Method for the development of a model

The analytical model for the explanation and prediction of picture-text learning material is presented in Chapter 5. The construction of the model is based on existing theories that explain the efficacy of picture-text material, as well as on factors that affect picture facilitation, and observations from the experiments that were completed. It is influenced by models proposed by other researchers and hypothetical conjectures derived from the study as a whole.

1.8.4 Method followed for establishing recommended steps that can be used for the design and development of picture-text learning material

The guidelines for the development of picture-text learning material are a synthesis of proposals and models forwarded by other researchers, regularities that were identified during the literature study, and observations that were made during the empirical work.

1.9 SEQUENCE OF THE FOLLOWING CHAPTERS

Chapter 2 provides a review of the relevant literature. It also presents a taxonomy of pictures in instructional text, discusses the factors that facilitate picture-text learning material, explains the reasons for this facilitating effect, and provides a critique on existing research methods in this field.

Chapter 3 provides a report of all the experiments that were completed for the empirical work. Each experiment is discussed separately, giving its method, results and conclusions.

Chapter 4 provides the conclusion and recommendations. This chapter proposes a learner-centred theory for the picture facilitating effect and recommends theoretical guidelines for the design and development of picture-text learning material.

Chapter 5 provides an analytical model for the explanation and prediction of picture-text learning material. The model consists of interrelated constructs, comprising the explanatory theories for the efficacy of picture-text material, factors that affect picture facilitation, observations from empirical work, previously mentioned models, and hypothetical conjectures derived from the study.

Chapter 6 is a synthesis and summary of the thesis.

1.10 SUMMARY

Chapter 1 provides the introduction and background to the study. It presents the problem, the purpose and the relevance of the study, as well as the general research hypothesis. It also sets the delimitations, defines the important terms and gives a brief description of the methodology.

Three concepts are introduced in the introductory section of the first chapter, namely that pictures under certain conditions can significantly facilitate recall and comprehension of information presented in picture-text learning material; that some subjects have difficulty in utilising pictures effectively; and that unfamiliar graphic conventions, amongst other factors, contribute to this difficulty. Pictures that are culture specific and socially sensitive appear to be a recognised method whereby communicators attempt to improve the efficacy of their printed material. It is, however, not evident from the empirical literature whether such visuals can produce a measurable increase in recall, comprehension and problem-solving skills when culturally modified visuals are used in conjunction with educational text aimed at developing communities.

The aim of the study is to investigate the use of pictures in picture-text learning material and in particular the value of culturally modifying pictures in such material to increase the facilitating effect of the pictures in the text. Pictures in the context of this study are images that support and repeat the text and which are used in combination with the text. Pictures with an attentive and mood-creating function, for example in political, marketing and propaganda material, are excluded. Text in the context of this study was defined as information presented in printed form that a learner can master without the assistance of pictures. The facilitating effect signifies a relative improvement of the learner's problem-solving skills and his/her recall and comprehension of the information represented in the picture-text learning material. Learners in the context of this study are persons who have the verbal skill to read and understand instructional text material written for their level. The focus is on learners from developing communities.

The aim of the study was stated as a fourfold process, namely to develop a theoretical foundation and framework for the study through a literature study; to investigate the effect of culturally modified pictures when combined with printed educational text through a series of experiments; to make a theoretical contribution to the field of study with a model that would explain and predict the picture facilitating effect; and to make practical and applicable recommendations for the design and development of picture-text learning material.

The general hypothesis was stated that the subjects would prefer culturally modified pictures to pictures that are not modified to their culture, and that modified pictures in printed educational text would facilitate recall, problem-solving skills and comprehension more than text without modified pictures.

The results of the empirical work will have implications for scientists and practitioners who must solve problems primarily in the field of visual communication, educational technology and graphic design.

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ADDENDUM 1

CLARIFICATION OF ADDITIONAL TERMS

Abstract pictures: Abstract pictures do not represent reality and are characterised by little or no reference to objects in nature. An abstract painting entitled “Summer”, for example, could consist of geometric shapes and a spectrum of warm colour with no recognisable shape. An abstract picture could also be a simplified picture of an object in nature. A running stickfigure, for example, could be regarded as an abstraction of a running athlete.

Active pictures: Active pictures are realistic pictures that represent an activity that takes place. A realistic illustration of a cricket player, for example, diving through the air with an outstretched hand that is about to catch a cricket ball, is an example of an active picture. The drawing will depict a person and a ball suspended in the air. The viewer must infer that the player is about to catch the ball and that both the ball and player will come back to earth. A literal interpretation of the illustration would be that the person and ball are hanging in the air. Motion and sequence in pictures are situations where active pictures are used. Viewers must not only be able to understand (read) the picture, but must also be able to interpret the picture in its context.

Ambiguous picture: Ambiguous pictures, or suggestive pictures, are images that can express emotions or convey moods (Pettersson, 1993:203). The aim of ambiguous pictures is to influence the viewer in addition to the literal message of the picture. Paintings, propaganda pictures, pictures in advertising, and pictures for educational purposes can be ambiguous. Ambiguous pictures are the opposite of unambiguous pictures. See also unambiguous picture.

Annotated illustrations or pictures: Pictures where labels and captions are incorporated into a picture.

Appropriateness: The word appropriateness in itself is a loose term that can have a wide meaning and initially appears to be non-specific. In the context of this study and in the context of “culturally modified pictures” and “picture-text material” this term is used to describe either pictures or text that are, as stated by Hugo (1998:87), “... *suitable for the educational level as well as the cultural background of a target audience*”.

Construct: The word construct is used to define a concept that has been intentionally adopted for this study and has a wider meaning than the word concept. It is the construction or ordering of a thought or idea through the synthesis of several

elements or factors that are related. Several constructs form the basis for a model proposed in Chapter 5.

Contiguity principle: This principle states that the effectiveness of instruction increases when the media involved in the instruction (pictures and text) are presented simultaneously (Mayer and Anderson, 1992:444).

Cue summation principle or theory: States that learning tends to increase as the number of cues or stimuli is increased (Hartman, 1961; Severin, 1967).

Culturally modified pictures: Culturally modified pictures in the context of this study are pictures that reflect the food, clothing, symbols, physical features, environment and other items of the people at whom the visual message is directed. Similar concepts are described by Hugo and Smit (1998:88) as “*sociocultural sensitivity*”, and as “*visually translating material for ethnic population*” by Schiffman (1996:67).

Culture: Culture, in the context of this study, refers to the non-verbal visual elements of an identified population, for example food, clothing, buildings, physical features and gestures, music, graphic images and symbols. Culture could, inter alia, be described as a way of life with corresponding values, convictions, habits, language, behaviour patterns and products emanating from creative activities (Hugo, 1997:28).

Decorative pictures: Decorative pictures can fulfil two functions, namely a numeration function and a motivation function. The one is to increase sales of the material containing the picture and the other is to create an interest in the material (Levin, Anglin and Carney, 1987:53-54). Decorative pictures are text irrelevant.

Development communication: This concept refers to communication methods aimed at low-literate subjects who are from developing communities and countries. The aim of communication material in this category is usually to improve farming methods, provide voter education, aid primary health care activities and improve life skills, to name but a few.

Explanative text: Text that provides a step-by-step description of a cause-and-effect action (Mayer, 1993:268).

Extension and development work: The word extension refers to a process where information is extended from a person with the knowledge to a person that needs the knowledge by means of educational media, practical demonstrations or personal contact. Development work refers to the process of improving the status of a system, for example farming methods. The University of Reading (UK) has a centre, aptly named the “*Agricultural Extension and Rural Development Centre*” which, amongst other activities, is involved with improving media messages so that they can be understood by farmers from developing communities.

Generative theory: A three-phase constructive process in which learners firstly select and organise from a text base to form a verbal representation, then secondly select and organise pictures from a picture base to form a visual representation and thirdly integrate these representations or build a one-to-one correspondence between the representations (Mayer, Steinhoff, Bower and Mars, 1995:39).

Partial picture: A partial picture is not a picture with a part missing, as the word seems to imply. It represents the text apart from the information that will be asked for in the post-test. Partial pictures are used in experimental work when a researcher wishes to determine to what extent a subject makes use of text or the picture when learning from picture-text material.

Passive pictures: Passive pictures are unambiguous, they represent reality and do not require the viewer to interpret the picture as in active pictures (see also active pictures).

Peri-urban schools: Schools in townships and on the fringes of informal settlements.

Pictorial learning facilitation: This term is similar to the term *Picture facilitating effect* or *Picture superiority effect* with the difference that it describes a learning process that takes place with the aid of pictures and not just the effect of pictures in learning material. The term “Picture facilitating effect” has an outcomes focus, whilst the focus of “Pictorial learning facilitation” is on a process.

Picture facilitating effect: The increase in the amount of information remembered or recalled, the increase in comprehension of processes, and the functioning of systems and problem-solving skills shown when an appropriate picture is combined with instructional text (see also pictorial learning facilitation).

Picture readability: Picture readability and picture legibility are related terms and are sometimes used as equivalent terms. Picture readability is used as a term to describe the picture’s ability to be read and comprehended by its intended market. Labels, captions, graphic cues, familiarity of the image to the reader, and the context of the picture in relation to the instructional text are some factors that can increase or decrease the readability of a picture. A decorative picture, for example, is not relevant to the text, and will have no readability.

Picture legibility: This term would refer to the graphic execution of a picture. Realism, clarity, the illustration style and the quality of a photograph are some of the elements that can affect the legibility of a picture. A picture can, for example, have high legibility and low readability at the same time. Realistic and clear illustrations even if they are relevant to the text, can have high legibility but will have low readability if a reader cannot interpret or make use of the picture.

Picture superiority effect: This term is analogous to the terms: *Picture facilitating effect* or *the facilitating effect*.

Picture-text learning material: Text in the context of picture-text material refers to text with an instructional nature rather than text with a prose content. The pictures are an adjunct to the text, they repeat information in the text and they act as a support mechanism to the information presented in the text.

Readability scores: Readability scores are reported for the text that is used in each experiment. These scores are calculated by Microsoft's Word for Windows software program and is based on the amount of words per sentence and the average amount of syllables per word. The Flesch Reading Ease score is based on a 100-point scale; the higher the score, the easier it is to understand the document. The Flesch-Kincaid Grade Level score is based on a U.S. grade-school level. A score of 6.0 means that an sixth grader in the U.S. can understand the document.

Recall: The term recall, in terms of this study, is the process whereby a subject is able to recall information from the text or pictures for a specific answer.

Recognition: It is the process whereby a subject is able to recognise a correct answer in a multiple-choice question or in terms of this study, the amount of visuals that a subject can correctly recognise after being exposed to them on a previous occasion.

Representational pictures: Pictures that are realistic and which are literal in their interpretation. An illustration of a human skull in a medical textbook would represent a skull and would not imply danger or poison in the way that a skull and bones are used to signify danger.

Rural schools: Schools in rural towns, farming areas and small villages.

Schematic picture: Schematic pictures represent reality but are not necessarily realistic pictures. A map of a town, an engineering drawing and a graph in a research report are some examples of schematic pictures.

Semiotics: The study of signs, including language, pictures, clothing and cultural artifacts.

Semantic code hypothesis: This hypothesis suggests that a semantic code, for example in a label next to a picture, will help to improve recognition of the pictorial code (Beck, 1991:16).

Stimulus generalisation theory: States that learning is improved when the test situation is similar to the learning situation.

Symbol: A symbol is a simplified picture that represents reality and can be realistic or abstract. A drawing of a skull would signify danger, as found on electrical substations, or could signify poison as found on some containers that are filled

with pesticides. A triangle, as used in traffic signs, is an example of an abstract picture that denotes danger. Music, science and mathematics use universally accepted symbols. See also unambiguous picture.

Syntax of a picture: The placement of the picture in the text. A picture can be placed after or before its legend, opposite the text on a facing page, or it can be linked to text through arrows and graphic cues.

Typology: The study of different types of illustrations in instructional text.

Unambiguous pictures: Unambiguous pictures are literal in their meaning and do not have a hidden or latent message. These pictures do not attempt to influence the viewer apart from the literal message of the picture. Unambiguous pictures can be symbolic or realistic. Traffic signs, which give one literal message, are one example of unambiguous pictures. See also ambiguous pictures.

Urban schools: Schools situated in suburban areas of a town.

Visual literacy: Visual literacy is a concept that has its roots in philosophy, art, linguistics, imagery theory, perceptual psychology and communication research (Moore and Dwyer, 1994). Dondis (1973) noted that it includes comprehension and that it must give meaning to the subject. The term “visual literacy” is, according to Messaris (1994:176), “... *an appropriate label to describe a viewer’s familiarity with specific images or sets of images that have played a role in his or her culture’s visual heritage ...*”. A definition, proposed by Braden and Hortin (1982:41) states: “*Visual literacy is the ability to understand and use images, including the ability to think, learn, and express oneself in terms of images.*”

Visual literacy is defined for this thesis as follows: *It is the ability to understand (read) a visual and to interpret (give meaning to) the visual in its context (its educational text)*. A person’s level of visual literacy is influenced by his or her prior experience and exposure to visual media, for example television, magazines, advertising, comics and other forms of visual literature. A person’s level of visual literacy can furthermore be affected by educational and socio-economic variables (Cripwell, 1989; Goldsmith, 1986; Hugo, 1991; Peeck, 1993). Poor visual literacy, or poor pictorial literacy combined with the screen effect of culture (as defined previously) can contribute to poor learning performance when using picture-text learning material. Culture, visual literacy and learning are, in terms of this study, related, and contribute to educative action to effect specific changes in an individual. A book that provides a wide spectrum on this topic is “*Visual literacy*” by Moore and Dwyer (1994).

Visuals: A generic term that is used in this study to include photographs, realistic illustrations, symbols, abstract illustrations and graphic elements, for example charts, maps, graphs and decorative patterns.

CHAPTER 2

AN ORIENTATION AND REVIEW OF THE LITERATURE APPLICABLE TO THE STUDY

Chapter 2 is a review of the literature relevant to this study. This review provides an introduction and an orientation to the research that has been conducted in this field of the study. This review established a theoretical foundation and framework for the study, which was used to give direction for the empirical work and the subsequent development of theory in Chapter 4 and Chapter 5. This chapter has been divided into thematic subsections. The choice of the themes of the sections was influenced by recurrent themes in the literature and the focus of the study.

2.1 INTRODUCTION AND ORIENTATION

The volume of literature on pictorial communication, visual literacy and visual perception is extensive. Goldsmith (1984), in her book, *“Research into illustration - an approach and a review”*, lists in her general bibliography more than six hundred articles and books that deal with illustrations in reading and comprehension. She restricted her work to empirical studies, of which most were done between the late 1960’s and the early 1980’s. Pettersson (1993) lists in his book, *“Visual Information”*, more than five hundred sources dealing with pictorial communication and visual literacy. His review and literature list cover empirical studies, theoretical work and unpublished papers. Pettersson did not restrict his review to a particular time period.

Research results on the facilitating effect of pictures in instructional text are mostly found in educational, psychology, design and communication journals, as well as scholarly books that are based on extensive literature reviews and larger research projects. The majority of the journals that were consulted for this study are from educational technology, psychology, educational psychology, educational and design related journals. A refereed academic journal, *“Visual Literacy”*, devoted one edition to one article appropriately named *Visual Communication: A Taxonomy and Bibliography* (Moriarty and Kenney, 1995). This article consisted of a literature list that dealt with visual communication theory, art, psychology, education, audiences, communication studies, cultural studies, biological and physical factors and processes, professional

disciplines, the history and research methods in this wide field. The section on visuals and education alone lists 216 sources. There are a total of 1617 references listed in the article.

The question facing the researcher, as it did Goldsmith (1984:6), is which studies to select as background material for this study? The aim of the empirical work is to investigate whether the process of culturally modifying pictures would increase the general facilitating effect that pictures have when they are combined with instructional text. The researcher has, therefore, confined the literature review to research reports in journals and scholarly work presented in books and as conference papers that address the advantages and limitations of pictures in education and communication, and to pictorial attributes that facilitate learning.

The review follows a thematic order and presents the subject matter under separate headings. The researcher focused on empirical studies that made use of sound research methods and where sufficient information is given to replicate the study. Appropriate comments are made where there is doubt on the validity of the work and where the generalisations are limited.

This review reports on the facilitating effects of pictures in picture-text material; surveys research on the interference of pictures in learning; provides a taxonomy of pictures in text that facilitate learning; discusses the factors that influence the facilitating effect of pictures; and provides a section on cross-cultural research in pictorial communication. The chapter also presents a perspective on communication models and cultural aspects in picture communication materials, explanations for the facilitating effect of pictures, gives a critique on current research methods, and concludes with a summary of Chapter 2.

2.2 COMMUNICATION MODELS AND CULTURAL ASPECTS IN PICTURE COMMUNICATION MATERIALS

This section will provide a review of some communication models relevant to the focus of the study. It will present a perspective on cultural aspects in communication and will argue that communication models operate within a cultural arena that affects all facets of communication and so affects the outcomes of picture-text learning materials.

2.2.1 Communication models

Researchers and theorists have developed several models and theories in order to explain and predict the process of communication. A review on the current state of communication theory by Neuliep (1996:43-62) provides an impression of the breadth and depth of this scientific field. Neuliep cites and briefly discusses more than seventy theories and then states that they do not include all the research that has been done in this field. It is, therefore, nearly impossible to provide a review of all the theories and all the models that predict and explain these theories. This section will thus provide a brief review of some models that appear to be applicable to the focus of this study. These models are graphic representations of theories and they attempt to predict and explain the process of communication and related activities. A model is useful in that it can portray a psychological process that would normally be difficult to define, and can be used to describe and explain the working of such a process. Wisely (1994:87), in a discussion of the function of a model, remarks that a model also simplifies the reality, it selects elements that are relevant to what is being studied, and it illustrates the relationship of these elements.

Possibly the first model of communication is Aristotle's model of linear communication which, according to Neuliep (1996:30), has been extrapolated from his writings. This model accounted for a one-way form of communication and included the speaker, the message, and the audience or listener.

A well-known statement on communication, and one that has been structured into a model, is made by Laswell (1948:117), who stated "*Who says what in which channel to whom with what effect*". Laswell's model added the concepts of the "*medium*" and the "*effect*" that the message has on the receiver. The "*who*" signifies the sender or communicator, the "*says what*" the message, the "*in which channel*" the medium, the "*to whom*" signifies the audience or receiver, and the "*with what effect*" signifies the impact.

Shannon and Weaver (1949) introduced the concept of "noise" in the communication process. Their model explained the process of communication in telecommunication, from when the message is sent from the source, through the transmitter, to the receiver and the final destination. The noise signal, also known as interference in other models, affects the signal, which in turn is one reason why communication fails.

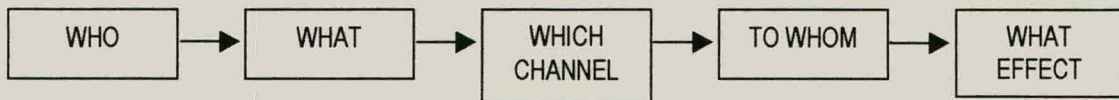
The three models cited above are all linear models in that they do not require or allow feedback or interaction with the sender or the information source. Simplified representations of the linear models are given in Figure 2.1 on the next page.

FIGURE 2.1

A simplified representation of three linear models of communication.



Aristotle's model



Laswell's model



Shannon and Weaver's model

Schramm's structural model, proposed in 1948, (as described by Pettersson, 1993 and Wisely, 1994) portrays an overlap between the sender's and the receiver's field of experience. This overlapping field of experience is the area where effective communication occurs.

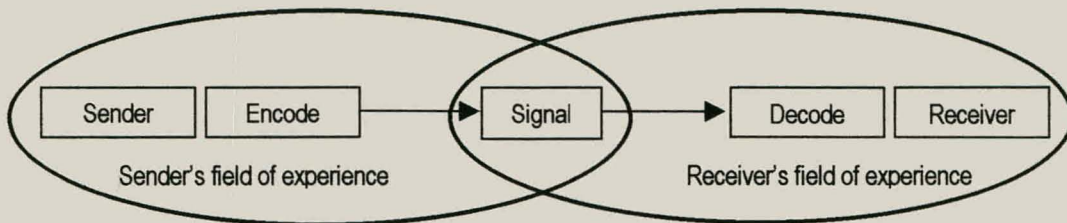
Another structural model proposed by Goss in 1983 (cited by Neuliep, 1996:31) takes into account psychological and social concepts of communication. This model emphasises an interaction or relationship between sender and receiver resulting in a cyclical communication process. The communication process is a circular process that takes place within a certain context where two persons have a social relationship. The message can also be encoded and decoded on three different levels, namely a verbal, a vocal and a non-verbal level.

The focus of the SMCR (Source, Message, Channel, Receiver) model, proposed by Berlo (1960), outlines the factors or the characteristics that affect the sender and the receiver in the communication process. Culture and attitudes can, for example, affect the sender or source; the contents of the message and the code, for example, affect the

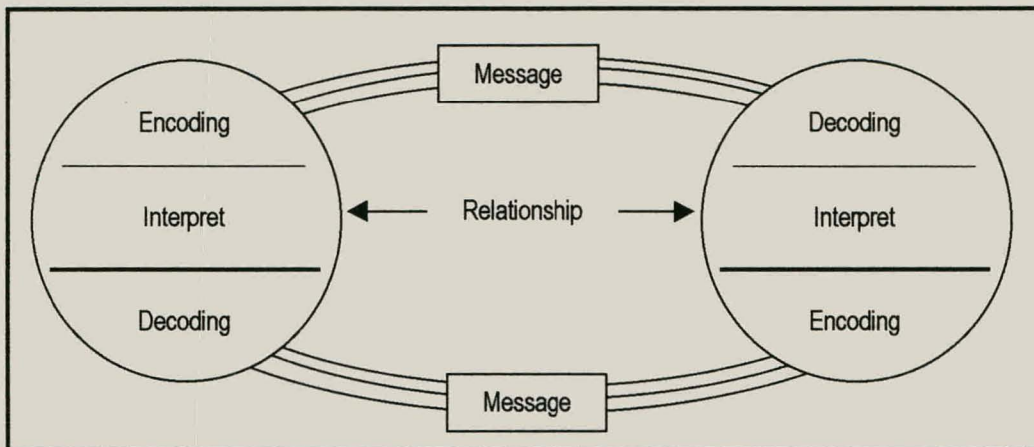
message; sensory perceptions affect the channel; whilst culture and attitudes, for example, can affect the receiver. The models of Schramm and Goss introduce the sender's and receiver's experience as well as a relationship or an interactive process between the sender and receiver. Berlo's SMCR model further defines smaller ingredients in the communication process that in turn affect different steps in the communication process. Schramm's, Goss's and Berlo's models are given in Figure 2.2.

FIGURE 2.2

The communication models of Schramm, Goss, and Berlo.



Schramm's model (1954)



Goss's model (1983)

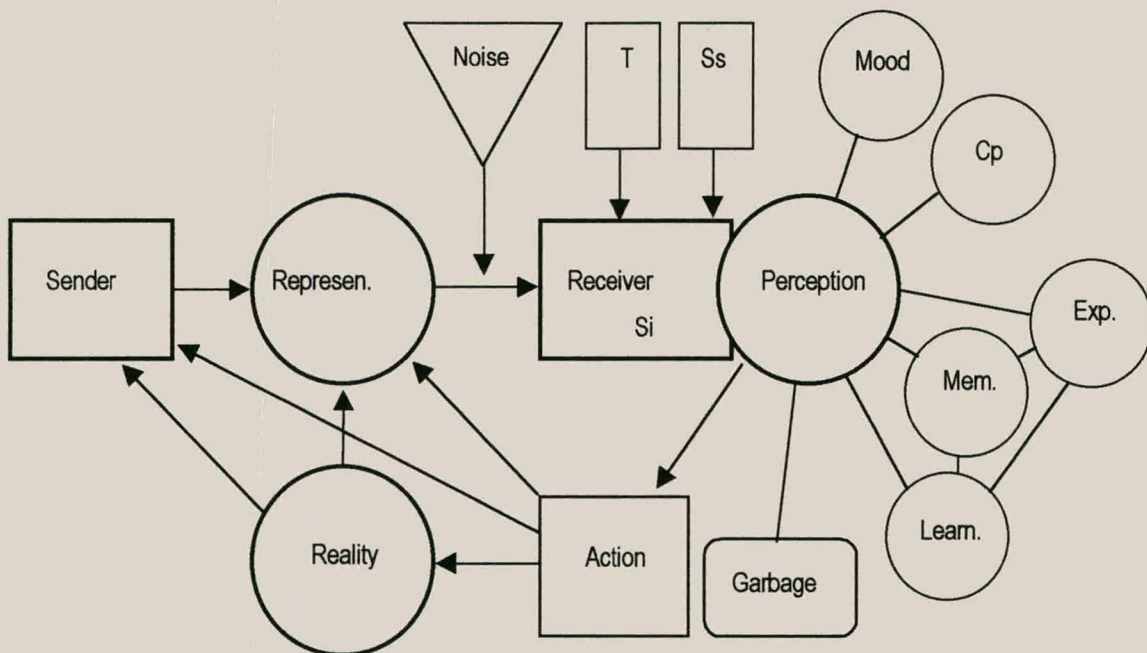
Source	Message	Channel	Receiver
Communication skills	Elements	Seeing	Communication skills
Attitudes	Contents	Hearing	Attitudes
Knowledge	Treatment	Touching	Knowledge
Social system	Structure	Smelling	Social system
Culture	Code	Tasting	Culture

Berlo's SMCR model (1960)

A structural model, more from a visual communication and visual literacy perspective, was proposed by Pettersson in 1982 (cited in Pettersson, 1993:5). Pettersson stated that many of the previous models that attempt to incorporate the increasing number of variables fail to incorporate a perception process. A receiver's perception of a message varies because of his/her sociocultural status, experience, mood, cognitive processes, and stage of development. Perception, in turn, is removed from the representation or the message, which is in turn removed from reality. A viewer or receiver can thus understand the message, as stated by Pettersson (1993:5), as "garbage". They can also understand the message correctly, act, and provide feedback to the sender. Pettersson's model is given in Figure 2.3.

FIGURE 2.3

Pettersson's 1982 communication model (from Pettersson, 1993:5).



T = Time and stages of development, Ss = Cultural and social status, Représen. = Representation, Si = Sensory impression, Cp = Cognitive processes such as intelligence and creativity, Exp. = Experience, Learn. = Learning, and Mem. = Memory.

The seven models of communication that were discussed in the preceding paragraphs have shown certain similarities, namely that there is always a sender (source / speaker), there is always a message (representation) and there is always a receiver (listener). The basis of a basic communication model, as in Aristotle's case, could consist of these

three elements. The models have shown a growth in complexity where these three main components have been augmented by additional objects, for example the concept of a “*channel*” by Laswell, and the concept of “*noise*” in the Shannon-Weaver model. Communication models have been developed further by incorporating a process of experience between the receiver and sender as depicted in the Schramm model, and a process of interaction through a relationship between sender and receiver as in the Goss model. The Goss model further introduces the influence of the environment on the communication process as a whole. The models of Pettersson and Berlo further interpose several objects in the models that affect the stages, objects or processes in a communication process, namely culture, social system, mood and sensory impression, to name but four of these objects in the models.

A convergence model proposed by Rogers in 1986 (cited in McQuail and Windahl, 1993:35) depicts a communicative relationship between two participants where several cycles of information exchange occur during a communication process. This cyclical process conveys and exchanges information before mutual understanding occurs. The value of this models is that it indicates that communication between the learning material (person a) and the person receiving the material (person b) must take place even though the learning material is static and cannot actively contribute to the cyclical process. Appropriate pictures can, however, in the context of the model allow the learner (person b) to form a relationship with the learning material (person a).

A linear gatekeeping model based on the theory of Galtung and Ruge (McQuail and Windahl, 1993:173) develops one aspect of gatekeeping, namely criteria that affect the rejection or selection process of world events or news. McQuail and Windahl (1993:174-175) provide nine factors of which sociocultural values and cultural proximity are but two factors. Applying this model to picture-text learning material could predict that the learners’ culture could affect their acceptance of the messages. Inappropriate cultural conventions in the pictures could, in terms of this model, lead to a rejection.

What is clear from the brief review of the communication models is that they have progressed from a simple model by Aristotle, a gatekeeping model where cultural values could lead to a rejection, to a more complex model with a visual literacy orientation by Pettersson. A combination of these models would produce an interacting model consisting of interrelated components that would relate to its environment as a whole and as individual components.

Goldsmith’s model (1984:126), initially proposed in her Ph.D. thesis in 1978, is a model for the analysis of illustrations. She identified twelve elements, presented in a 3 x 4-array table, which provides a structure where illustrations can be evaluated for their

information accessibility. She also added that her model is a useful tool for the classification of papers that deal with the perception and comprehension of illustrations, and that the model can define precise areas of each paper's investigation. Although her model is not a communication model, it is included in this review because it shares similarities with areas of study that are present in communication and objects in communication models. Her model is also widely cited in the literature that deals with learning from pictures and the use of illustrations in text.

Her analytical model is based on three semiotic levels, namely syntactic, semantic and pragmatic, and four visual factors, namely unity, location, emphasis and text parallels. The areas that it shares with language and communication studies are syntactics (the study of the rules of language), semantics (the study of the meaning of words), and pragmatics (how behaviour is affected). Her model is given in Figure 2.4.

FIGURE 2.4

Goldsmith's analytical model (1984:126).

	<i>Syntactic</i>	<i>Semantic</i>	<i>Pragmatic</i>
<i>Unity</i>	1	2	3
<i>Location</i>	4	5	6
<i>Emphasis</i>	7	8	9
<i>Text parallels</i>	10	11	12

Whereas "syntactic" in language studies refers to the study of the rules of language, Goldsmith uses this term to define a level where there is no recognition of images. She defines her second level, "semantic", as the literal identification of an image (in language studies the study of the meaning of words and the relationship between them), whilst her "pragmatic" denotes the interpretation by the viewer, which in turn is dependent on culture, development and similar factors. Her "unity" factor is an area of a picture with a separate identity, "location" is a spatial relationship between the images in an illustration, "emphasis" is a hierarchical relationship between images in an illustration, and her "text parallels" is a relationship between the illustration and the text, and an indication of the degree to which the illustration translates or represents the text.

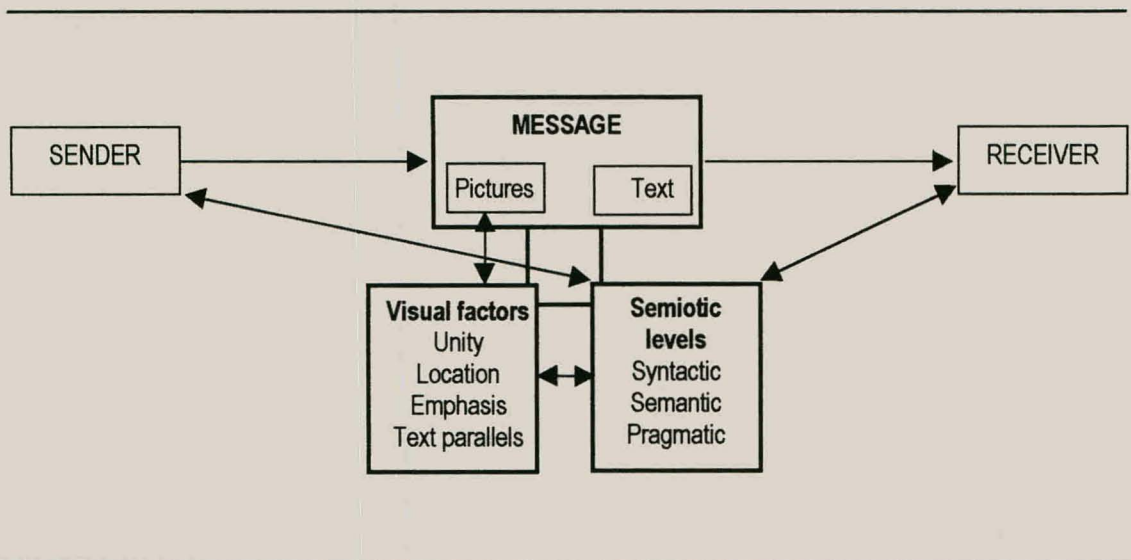
Goldsmith's model is an analytical model whose focus is on illustrations. Her model could, in terms of a linear communication model, form part of the message object

between the sender and the receiver. Her four visual factors, namely unity, location, emphasis and text parallels, when viewed from the position of a communication model, are objects that have a relationship with each other within a picture (location and emphasis) and which have a relationship with the text (text parallels). The use of her three levels of semiotics also signifies a relationship. Her syntactic level, which assumes no recognition or identification of images, is by virtue of the concepts “presupposition” and “recognition” related to the sender and receiver respectively. The semantic and pragmatic levels signify a relationship with the viewer in that the image is identified and interpreted. The pragmatic level further signifies that factors external to the image, but which are related to the viewer, could affect the interpretation of the image, similarly to the “*Mood*” and “*Cultural and social status*” objects in Pettersson’s model. Goldsmith’s analytical model, could, when viewed from a different functional perspective, be placed as objects in a communication model. Placing her semiotic levels and visual function as objects in a basic communication model that incorporates text and pictures could result in a basic model as given in Figure 2.5.

Goldsmith’s model, if incorporated into a communication model, can be viewed as an interrelated analytical component that is connected to the message and at the same time reflects a relationship between the sender, the receiver, and the pictures. It can be argued that, although Goldsmith uses terminology similar to that used by language scientists, there appears to be little parallel between her concepts of syntactic, semantic and pragmatic and those in the science of language and communication studies.

FIGURE 2.5

Projecting Goldsmith’s use of visual factors and semiotic levels into a basic communication model.



Placing her use of the words, and the words as used in the language and communication sciences, next to each other, gives a different insight as illustrated in the following tabled information:

	<i>Goldsmith</i>	<i>Language and communication</i>
<i>Syntactic</i>	It does not presuppose the recognition of images.	The rules of language (grammar).
<i>Semantic</i>	The literal identification of an image.	The meaning of words and the relationship between them.
<i>Pragmatic</i>	The interpretation of the image by the viewer, depending on various factors.	How behaviour is affected.

Goldsmith's convention moves from the recognition of images and the identification of the image, to the interpretation, whilst the communication perspective moves from rules to meaning to the outcome of the communication, or to put it differently, the effect on the receiver's behaviour. The similarity between these two approaches is that both show a progression from the basis or beginning to the application or outcome. Another factor of Goldsmith's model is that, although static, it is as an analytical instrument and it becomes, when interspersed with a communication model, an open system where the individual components relate to each other.

Combining the seven communication models and Goldsmith's analytical model into a composite model could point towards a complex communication model that is composed of several objects and smaller elements. An object in the context of this discussion is, for example, "the sender" or "the message" in a model. An element could be, for example, the "communication skills" of the sender and the "mood" of the receiver. Such a larger and more complex model would have several characteristics, namely relationships and interdependence between the components and the elements. The effectiveness of a message, for example, depends inter alia not only on the skills of the sender, but also on the ability of the receiver. The receiver is at the same time affected by his/her culture and by noise or interference in various places in the communication process.

In summary of this first section it can be stated that a communication model whose function it is to present the phenomena of communication (within the scope of this study) in a systematic and comprehensible but simplified graphic format must represent an open system, and that such an open system must have an interactional approach.

2.2.2 Cultural aspects in picture communication material

The first subsection provided a review of communication models relevant to the study. The review showed that communication, as depicted in structural models, consists of several components that relate to each other, and also showed that several elements in the communication process can affect the eventual outcome or aim of the communication process. Pettersson (1993:5) noted that the receiver's perception varies and is affected by several factors, one of these being the receiver's cultural and social status. This subsection provides a perspective on the integration of culture and communication and will focus on those factors that could have a potential negative or positive effect on the outcomes of picture-text learning material.

Green and Lascaris (1990:3), in their popular book "*Communication in the Third World*", written from a marketing and advertising perspective, aptly introduces their ideas by stating that "*you talk to people from a Third World base, not down to them*". Whilst it is debatable if there is a difference in the outcome of talking "*to*" a person or talking "*down to*" a person, the book provides useful guidelines for advertisers. The approach of Green and Lascaris appears to be written from a position of power, knowledge and experience in the marketplace. In contrast to this "top down" method of communicating, the position of Tomaselli and Tomaselli (1984) is more from a "bottom up" approach, whilst Linney (1995) advocates an even stronger "people-centred approach" where the target market is responsible for developing the communication material. In spite of Green and Lascaris's authoritarian perspective, they provide, as part of their ten guidelines to successful advertising, some broad guidelines pertinent to cultural aspects of communication. These guidelines are: focus on branding; use role-model endorsement; use the experience of sport and seek associations between brands and sport; use appropriate music norms; learn about camaraderie in metro and township scenes and use these emotional connotations; and use the educational environment as a marketing tool. What is significant about their pragmatic approach, is that these guidelines focus on sociocultural aspects of a particular target market, namely familiarity with visual items (branded goods, role models), experience (sport, music) and social activities (camaraderie). The underlying suggestion of Green and Lascaris is to take cognisance of sociocultural aspects of your target market and to use these cultural elements and social practices in advertising and marketing activities. This paradigm can hardly be regarded as significant, as it is a recognised approach advocated by researchers who work in related fields of communication, for example in health care (Holmes, 1964 and 1968; Linney, 1985; Hugo and Smit, 1998).

What is significant is that the value of sociocultural elements in communication with a commercial outcome, as suggested by Green and Lascaris, appears to be a recognised ingredient in an advertising campaign, both in local and international advertising activities. Suffice it to say that this approach and practice is evident in the mass media.

A guide for fieldworkers by Swanepoel and De Beer (1996:5-6), whose aim it is to introduce the subject of communication in development, lists several barriers to reception, understanding and acceptance. The publication also cites a set of rules on how to overcome communication barriers and practical “do’s” and “don’ts” regarding communication. Cultural differences, in addition to social and political differences, are stated as factors that will create a barrier to the acceptance of a message during a communication process. This difference in culture as a barrier to communication is furthermore illustrated by Mbombo (1996) who, as a Black medical doctor, cites several incidences where mixes of poverty, illiteracy and culture can create barriers to communication. A typical example is where illness is explained in terms of witchcraft or a “*tikoloshe*”. Mbombo (1996:113) also explained that it would be inappropriate for a medical practitioner to ask “*What is wrong with you?*” and that “*What can I do for you?*” would be more appropriate since the medical practitioner is seen in the same light as a traditional healer, and is supposed to know what is wrong.

It is not only with communication-related aspects in the commercial, medical and social environment where conflict can arise due to cultural differences. Laws and moral precepts, signs of cultural identity similar to religious practices and language, embody the values and beliefs of the people that make up a particular group (Bennett, 1996). It is when people from different cultures meet, and when laws that govern one’s group’s behaviour are in conflict with the other group’s beliefs and practices, that difficulties will arise. Some examples are monogamous and polygamous marriage practices and the position of women in society when Western practices are compared with practices in some Middle East countries.

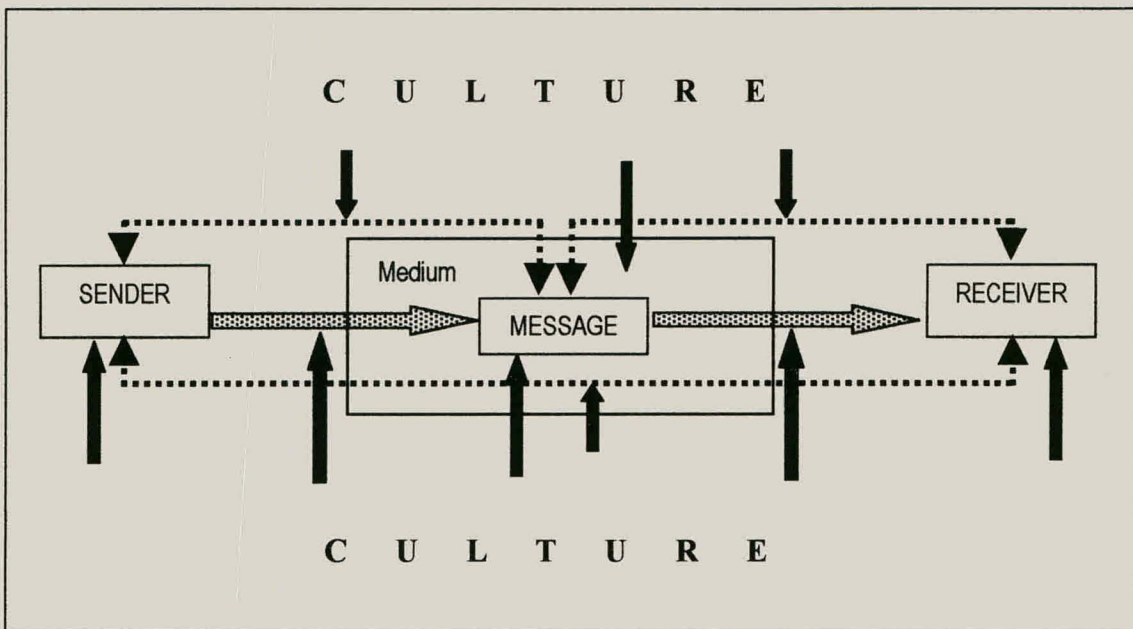
From the above it can be argued that culture in its widest sense is expressed and embodied in most facets of a person’s life. Culture, expressed in laws and precepts, governs how an individual can or must behave within a particular society; it determines how marketers will approach an advertising campaign targeted at a specific group or how a medical doctor will communicate with his/her patient, to name but a few. The concepts of culture and communication are interwoven and regulate how people not only behave or express themselves, but also how they form a message and how another person responds to a message. This unison between culture and communication is

described by Samovar and Porter (1995:44) as “*inseparable*”, making it difficult to decide which is the “*voice*” and which is the “*echo*”. Culture and communication are inseparable. The influence of culture could prove to be a major component in a structural communication model, and not a single influencing variable as depicted in Pettersson’s (1993) model.

The preceding subsections have shown that culture and communication are inseparably linked and that culture is a lens or a filter through which people receive, interpret and transmit messages. Communication is an open system and takes place within a cultural environment. This environment affects the sender, the receiver and the relationship between the sender and the receiver. This concept is graphically presented in Figure 2.6 as a picture-text-communication process that takes place within a cultural environment. The purpose of this model is to show the importance and position of culture in relation to the communication process.

FIGURE 2.6

A graphic representation of the communication process within a cultural environment.



The communication model operates within a cultural environment. The black arrows denote the specific positions in the communication process where cultural influences may occur. The broken arrows indicate the communication and feedback process. Culture acts as noise factor in a communication process and can interfere with the

sender's ability to encode a message, it can interfere with the feedback process between the receiver and the sender and influence how the receiver interprets the message. Text, pictures and picture-text messages are subjected to cultural influences in the learning process where picture-text learning materials are used.

2.3 A TAXONOMY OF PICTURES IN INSTRUCTIONAL TEXT

Scholars propose different taxonomies of pictures to establish a framework for research, scholarly discussion and the formulation of theories, and to synthesise research results. The predominant listings are of a functional nature, based on the supporting role that pictures play in text-picture material. The functional approach is, according to Weidenmann (1989:158), the most widely accepted system that would attempt to explain the beneficial effects of pictures when they are added to text. Two other classification systems are the semantic system (Knowlton, 1966) and the morphological schema (Twyman, 1979:119-120). The schemata of Twyman is based on their physical attributes rather than their communicative intent. Pettersson's (1993:201) wider classification system appears to be a combination of a functional and a descriptive approach.

Some of these classifications are briefly summarised to place this study in the context of the wider field of picture-text research. The discussion in this section excludes learner-produced drawings, imaginable pictures and non-representational pictures, for example graphs and charts, as they fall outside the scope of the study.

This section provides a review of different functional classification systems and presents a taxonomy for the study.

2.3.1 A review of some of the classification systems

One of the earlier attempts to classify pictures in a systematic manner was the functional approach of Smith (1960:29), who postulated that pictures serve three main functions, namely motivating a reader, reinforcing what is read, and enhancing the verbal material.

Knowlton (1966) continued with this approach and based his taxonomy on the communicative intent of the pictures. He divided pictures into three major groups:

realistic pictures, analogical pictures and logical pictures. Realistic pictures depict the object that the communicator intends to portray. Analogical pictures are pictures that represent the visible or invisible world through an analogy that is normally difficult to describe in words. A picture of soldiers fighting an invading army would be an example of an analogy representing the human immune system. Simplified and schematised pictures that are used to depict complex relationships, for example a city map, a wiring diagram or an atom, are logical pictures.

A classification system, comparable to Smith's (1960) division, is Duchastel's functional framework, whereby pictures are classified according to three roles that they fulfil, namely attentional, explicative and retentional roles (Duchastel, 1978, 1980; Duchastel and Waller, 1979). Duchastel describes attentional pictures as pictures that have a motivating and attentional role; explicative pictures have a didactic role and explain aspects of the text; retentional pictures act similarly to headings and are linked to the main sections in the text. Retentional pictures give the reader a conceptual plan of the textual material, and they are supposed to help the reader to retrieve information through a dual coding process (Paivio, 1971; 1978; 1983). These categories are not mutually exclusive and a picture could fulfil more than one role. Duchastel and Waller furthermore subdivide their explicative category into descriptive illustrations (showing what an object looks like), expressive illustrations (to add impact), constructional illustrations (technical drawings), as well as functional (diagrammatic illustrations), logic-mathematical (mathematical concepts like graphs), algorithmic (systems charts and data illustrations), and graphic illustrations (representation of numeric data). A more simplified taxonomy, in which we receive and transmit pictures, is proposed by Dondis (1973), namely representational, abstract and symbolic pictures. The functional classification of Sless (1981:112-141) includes descriptive, expressive, constructional and functional categories.

A widely cited classification system was developed by Levin (1981 and 1989), who divides pictures into five different functional groups, namely decorative, representational, organisational, interpretative and transformational pictures.

Decorative pictures are text-irrelevant and are used to make the printed material more attractive. The function of decorative pictures is to increase the reader's interest and to increase the sales of the material. Decorative pictures normally do not facilitate the educational effect of learning material.

Representational pictures overlap the text, representing objects and ideas in the text and relating the same story as the text. These pictures not only repeat the information in the text, but also make the text more understandable. Pictures with a representational function assist learning and appear to be the most widely used type of picture in educational text-picture material.

Organisational pictures are pictures that visually portray poorly organised text or text that is difficult to structure. Pictures that accompany text explaining how to repair a combustion engine or how to assemble a model aeroplane are examples of organisational pictures. These pictures might appear to be representational in nature and to repeat information in the text, but they have an organisational function.

Interpretative pictures explain abstract sections in text and clarify text that is difficult to understand, for example complex scientific text. These pictures are similar to organisational pictures. The type, structure and complexity of the text determine the classification of a picture as an interpretative or an organisational picture. A picture accompanying text on the nitrogen cycle could be classified as an interpretative picture.

Transformational pictures are Levin's last classification. This function takes place when pictures transform information into a more concrete form and make it easier for a student to retrieve large amounts of information. Text that is difficult to remember can be made easier by using pictures to recode information mnemonically, for example the different cloud types.

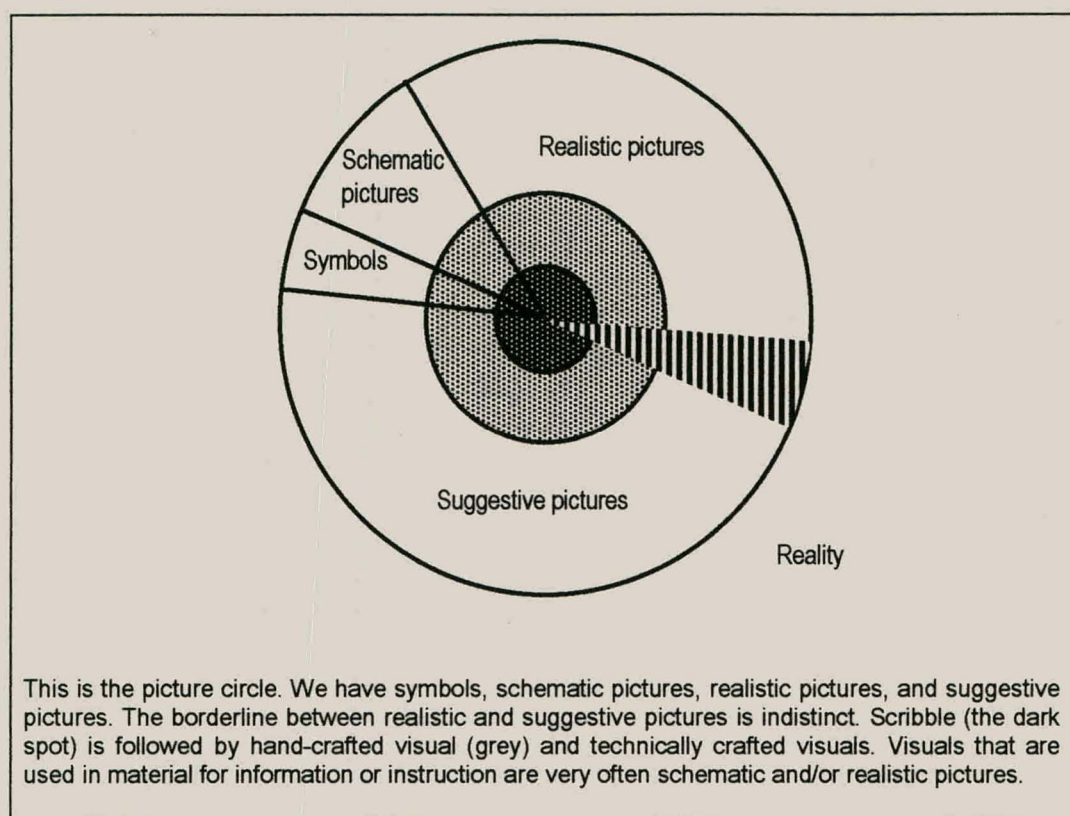
In an analysis of picture facilitating effects, Levin *et al.* (1987) reviewed 87 documents representing some 100 experiments. They found that transformational pictures have the highest facilitating effect when compared to the other four picture functions. That transformational pictures could have the strongest facilitating effect was also hypothesised by Knowlton (1966), except that transformational pictures would fall in his analogical picture group.

A classification system similar to Levin's (1981) is proposed by Mayer and Gallini (1990) and Mayer (1993), who divide pictures into decorative, representational, organisational and explanative pictures. The functions of pictures in these groups are the same as Levin's, except that Mayer's explanative pictures include Levin's transformational and interpretative groups.

Pettersson's (1993:201-224) classification of pictures is from a wider communication perspective. He uses the term visuals instead of pictures. He classifies visuals according to where they fit into a communication model, namely sender, receiver, content execution, format and context. He also includes "*function*" and "*use*" as additional criteria. His "*picture circle*" is an attempt to symbolise one model of classification. The "*picture circle*" and accompanying labels are given in Figure 2.7.

FIGURE 2.7

Pettersson's Picture Circle (from Pettersson, 1993:204).



Brody (1984:51) criticised the functional approach as proposed by the aforementioned scholars. He stated that the classifications are too broad or general in nature and that the functions do not accurately describe the activity that takes place during the instructional process. He proposed that the functions must be stated according to the contribution that they make to the instructional process, and he listed twenty-one instructional functions that pictures serve. His functions are repeated for clarity in Table 2.1.

TABLE 2.1

Representative instructional functions served by pictures (Brody, 1984:53).

<i>Present new information</i>	<i>Change of pace</i>
<i>Concretize abstract information</i>	<i>Isolate</i>
<i>Compare</i>	<i>Simplify</i>
<i>Emphasize point</i>	<i>Organise</i>
<i>Provide examples</i>	<i>Present redundant information</i>
<i>Motivate</i>	<i>Summarize</i>
<i>Advance organizer</i>	<i>Gain attention</i>
<i>Control learner behaviors</i>	<i>Direct attention</i>
<i>Common referent</i>	<i>Novel stimulus</i>
<i>Model cognitive process</i>	<i>Provide analogy</i>

Brody's classification is useful in that the above can be accommodated in a narrower classification system and the pictures can then be described with these and other functional words to describe their activity within the text-picture context.

Peeck (1987) divides pictures into two broad clusters according to their functions and effects, namely an affective-motivational and a cognitive cluster. Her affective-motivational cluster includes the enjoyment, attentive and motivational function of pictures, whilst the cognitive cluster deals with the role of pictures in comprehending and remembering text. Her cognitive cluster includes Levin's (1981) representational, organisational, transformational and interpretative functions, and her affective-motivational cluster includes decorative pictures. Pictures in these two clusters can, as in Levin's classification, overlap and fulfil both an attentive and a comprehension function, depending on the text and artistic style of the picture.

2.3.2 A proposed taxonomy of pictures for the study

There are two broad common picture categories reflected in the taxonomies of Smith, Knowlton, Duchastel, Levin, Mayer and Peeck, namely pictures with cognitive functions and pictures with decorative and aesthetic functions. Pictures with a cognitive function facilitate learning, and pictures with a decorative function do not facilitate learning. A synopsis of the functional approach is combined with Brody's (1984) functions and is given under four broad categories in Table 2.2 on the next page. These four categories are adopted as a taxonomy for this study.

TABLE 2.2

A proposed taxonomy of pictures in instructional text.

This system is based on the functional approach and on the functions that pictures can serve in text.

Category	Instructional function	Reference
<p>1 REPRESENTATIVE PICTURES Pictures that are representative in nature</p> <p>The function of these pictures is to repeat the same information that is represented in the text. These pictures overlap with the text and make the text more understandable. The pictures are literal in their representation. The majority of pictures that are used in conjunction with instructional text fall into this category.</p>	<p><i>(Taken from Brody, 1984)</i></p> <p>Provide examples; Emphasise point; Present new information; Common referent; Isolate; Simplify; Reiterate; Present redundant information; Summarise; Make words concrete.</p>	<p><i>Other classification names</i></p> <p>Reinforcing (Smith, 1960); Enhancing (Smith, 1960); Realistic (Knowlton, 1966); Retentional (Duchastel, 1978); Representational (Levin, 1981; Mayer 1993); Cognitive cluster (Peeck, 1987).</p>
<p>2 EXPLANATIVE PICTURES Pictures that are explanative in nature</p> <p>Pictures in this category can explain procedures that are discussed in the text, they can clarify objects which are difficult to explain, and they can assist in interpreting difficult text. These pictures are, as in representational pictures, literal in what they represent. The facilitating effect for this category is higher than for representational pictures.</p>	<p>Provide examples; Compare; Advance organisers; Control learner behaviours; Isolate; Simplify; Organise; Present redundant information; Summarise; Draw and direct attention.</p>	<p>Logical (Knowlton, 1966); Explicative (Duchastel, 1978); Organisational (Levin, 1981; Mayer, 1993); Cognitive cluster (Peeck, 1987); Explanative (Mayer, 1993).</p>
<p>3 ORGANISATIONAL PICTURES Pictures that organise information and pictures that are analogical in nature</p> <p>Pictures can provide an analogy for a portion of text that is procedural or explanative in nature and which is difficult to understand. Pictures in this category are not necessarily literal in their representation. The facilitation effect of organisational and analogical pictures is higher than that of representational pictures.</p>	<p>Provide examples; Concretise abstract information; Model cognitive process; Simplify; Present redundant information; Construct mental model; Summarise.</p>	<p>Analogical (Knowlton, 1966); Transformational (Levin, 1981); Cognitive cluster (Peeck, 1987); Explanative (Mayer, 1993)</p>
<p>4 DECORATIVE PICTURES Pictures that are decorative in nature</p> <p>Pictures in this category beautify printed material and help in the marketing process of the material. There is currently no evidence in the literature that this type of picture facilitates learning when it is combined with instructional text.</p>	<p>Novel stimulus; Gain attention; Motivate; Change of pace; Present redundant information; Attract buyers.</p>	<p>Motivating (Smith, 1960); Attentional (Duchastel, 1978); Decorative (Levin, 1981; Mayer, 1993); Affective-motivational cluster (Peeck, 1987).</p>

2.4 WHEN PICTURES DO NOT FACILITATE LEARNING

Researchers agree that pictures interfere with the process of learning how to read and that pictures with a decorative function do not assist learning. The first part of this section will discuss studies which found that pictures interfere in the process of learning how to read, while the second section will discuss the null facilitating effect that pictures with a decorative function have when they are combined with instructional text.

2.4.1 Pictures do not facilitate the process of learning how to read

Scholars frequently quote Samuels (1970) and Concannon (1975) who, in their review of published research, found seemingly little or no evidence that pictures will facilitate learning. The review of Samuels looked at studies that investigated the effect of pictures on subjects when they learn to read; the use of pictures to aid comprehension; and the influence of pictures on attitudes. A common element of the studies is that the text could be understood without the pictures, or where the goal of the lesson could be achieved even if the pictures were removed. With reference to some of his own work and nine other studies, Samuels (1970:402) remarked that researchers appeared to agree that pictures interfere with readers' ability to acquire a "sight" vocabulary. Three of these studies were similar in that the researchers used a look-and-say method whereby the children received a word and a picture in the learning phase, and had to name the word in the testing phase without the picture. The results indicated that words and pictures in a paired associated situation interfered with the children's ability to learn words. Samuels also reported that pictures did not affect the better readers but interfered with poor readers when learning sight vocabulary. Children also learned sight vocabulary more rapidly without the presence of pictures. Pictures did not necessarily assist children with recall or the comprehension of text. A traditional approach of some primary-school teachers is to point to a picture representing the same word when teaching sight words to beginner readers. The underlying assumption is that the extra picture stimulus will reinforce the word, that it will assist recall and hence facilitate the learning of sight words (Solman and Wu, 1995:227). The results of Samuels's review points to the contrary.

Concannon also questioned this underlying assumption in her review of fourteen studies that were published between 1938 and 1972. Her aim was to find evidence in the literature to confirm that pictures can facilitate learning when they are combined

with text. From her review it appears that three studies reported that text alone was superior to text with pictures, and one study reported that children retained more knowledge when reading text with a picture. Five of the articles that she reviewed indicated that pictures are not desirable when learning sight vocabulary. In her summary, she stated that “... *the limited research indicates findings that pictures serving as motivating factors actually do not contribute significantly to the child's ability to decode*” (Concannon, 1975:256) and also remarked that more conclusive studies are required before a final decision can be made.

Her review might give the impression that pictures do not help learning when they are combined with text, but as indicated in her summary statement, this is not conclusive enough and more research is needed. One important area that her review highlighted, was the undesirability of combining pictures with words when children are learning sight vocabulary. Concannon's and Samuels' reviews were limited and both indicated that more research was needed to investigate the effects on learning of colour, detail and complexity in pictures, and to compare the relative effectiveness of photographs and illustrations.

Goldsmith summarised sixteen empirical studies conducted between 1969 and 1979, which investigated the effect that pictures have on young children when they are learning to read (1984:80-120). Seven of the papers reported that their subjects performed better without the pictures. She stated in her conclusion that these studies do not lend themselves to the formulation of guidelines and that the preference of children to have pictures with reading material must not be ignored.

The customary procedure for investigating the use of pictures in learning single words consists of comparing the learning effect of words combined with a picture, with the learning effect of words without a picture. The experimental design used by researchers is either a pre-test, post-test or a post-test-only design in different combinations, whilst control groups are not always used by the researchers. Solman *et al.* (1992), extended this standard experimental design with four variations of the test material. Their test material variations consisted of a large picture above a small word, a small picture below a large word, a small word without a picture, and a large word without a picture. They selected twelve words and prepared twelve flash cards for each word and for each of the four variations. The pictures were simple line drawings that matched the words. They used sixteen children with a mean age of 5.6 years and excluded those that could name more than one correct word in a pre-test. A different set of words and word-picture flash cards were used in the pre-test. Each subject received the material in random order in learning and test trials until they named three

words correctly in any of the four variations, in three successive trials. The proportion of correctly named words, inclusive of all the previous trials, was taken as the criterion of achievement. The children correctly named 19.5 percent of the two variations where a word was combined with a picture, and gave a 40 percent correct response for the two variations where a word was presented alone.

Solman *et al.* (1992) duplicated this experiment with sixteen new subjects of the same age group, but enhanced the pictures by doubling the thickness of the pictures' lines, extended the viewing time for the picture-word combination to eight seconds and reduced the viewing time of the word-only cards to four seconds. Their results were similar to those of the first experiment in spite of the additional emphasis on the pictures in the second experiment. The subjects obtained a mean score of 16.8 percent for the picture-word cards and 43 percent for the word-only stimuli. In discussing their results, they (*Ibid.*, 1992:149) remarked: "*These results again demonstrate the deleterious effect of pictures when young children learn to name words, and they provide further support for the blocking explanation of this picture and word problem.*"

Wu and Solman (1993) were able to reverse this blocking trend with a feedback cueing technique. They used the picture as feedback stimulus after the child gave or attempted to give the name of the word stimulus, and obtained a learning rate with this picture-word feedback technique that is equivalent to a word-only presentation. In a later experiment, they (Solman and Wu, 1995) attempted to increase the learning rate of a picture-word stimulus by changing the feedback cueing techniques through the enhancement of the picture in the feedback process. All their subjects received all three experimental stimuli in random order. The stimuli material consisted of the word-alone, a standard word-picture, and an informative-picture stimulus. The same twelve words were used in each of the three stimuli. The informative-picture stimulus consisted of a word card with the corresponding picture on the back of the card. The word-picture was a word card with the picture above the word, and the word card contained only a word. Twelve children with a mean age of 5.4 years participated in the experiment. A pre-test was used to ensure that all the children could recognise all the pictures and that they did not know the words. Children who could name the words were excluded from the experiment. The procedure of testing was similar to a previous experiment (Solman *et al.*, 1992), except that the children received three sets of stimuli instead of four. The pictures were enhanced during the feedback session by showing the child the picture at the back of the word card after an attempt had been made by the child to name the word printed on the front of the card. Positive verbal reinforcement followed a correct response. The card was then turned around to show

the word again and the child was requested to repeat the word-naming twice. The child received the correct response if he or she did not attempt a naming response. They were then again asked to repeat the response before looking at the picture. The child was then asked to repeat the word-naming twice. The same procedure was followed with the word-alone and the word-picture cards. No deliberate picture manipulation was used during the feedback session with the picture-word stimuli. A post-test, with the twelve words, followed each learning session where the children were asked to name the words. These learning and test sessions were repeated until each child reached a criterion of three correct naming responses of four words in any of the three variations of the stimuli.

The results showed that the children reached the criterion for the informative-picture-feedback ahead of the word-alone presentation, but the difference was not statistically significant. The standard picture-word stimuli received, as expected, the lowest mean. Although the children appeared not to benefit when pictures were included in single-word learning, the motivational influence of pictures was not accounted for.

Solman and Wu (1995) repeated their first experiment with the difference that they used a pre-test, post-test design with three control groups only. In this between-subject design, subjects in the three groups received either the word-alone, the word-picture or the informative-picture treatment. Their aim with the changed experimental design was to account for the motivational effect that the pictures could have had on the word-alone stimuli. This motivational effect is based on the argument that affective factors, attitude, interest and motivation could influence the behaviour of learners and their ability to retain information (*Ibid.*, 1995:234). Pictures in a repeated-measures design can act as an affective factor. Thirty boys and thirty girls with a mean age of 5.6 years participated in this experiment. Each group received the same six words in the same learning test trial used in the first experiment. A child received an immediate post-test after each learning session, until he or she reached the criterion of a correct naming response to all the words in three consecutive tests. The children were also tested for retention two and four weeks later.

This second experiment gave results that pointed in the same direction as the first experiment. Four data sets were collected, namely the number of test trials that each child had to go through before reaching the criterion, the proportion of correctly named words in the post-test, and the number of words recognised in two delayed retention tests. As in their first experiment, there was no significant difference between the word-only and the informative-feedback techniques. The group that received the picture-word combination had a significantly lower mean than the other

groups. There was no significant difference between the two groups in the delayed recall tests. The feedback cueing process neutralised the blocking process associated with picture-word stimuli and equalled the word-alone presentation. The second experiment gave no evidence that picture motivation plays a role in learning sight words. Solman and Wu (1995:240) conclude by recommending that children must learn sight words without pictures, and that pictures can be used as a feedback after the child has made a response to name the word.

The non-facilitating and interference effect of pictures during learning of reading was challenged by Donald (1979) on the basis of the statement that learning to read must be seen in the context of reading continuous text and not learning isolated words. In a small study ($n = 20$), and using only second-year readers, he found that his results indicated a facilitating effect and that illustrations improved contextual word recognition accuracy. Donald (*Ibid.*:289), however, noted in his discussion that: "... *the results also suggest that a child who tends to overuse contextual information - 'the wild guesser' - may not benefit from the presence of illustrations*". In his discussion, Donald's comment that the wild guesser may not benefit from pictures points in the same direction as the results of Solman and Wu (1995). Although Donald's results indicated that pictures helped word recognition, this involved second-year readers and word recognition in context, not isolated words and not beginner readers. He acknowledged that illustrations act as distracters from the word to be learnt, which is the only source of information. His results, therefore, do not contradict previous results, but rather indicate that pictures have a general facilitating effect when they compliment or overlap the text.

This blocking trend and the problem associated with pictures and the learning of sight vocabulary are also substantiated by other scholars (Solman, Singh and Kehoe, 1992; Solman, 1992) and by Levie and Lentz (1982) in their review paper. Solman and Wu (1995:240) list nineteen more studies that indicate a detrimental or non-facilitating effect for pictures when children must learn sight words. There is also consensus in the literature that less-skilled readers are more prone to picture interference than older and more-skilled readers. Pictures with text sometimes slowed children's oral reading (Willows, 1978), and would actually reduce memory performance when the pictures did not match the oral prose (Peeck, 1974).

The reason for this interference effect of pictures in the learning-to-read process is attributed to the principle of least effort. A subject will select that item from a complex stimulus that will require the least amount of effort to produce a correct

response. This, according to Samuels (1970), explains why beginner readers attend more readily to a picture when they are presented with a word and a picture at the same time. The picture will require less effort to provide a response than a word that they still have to learn, and the shift in attention from the picture to the word fails to materialise with some learners. The assumption is that the extra stimulus will reinforce the word, that it will assist recall and, therefore, facilitate learning (Solman and Wu, 1995).

2.4.2 Decorative pictures

Decorative pictures are pictures that embellish text and which have an element of artistic expression to them. The functions of decorative pictures are a numeration function, namely to increase the sales of the printed material, and a motivational-attentional function, namely to attract attention and to motivate. Woodward (1993:118), in a review of the instructional purpose of illustrations in U.S. textbooks, remarked that publishers tend to use illustrations as a marketing tool to attract attention, to create a positive effect and to change illustrations on the book covers to create the effect of a new and revised textbook. Illustrations are also used to serve social policies and for political purposes. Levie and Lentz (1982:198), in their extensive review on the effects of text illustrations, remarked that illustrations would not automatically help students to learn messages that are contained in the text.

Suffice it to note that there is consensus in the literature that decorative pictures or text-irrelevant pictures do not facilitate recall and comprehension and do not assist subjects with inferential questions (Mayer, 1993; Levin *et al.*, 1987; Levie and Lentz, 1982; Levin, 1981). Decorative pictures do not repeat or explain information in the text and cannot help a reader to make inferences or understand the text. Decorative pictures are text-irrelevant and have no link to the instructional text.


An example of decorative pictures and decorative elements in an educational textbook is given in Plate 2.1 on the next page. Several elements on this page have text-irrelevant decorative elements and pictures. The instructional text mentions “Nkupe” and “South Africa”, but this is not illustrated by the pictures. The text on the hunter-gatherers above the comic-type illustrations in the rectangles is more entertaining than instructional. The colour band at the top, the large 4 and the simplified illustration of a man hunting an animal are all decorative elements without an instructional purpose.

PLATE 2.1

An example of decorative pictures and decorative elements in an educational textbook
(from Clacherty & Ludlow, 1995:34).

34

4 Hunter-gatherers



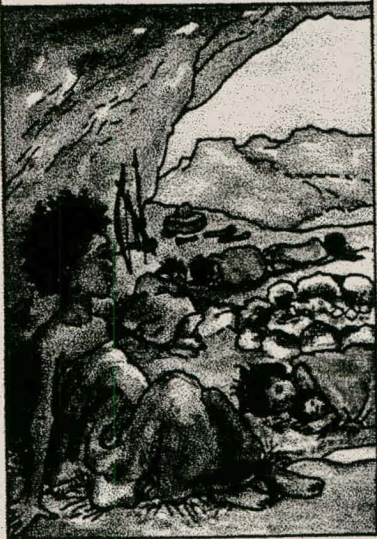
I'm sure you remember that hunter-gatherers were people who lived by hunting animals and gathering foods like fruits, berries and roots.

In this chapter you are going to learn much more about hunter-gatherers.


You are going to find out about hunter-gatherers who lived at a place called Nkupe in southern Africa between 6 000 and 3 000 years ago.

This is a story about a day in the life of a hunter-gatherer girl called Nisa. She lived about 3 000 years ago.

1 One morning Nisa woke up early. The rest of the people in her group were still sleeping in their cave shelter in the Drakensberg Mountains.



2 Nisa walked to the rocks above her home to look at the beautiful hills in the early morning light.



2.5 EVIDENCE FOR THE FACILITATING EFFECT OF PICTURES IN INSTRUCTIONAL TEXT

There is abundant evidence that pictures, under certain conditions, can significantly facilitate the comprehension and recall of prose and instructional text. Pictures can also interfere with learning how to read or can have a neutral effect on learners' cognitive processes during learning. This section provides a review of the literature that corroborates the facilitating effect that pictures have on learning when they are used in conjunction with instructional text. Pictures in the context of this and the next section include photographs, line drawings, as well as detailed and simple illustrations in full colour and in black and white.

2.5.1 Evidence for picture facilitation in learning

There is considerable empirical evidence that text-relevant pictures facilitate comprehension and the recall of information that is presented in prose material (Levin and Lesgold, 1978; Levin, 1981; Levie and Lentz, 1982; Digdon, Pressley and Levin, 1985; Levin *et al.*, 1987). The children in Levin and Lesgold's experiment listened to a prose passage rather than reading a printed prose passage as in the other experiments. This facilitating effect is durable over time and pictures do not necessarily interfere with information not represented by the picture (Anglin, 1986 and 1987). The magnitude of this facilitative effect varies as it depends on the type of picture, the text, the learner and the evaluation methods.

The educational effect of pictures in explanative picture-text material can be of an impressive magnitude. An increase, for example, of more than 50 percent in problem-solving ability and retention of concepts is reported by Mayer (1993) when explanative illustrations are used with explanative text, when the learners have low prior knowledge of the material, and when the test criteria measure conceptual retention and problem-solving skills. The work of Mayer is based on 24 published experiments that were completed over a period of 20 years. A moderate facilitating effect of between 11 percent and 15 percent is reported by Anglin (1987), who used prose and representational pictures. The facilitating effect is normally higher with explanative pictures than with representational pictures. Levie and Lentz (1982) give a mean improvement of 36 percent for groups reading text with pictures when compared to

groups that read text alone. They based their results on a review of 23 studies that produced 46 comparisons.

A frequently quoted review by Levin and Lesgold (1978:233) found that pictures produce a consistent increase in comprehension during prose learning. They stated that pictures are beneficial if the subjects are children and if they listen to a narrative prose passage, that the pictures must overlap the prose content, and that testing must be on factual content. The literature that they reviewed shared common elements that formed *five ground rules* when pictures would invariably facilitate prose learning. The five ground rules are that:

- *the subjects must be children;*
- *the presentation of the text must be done orally;*
- *the pictures must convey the same information as the text or must overlap the text;*
- *the stories must be unfamiliar to the subjects, and*
- *factual recall must be used to measure the facilitating effect.*

In their review Levin and Lesgold (1978:237) stated: "*These data clearly suggest that picture effects are not only pervasive, but of impressive magnitude as well*", and that pictures that accompany prose, improve comprehension with at least 40 percent. In another study Levin *et al.* (1987) noted that even when a control group is exposed to a listen-twice procedure, the difference in performance is still half of that when the control group is exposed to a listen-once procedure with exposure to a picture. These results indicate that the facilitation effect of pictures with prose is more than a repetition effect of text. Levin and Lesgold (1978) also found that the increase in comprehension could be generalised across certain situational, subject and procedural variables. Children from different ages, social backgrounds, levels of intellectual ability and cultures all showed an increase in comprehension. The method of presentation was not crucial, as the superiority effect was obtained with different methods of presentation, such as the use of slides, line drawings and paper cut-outs, and by presenting the pictures during different times of the prose. Children benefited from the accompanying use of pictures when reading prose passages, whether these were short or long, simple or complex. Children exposed to prose-pictures were also able to recall more thematic, central and incidental information than prose-only children. They referred to work in progress and indicated that the picture superiority effect persisted over three days.

The studies that Levin and Lesgold reviewed used children who were taught through prose and pictures; the children were not actively involved in accessing the material through their initiative; they were under the direct control of the experimental facilitator, and had to respond to cued questions. These results will be difficult to generalise to a learning situation in developing communities, due to the change in teaching practices in developing communities. Teachers will not always have the means to teach students with verbal prose and pictures. The superiority effect of pictures, however, is not always as pervasive in a classroom situation as it is in an experimental situation.

The last of the previously mentioned *five ground rules* stated that factual recall must be used to measure the facilitating effect. Holmes (1987:16) extended these *five ground rules* by showing that pictures can also facilitate the answering of inferential questions when photographs are combined with a prose passage. A review by Schallert (1980:519) extended this even further and concluded that illustrations can be beneficial not only for reading but also for listening with comprehension, for adults and children, for redundant, non-redundant and expository text, as well as for narrative prose.

Digdon *et al.* (1985) investigated children's learning when pictures do not overlap the story. They found sufficient evidence that a two-picture treatment produced better learning when compared to a no-picture or partial-picture presentation, or a picture with just one object. Their two-picture treatment consisted of a partial picture, that is a picture where an object is missing and which is probed for in a post-test, and a separate picture of the missing object. What makes it difficult to apply their results to a wider population is the experimental condition of having a separate picture of an object that is missing in the partial picture. Producing two pictures to fulfil the function of one picture for a facilitating effect would not be a logical design decision if the same could be achieved with one picture. They (*Ibid.*, 1985:143) concluded by stating that it is not necessary for pictures to overlap completely to improve learning. It could also be that the separate picture of the object missing in the partial picture, converted the partial picture to a picture that overlaps the text and that the two pictures acted in a repeat function.

Questions arose from the above, namely to what extent can these results be generalised to school children from developing communities; what are the *ground rules* for pictures to facilitate instructional text for these scholars; and which graphic variables can add to this facilitating effect?

Harring and Fry (1979:188-189) provide an answer to one of the above questions by reporting that pictures can facilitate the recall of main ideas in printed instructional text. The pictures that they used were rather unimaginative. The pictures consisted of black outline drawings with little or no detail and the prose consisted of a 350-word fable. They reported that the pictures enabled the subjects to recall the main information immediately and five days later. There was, however, no facilitating effect for lower order detail. In a related study, Anglin (1986:29), who used college students, found significant facilitating effects for pictures during immediate and delayed testing. His drawings also consisted of black outline drawings, and the prose was of human interest. Others (Peng and Levin, 1979; Levin and Berry, 1980) also reported picture-facilitating results when using prose with human interest. Pressley, Levin, Pigott, Le Compte and Hope (1983:141-142) found picture-facilitating effects for oral and printed prose, but found no significant negative effect for mismatched pictures. They also suggest that their results indicate that their data challenge the apparent motivational effect that pictures have on the recall of prose (*Ibid.*, 1983:142). Their results of the mismatched picture experiment differ from those of Peeck (1974), but also question the theory that pictures act as motivators in text and therefore assist learning.

2.5.2 Summary of evidence for the facilitating effect of pictures in instructional text

The development of knowledge about the effect of text illustration on learning has grown from the initial doubt about the educational value of pictures when they are combined with text (Samuels, 1970; Concannon, 1975), to a position where the facilitating effect was acknowledged (Levin and Lesgold, 1978), to where researchers tried to establish techniques to increase the facilitating effect of pictures (Lamberski and Dwyer, 1983; Beck, 1984; Digdon *et al.*, 1985). These techniques are discussed in Section 2.5.

Common factors in the works cited above are that the pictures consisted of black outline drawings, they were unimaginative, the stories were of human interest or were fables, and they played a supporting role to the text. The subjects consisted mainly of children and college students as these appear to be more easily accessible to researchers. The subjects, experimental designs, test material, and independent and dependent variables that researchers used in the studies were seldom equivalent,

which is one of the reasons for the varying results. The facilitating effect that was shown with varying experimental conditions attests to the robustness of this phenomenon.

Suffice it to note that pictures can facilitate the recall and comprehension of instructional text; they can help learners to remember prose passages; they can assist learners to answer inferential questions; and this effect is durable over time. The facilitation effect can range from significant to indistinguishable. The facilitation effect applies to both children and older learners. Heterogeneous experimental conditions contribute to different research results. It must be noted, however, that numerous interrelating factors, namely the text, the experimental conditions, the picture and the learner affect, the magnitude of this facilitating effect.

2.6 FACTORS THAT INFLUENCE THE FACILITATING EFFECT OF PICTURES IN INSTRUCTIONAL TEXT

The facilitating effect of pictures in instructional text is described in the cognitive-psychological literature as an interactive process between the text, the pictures and the subject (Molitor, Ballstaedt and Mandl, 1989). Four conditions are, according to Mayer (1989) and Mayer and Gallini (1990), required before pictures will promote the understanding of scientific text. The text must be explanative, it must present cause-and-effect systems, the tests must be sensitive enough to measure the subjects' understanding, the pictures must be explanative, and the learners must be inexperienced in the learning. A similar list of conditions, compiled by Dwyer (1978:xiii-xiv), indicated that the effectiveness of a picture depends on the amount of realism in the pictures, the method of presentation, student characteristics, the level of the educational objective to be achieved, techniques used to focus attention on the visuals, and the tests used to assess the effectiveness of the visuals. He also found that an increase in realism will not necessarily facilitate a corresponding increase in information that a student can obtain from the pictures (Dwyer, 1979). Dwyer compiled these guidelines after a review of more than 650 articles that represented the work of more than 625 researchers.

The following section briefly synthesises the factors that influence the facilitating effect of pictures. The factors are discussed under four broad categories, namely picture characteristics, type of instructional material and text content, learner characteristics, and evaluation methods.

The listed factors are not comprehensive, nor can they be generalised without circumspection. The different combinations of texts, learner characteristics, pictures and evaluation procedures will all affect the outcome of an experiment and make it difficult to compare experiments with each other due to the changing interrelating variables. The conditions of a laboratory picture-text experiment are also not necessarily the same as the learning environment of a learner. A sound approach would be to view the factors that facilitate learning "... *rather as indicators of the direction of the evidence, ...*" (Allen, 1975:142) than as theory. Certain tendencies that emerged from these studies and which can be generalised to a wider audience, are summarised in a table at the end of this section (p.76-78). A useful guide in this field, but one that appears to be based on a few sources of which most are cited in this chapter, is a book by Lowe (1993).

2.6.1 Picture characteristics

Pictures are multivariable stimuli and are presented in different modes, for example photographs or hand-drawn images, in monochrome or in full colour. Identifying picture characteristics that contribute to the facilitating effect is furthermore compounded by divergent art styles and the picture syntax.

The wide range of pictures that researchers use are not always reproduced in academic journals, and the text descriptions of these pictures are not always sufficient to make accurate comparisons between the experiments and the pictures (Brody, 1981; Peeck, 1987). The facilitating effect of pictures is, however, consistent across different studies and could be an indication of the robustness of this effect. The following picture variables are factors that can contribute to the picture facilitating effect in educational picture-text material, and have wide generalisation possibilities:

2.6.1.(a) Clarity of the pictures

That pictures must be text-relevant, clear, interpretable by the learner, and must not conflict with the text, is the general conclusion of all the major reviews and picture-text studies (Dwyer, 1978; Levin and Lesgold, 1978; Harring and Fry, 1979; Levie and Lentz, 1982; Levin *et al.*, 1987; Pettersson, 1993; Moore and Dwyer, 1994). Pictures that are central to the text, and which present new information that is important to the text, can facilitate comprehension (Schallert, 1980).

Pictures can have different functions in the educational process, in that some support text and act as a repeater; others elucidate text, for example technical drawings; whilst

photographic and illustrative comic strips can convey the main content of a message with text in a supportive role. Facilitating effects are accomplished not only through the content and position of visuals in the text but also through graphic variables, for example quality and clarity. Golden (1990) examined whether the combined quality and clarity of photographs would facilitate learners' recall in a delayed test. In his study, Golden attempted to answer the question of whether the cost of producing a photographic image of high technical quality is justifiable, or if a lower quality picture, with the same content, could be just as effective. He used a *signal-to-noise ratio* (S/N) framework to produce paired photographs of agricultural products. Each pair consisted of a high S/N photograph and a low S/N photograph, where the high S/N elements were better sharpness and image quality, realistic perspective and more detail. Two hundred and four tertiary students viewed eighteen pairs of high and low S/N photographs every six seconds, and were asked after five days to recall what they remembered. The subjects recalled seven hundred and twelve items from the high S/N photographs and six hundred and fifty items from the low S/N photographs, a difference that is statistically different. Golden, however, cautioned against generalising his results and remarked that the content of a photograph will determine if it is noticed and remembered in real life, irrespective of its technical quality. His results nevertheless support Pettersson's (1989:164) picture readability principles where a picture will be easy to read if the "... *picture has a dominant centre of interest at or near its optical centre (middle of picture) and few details which can be regarded as distracting*". The principle of high S/N pictures as a better product for communication is also intuitively supported by the practice of photographers and graphic designers of giving attention to technical qualities.

2.6.1.(b) Realism

The amount of realism and detail in pictures has been investigated by a number of researchers. The value of the detail and the value of the amount of realism, in terms of facilitation, depend on the time and effort that the learner invests in studying the picture (Peeck, 1987; Dwyer, 1978 and 1994). Learners appear to overlook detail in complex pictures (Beck, 1984:207) and do not always make effective use of pictures. An increase in detail and realism does not necessarily increase the facilitation effect in a linear manner.

2.6.1.(c) *Graphic cueing*

Pictorial cueing is a field where scholars examine how to use pictures as cues in learning, and how to use graphic cues in pictures through labels and graphic items to improve information acquisition from pictures.

Graphic cueing devices, such as arrows, colour coding, lines and labels, might be necessary before the facilitating effect becomes noticeable (Levie and Lentz, 1982; Peeck, 1993 and 1994). Other cueing strategies, for example underlining, coloured type, perceptual organisers and variations of a typeface, can also lead to increased learning. A combination of interrelated cueing in pictures and text can result in increased facilitation over non-cued material, whilst cueing only in pictures or only in text will not automatically facilitate comprehension or recall (Beck, 1984).

Both Beck (1984) and Lamberski and Dwyer (1983) used multiple cues in their test material and reported significant facilitating effects over those test materials that used only one or no cues in the pictures. The two-picture facilitating effect that Digdon *et al.* (1985) achieved also seems to indicate a repetition principle. It therefore appears that a combination of the attention factor and repetition principle is an important variable that graphic and instructional designers must consider when producing pictures for education.

Colour is one of the graphic variables that graphic and instructional designers use to draw attention to, or to enhance, a specific area of a picture. Underlining, italicising and coloured or bold type are some cueing techniques that typographers use to emphasise portions of text.

Beck (1984) compared typographical cues (underlining and coloured type), cues in pictures (arrows and labels), a combination of picture and typographical cues, and no cues. He used two hundred and fifty-six scholars with low and average reading ability in an eight-group post-test experimental design. Each subject received a set of twelve colour pictures and accompanying text of eighty-two words per set. The cues in the pictures consisted of arrows and labels that isolated the same attributes and were accompanied by text corresponding to the cued attributes. The picture-text cues were the same for the picture set and included red and italicised type as typographical cues. The criterion measure was twenty-four multiple-choice questions, of which the answers were imbedded in the pictures and the text. As was expected, the subjects who received the set containing the typographical cues and the labels and arrows as cues in the pictures, outscored the students who received non-cued sets of pictures.

Beck stated that pictorial and textual cues contribute to a repetition principle that can facilitate retention and maximise learning. Contrary to expectations, the subjects who received the textual cues, and those who received the labels and arrows cues, did not perform better than the group that received no cues at all. He also found that the average reader outperformed the reader with low reading ability, and ascribes this to the textual description that could have helped the average reader more than the low-ability reader. Beck (1984:215) concludes that when text and pictorial cues are combined they have a strong potential to clarify and reinforce a message, and there is a smaller chance of one of the cues being misconstrued.

2.6.1.(d) Captions

Including labelled information with an illustration can improve the recall of the information that is depicted in the illustration (Mayer, 1989). Illustrations with descriptive and instructional labels can increase the recall and comprehension of text-picture material (Bernard, 1990). Pictures should have captions to guide the reader in understanding the image, because readers can interpret pictures in different ways (Pettersson, 1993). It is also suggested by Woodward (1993:125) that the use of captions with pictures should be a standard procedure when textbooks are designed and when pictures are included in these books.

Lamberski and Dwyer's (1983:18) comment that adding additional cues to text will not facilitate learning in a linear relationship, is also underscored by Bernard's work eight years later when he investigated the use of captions to improve learning. Bernard (1990) compared the facilitating effect of descriptive labels, instructional labels, a combination of descriptive and instructional labels, illustrations without labels, and text without pictures. Referring to the use of a descriptive label (a label describing the text) and an instructional label (a label instructing a reader how to utilise the picture), Bernard, discussing his results, stated that "*However, the lack of differentiation among conditions indicated that the effects of captions were not additive; their combination did not produce superior performance over their separate use*" (*Ibid.*, 1990:222). Bernard (*Ibid.*:223) also reported a facilitation effect for text that contained illustrations and descriptive labels, and no facilitation for text with descriptive labels but without illustrations. Illustrations with text, but without labels, showed no facilitation, and instructional labels outperformed descriptive labels.

2.6.1.(e) Colour

The selective use of colour in pictures can help to direct attention to specific detail in a picture, and can increase retention and recall. Colour can, however, also act as a distracter by directing attention to the wrong part of a picture and by making the picture too complex (Dwyer, 1968, 1978; Lamberski and Dwyer, 1983; Peeck, 1987; Dwyer and Moore, 1995). There is consensus in the literature that colour is preferable over monochrome pictures and that realistic colour in pictures is better than unrealistic colour.

Lamberski and Dwyer (1983) also looked at colour as a stimulant variable, or as they termed it, a coding agent, to improve information acquisition from pictures. Their test material consisted of instructional material on the human heart, and contained two thousand words and twenty-one pictures that were cued with labels, arrows and shadowed areas. They developed two versions of the test materials: one where all the coding or cueing was in black and white, and the other in a colour-coding scheme of six colours. The questions also consisted of two versions: one in black and the other colour coded. The colours emphasised central concepts and not the peripheral areas. One hundred and seventy-six tertiary students, randomly divided into four groups, participated in a post-test only experimental design, where a terminology test, a comprehension test, an identification test and a drawing test were the dependent variables. Students who received coloured test materials scored significantly higher than those who received the material in black. The most important conclusions from Lamberski and Dwyer's work are that colour coding, as an attention mechanism, facilitates learning; that increased cues will not necessarily increase learning in a linear manner; and that learners prefer colour, which in turn could affect learning through the attention and motivation factor of the colour. Lamberski and Dwyer, furthermore, state that their conclusion "... *thus limits previous conclusions that colour has an adverse effect because it diverts attention from important learning cues ...*" (*Ibid.*:18), but also that peripheral colour cues or the embellishment of central stimuli may not enhance the educational value of self-paced learning material. These conclusions partly overlap with Pettersson's (1989:164) readability index that requires legible pictures not to be ambiguous or too "*artistic*", something that colour cues in peripheral areas and the embellishment of central areas can cause in pictures.

Dwyer (1994:398), with reference to his Program of Systematic Evaluation (PSE), which was initiated in 1965, listed several generalisations that he and other researchers have concluded. One of these generalisations is that colour coding can improve learner motivation, attention, and the formation of structure in the learner's memory. In a recent

paper, Dwyer and Moore (1998) remarked that research has indicated that colour coding also helps readers to organise and categorise information into useful patterns.

2.6.1.(f) Picture function

Pictures that increase facilitation are closely related to the text and to the type of function that they perform in instructional text. The facilitation effect of explanatory pictures is, for example, higher than the facilitation effect of representational pictures. Pictures that explain the working mechanism of a pump (Mayer, 1993) and pictures that depict structural relationships (Schallert, 1980) contribute to increased facilitation.

Pictures must be designed for a particular function, depending on the content of the text and on learner characteristics (Levin *et al.*, 1987). A medical text on blood pressure, aimed at readers who are unfamiliar with the circulation system, will do well to use an analogical picture depicting a hand-operated pump. The same text might use a representational picture, or even discard the picture when the learners are medical students.

2.6.1.(g) The syntax of the picture

Brody and Legenza (1980) examined whether the position of pictures in text will aid learning, similar to the facilitating effect of pre-questions and post-questions in text. They also tried to ascertain whether there was a difference in comprehension when a picture presented a broad overview of the story or when a picture represented a specific incident in the text. Brody and Legenza employed ninety-six subjects in a post-test experimental design, using four groups. One group viewed the overview picture before the text, the other group viewed the picture after the text, the third group viewed a specific picture before the text, and the last group viewed the specific picture after the text. Their text contained one thousand two hundred words about a town square in Marrakesh, in Morocco. Brody and Legenza reported that a picture after text is more beneficial than a picture before text, and that the overview picture performed better than the picture portraying a specific incident. They stated that their results are similar to the post-question work of Rothkopf and Billington (1974) and McGaw and Groteleuschen (1972), and that these results support the opinion that post-pictures act as a review process (Rickards, 1979). Brody and Legenza conclude

that their work *appears* to be highly generalisable (1980:587) and suggest that the results could be magnified with subjects who are less sophisticated.

In contrast to the results of Brody and Legenza is the notion of Kozma (1991) who, after a review of four published articles, stated that pictures must be placed early in the text for knowledgeable readers, and must be interspersed with corresponding text when less-knowledgeable readers study the material.

The idea of having pictures before or after a portion of text does not concur with the general practice in the publishing industry that pictures must be concurrent with text, and contradicts the principles forwarded by Pettersson (1984 and 1989), who proposed that a picture's legibility will be enhanced when it is accompanied by a legend. Pettersson (1984) developed a picture readability index by which pictures can be graded from zero (incomprehensible) to five (that is, very comprehensible). Initially he used 19 variables to rate a picture, for example the shape, colour intensity, degree of realism, and the location of the centre of interest. He found that by rating pictures according to certain variables, pictures with high values were ranked and rated higher by adults and children than those with lower values. One of these variables is that pictures must have a legend that is short, easy to understand and which is related to the picture. Pictures that are inserted on the preceding page or on the following page will therefore have low legibility but can, according to Brody and Legenza, still have a facilitating effect.

The difference between Brody and Legenza's, and Pettersson's work, is that the latter developed his principles on subjects' ratings with the picture as the focus and text in a supportive role, whilst the focus of Brody and Legenza's empirical work was on pictures as a mathemagenic function. It would be of interest to know whether the picture facilitating effect could be further enhanced by combining the legibility principles of Pettersson and the "*review process*" of a post-picture as demonstrated by Brody and Legenza.

2.6.1.(h) *Picture media*

In the early 70's, researchers started to question what it is in pictures that facilitates learning, recall and motivation. There was sufficient evidence at this time that the meaningfulness of pictures affects their memorability, but results were still inconclusive in studies that attempted to determine if, and to what extent, colour, shading, photographs or illustrations would influence the facilitating effect of pictures.

Anglin and Levie (1985) reviewed nine studies that compared the facilitating effect of photographs, detailed drawings, outline drawings, colour illustrations and black and white illustrations. These studies measured recall and recognition of the stimuli and reported no difference between the media, whilst others reported in favour of detailed colour drawings (Denis, 1976) or colour photographs (Madigan and Lawrence, 1980). Anglin and Levie suggested that a ceiling effect could have contributed to the results where the researchers found no difference. Anglin and Levie's study combined characteristics of previous research and used four media and three different age groups in a delayed eight-week recognition test. The media that they used were colour photographs, black and white photographs, line drawings, and one-word labels. Anglin and Levie found no significant difference between the media, but they did report a higher recognition memory of black and white photographs when compared to the one-word labels. They suggested that the two-second exposure time for each picture and the eight-week delay until testing could have had a negative influence. The meaningfulness of a picture and its motivational aspects, which are important factors in facilitating recall, were not accounted for and could also have concealed a possible difference between the visual media.

Reports in the literature seem to suggest that detailed realistic illustrations could provide better comprehension and recognition than photographs. Kauffman and Dwyer (1974) found cartoons more effective than photographs in immediate and delayed recall. They also reported that most subjects preferred the cartoons as an instructional aid when compared to photographs.

The question of which type of medium is the best to use for educational pictures in societies with a low level of literacy was also addressed by Fussell and Haaland (1978) and Cook (1980a), as well as in a review by Goldsmith (1984). It must also be noted that colour photographs and full-colour illustrations were rarely used by researchers in experimental conditions. The lack of colour photographs and full-colour illustrations as test materials is most probably due to the cost involved in producing the material. That realistic illustrations could prove to be more effective than photographs seems to agree with aspects mentioned in previous paragraphs. It is possible to apply colour selectively to illustrations in order to draw attention to a specific part, to delete background detail that could distract a learner, to intensify detail where required, or to incorporate graphic cues into an illustration. The choice of whether to use photographs or illustrations will ultimately depend on the audience, the text, economic considerations and the object of representation.

2.6.2 Type of instructional material and text content

Mayer (1993) lists three classifications of text that are used in picture-text material, namely: *narrative text* which tells a story, for example a story with human interest; *explanative text* which explains a certain procedure, for example text from a science textbook that explains how photosynthesis works; and *descriptive text* which presents facts, for example a history lesson. The following text variables apply equally to narrative, explanative and descriptive types of text.

2.6.2.(a) Text content

Learning material with a high interest content, when compared to material with a low interest content, can produce higher comprehension-recall scores for answers based on pictures and for answers based on text content (Beck, 1983). Text that is easy to remember can produce a ceiling effect when compared to the same text with pictures (Levin *et al.*, 1987). Text that is concrete (Moore and Skinner, 1985; Holmes, 1987) and text that generates spontaneous visual imagery in its readers does not require pictures to increase its educational effect (Levin *et al.*, 1987). Pictures are more likely to benefit a reader when the text is difficult to comprehend, for example an unfamiliar object or situation. The picture can help the reader to visualise the object or situation (Peeck, 1993). Text that contains spatial-relational information (Dwyer, 1978; Schallert, 1980; Levie and Lentz, 1982; Peeck, 1987) and cause-and-effect information, for example the working of hydraulic brakes (Mayer, 1989 and 1993; Mayer and Gallini, 1990), benefits from the inclusion of pictures that depict these relationships and working conditions.

2.6.2.(b) Verbal cueing

The potential benefit of pictures in text is sometimes disappointing due to readers' superficial and inadequate processing of the pictures. The educational potential of pictures is not realised in daily educational practices (Peeck, 1993 and 1994). This underevaluation of a picture's informativeness weakens the picture's potential facilitating effect. This underevaluation and low level of encoding can, according to Weidenmann (1989), take place when readers are under pressure to work quickly and will, therefore, concentrate more on the text, which they regard as more informative, than on a picture. Specific verbal or written instructions on how to make use of the picture or what to look for in a picture (Peeck, 1993 and 1994) could lead to better picture processing, resulting in an increased picture facilitating effect. This is also one

reason why people who are unable to read have greater difficulty in utilising pictures, as they cannot comprehend the text or labels that could guide them in how to interpret the pictures.

Peeck (1994) investigated the manipulation of learning activities to maintain the potential facilitating effect of pictures. Her manipulation, or experimental variable, consisted of a verbal instruction to one of her groups in her experiment to use the illustration in conjunction with the text. She used forty-five tertiary students, divided into three groups, as her subjects in a post-test, control group experimental design. Her learning material was three thousand words of instructional text on the population density and behaviour of rats. One group received just the text, the second group received the text with two illustrations, and the third group received the same text and illustrations, except that this group was instructed to give specific attention to the illustrations and had to look at how information in the text was depicted in the illustrations. The subjects wrote a twenty-two question multiple-choice question paper three days later. Her results showed that the group that received the instructions to give attention to the picture outperformed the other two groups. There was no significant difference between the text group and the text-with-pictures group, but the text-with-pictures group that received an instruction, had a significantly higher mean than the other two groups. Peeck found that a significant increase in the facilitation effect of pictures is possible by using specific instruction to indicate to the reader what he or she should look for in the pictures. The failure of the pictures to facilitate the second group's performances is, as Peeck describes it, possibly due to an underevaluation of the picture and a superficial encoding by the subjects. Similar results were obtained by Smith, Smoll and Everett (1993) who, through a verbal reference technique, were able to enhance the recall of information in a warning label amongst football players.

What is apparent from Peeck's experiment is that a relevant picture can be ineffective due to underevaluation by a reader, and that this limitation can be reversed through specifically instructing the student on how to make use of the picture. Her results point in the same direction as those of Bernard (1990), who used illustrations and labels in pictures to draw attention to aspects in pictures, and Beck (1984), who used typographical cues combined with arrow and label cues in pictures to facilitate learning. McDaniel and Waddill (1994) also cite ineffective encoding of pictures by students as a factor that contributes to a lack of facilitation. Children and adults were able to increase their memory of pictures when they provided a verbal description of the picture during the study process (Kunen and Duncan, 1983). Providing a verbal label to a picture is a recognised pedagogical study technique.

From the above it can be concluded that explanative text has the greatest propensity for showing a picture facilitating effect if it is combined with appropriate pictures, learners, learning situations and testing methods.

2.6.3 Learner characteristics

Numerous learner characteristics can have an influence on how a learner will react to and perform with picture-text learning material. The following characteristics are those that are reported to have an effect on the outcome of picture-text learning material.

2.6.3.(a) Low prior knowledge

The facilitating effect of pictures becomes evident if subjects have low prior knowledge of the subject or of related subjects (Mayer and Gallini, 1990; Mayer, 1993). Subjects with low prior knowledge possess a relatively small amount of knowledge about the subject they are to study, when compared to subjects with high prior knowledge who possess a higher amount of knowledge about the subject. Text, for example, will not benefit from the inclusion of representational pictures if the learners find the subject matter easy or when they have no difficulty understanding the text. A trained motor mechanic, for example, will have high prior knowledge about the working of a bicycle pump when compared to a seamstress working in a textile factory. A high prior knowledge might induce a ceiling effect and the potential benefit of supporting pictures might not be evident.

2.6.3.(b) Influence of age

Adults and children process pictures differently (Peeck, 1987). Adults appear to utilise pictures more productively by looking at them more systematically and making increased use of the captions and the accompanying text. Dwyer (1978), after a review of research, found that as children become older, they are more capable of attending to areas of pictures that will help them. Young children prefer realistic coloured pictures whilst older learners, with their increased cognitive capabilities, can utilise more complex pictures (Spaulding, 1955; Travers and Alvarado, 1970).

2.6.3.(c) Individual abilities

Individuals' reading, verbal and reasoning abilities affect how they would utilise pictures (Peeck, 1987). In an earlier review of research on subjects' differing intellectual abilities, Allen (1975) proposed several indicators as hypotheses that could possibly benefit subjects of differing abilities. One of his indicators proposed that people with lower intellectual ability will benefit more from attention-directing devices like colour cues, verbal instructions, arrows and labels than subjects with a higher intellectual ability. This hypothesis is later partly supported by others who found that prompting readers to attend to illustrations in text appears to increase the facilitating effect of text-relevant illustrations for children (Levie and Lentz, 1982). Researchers found that subjects with a relatively lower reading ability appear to benefit more from illustrated text than good readers, and that poor readers make more use of illustrations than good readers (Levie and Lentz, 1982; Holmes, 1987; Peeck, 1987). Readers must, however, have adequate word-recognition and word-decoding skills before pictures will show a facilitating effect (Levin *et al.*, 1987). There are also indications in the literature that students with low reasoning and low verbal abilities (Peeck, 1987) as well as less-skilled learners (Mayer, 1993), might benefit more from the presence of pictures in text than high-ability and highly skilled students.

In contrast to Levie and Lentz (1982) and Peeck (1987), Waddil and McDaniel (1992) found that less-skilled comprehenders benefited selectively, whilst moderately to highly skilled comprehenders enhanced their recall when pictures were combined with text. Dwyer (1978) also reported similar results. He found that students with higher levels of prior knowledge, intelligence and reading comprehension achieved higher levels on the criterion measure than students with medium and lower abilities.

2.6.3.(d) Visual literacy

A learner's level of visual literacy, which is influenced by interrelated educational and socio-economic variables, is a factor that will determine if a learner can interpret a picture and understand the meaning of the picture (Goldsmith, 1986; Cripwell, 1989; Hugo and Skibbe, 1991; Peeck, 1993). The literature indicates that the effect of pictures can be increased if the learners' visual literacy is increased through training (Cripwell, 1989; Peeck, 1993) and incidental exposure to visual media. In a related field, Easterby and Hakiel (1981) found that subjects who had prior experience of a hazard sign were

able to increase their comprehension rate by a factor of 1.5 - 2 times when compared to those who had never seen the sign before.

2.6.3.(e) *Gender differences in pictorial processing*

Sewell and Moore (1980) cited several sources (Ernest and Paivio, 1971; Marks, 1973; Peeck, 1974; White, Ashton and Brown, 1977) who found support for a difference in gender performance during psychophysical experiments. They reported that women are inclined to make more use of a visual channel and rely more on imagery than men. There is, however, no evidence in the literature that seems to suggest that gender could be a possible variable in instructional picture-text experiments. Gender differences in pictorial processing could be possible in societies where men and women have strict traditional roles and where women, for example, are excluded from certain levels of education and exposure to visual media. Peeck (1974) was also of the opinion that females tend to use pictures more than males.

2.6.4 Evaluation methods

Researchers use a wide range of evaluation methods in text-illustration experiments. These methods include cued recall, multiple-choice questions, free recall, and problem-solving skills and sentence verification tasks. Experimenters who test for comprehension, recall and inference use tests immediately after an experiment as well as delayed tests. Evaluation methods must be appropriate for the text and for the illustrations that are used in the text. Tests that measure concept and problem transfer will show a picture facilitating effect when explanative texts with explanative pictures are used. Tests, for example, that measure the number of facts recalled or a general comprehension of facts when explanative text and explanative pictures are used will, according to Mayer (1993), not show a picture facilitating effect.

The superiority of illustrated text compared to non-illustrated text appears to be more pronounced in a delayed recall test than in an immediate recall test. The review of Levie and Lentz (1982) found six studies that indicated this trend. In a series of four experiments Peeck (1989) compared immediate testing procedure with a 3-to 7-day delayed testing procedure. She found that there was a substantial relative increase in correct answers in a delayed testing procedure when the questions were based on the illustrations.

2.6.5 Levin's ten commandments of picture facilitation

Levin *et al.* (1987:63) completed an extensive review of picture-text studies “... representing some 100 experiments from 87 separate documents ...” and proposed “*Ten Commandments of Picture Facilitation*”. These ten guidelines are function-based and provide the conditions under which pictures are likely to show a facilitating effect. The relevance of the article for the study and the extent of Levin's work in this field warrant a restatement of the *ten commandments*. These ten rules or guidelines (*Ibid.*, 1987: 73-74) are given in an abridged form and not in the original Biblical narrative¹.

1. *Pictures must apply to the text.*
2. *Pictures must be relevant to the text.*
3. *Pictures must not conflict with the text.*
4. *Concrete, easy to follow and memorable prose does not require pictures.*
5. *Prose that is image invoking does not require pictures.*
6. *Readers must have the necessary word-decoding and word-recognition skills.*
7. *Readers must have the necessary comprehension and reading skills.*
8. *Pictures must be clear and interpretable.*
9. *Pictures must encompass photographs and true pictorial representations.*
10. *Pictures must fulfil their function in the text.*

The last commandment or rule requires some explanation. Pictures must be designed to fulfil a certain function in a text. A representational picture will not show a facilitative effect if it is used with text that is difficult to understand. Text that is difficult to understand requires pictures that will help the reader to interpret the text, or pictures that will help the reader to transform the information into a more memorable form. Lowe (1993:97-98) similarly states that diagrams (including pictures) must “*parallel the text*”, “*provide additional information*”, be “*as close as possible physically*” and be connected to the text.

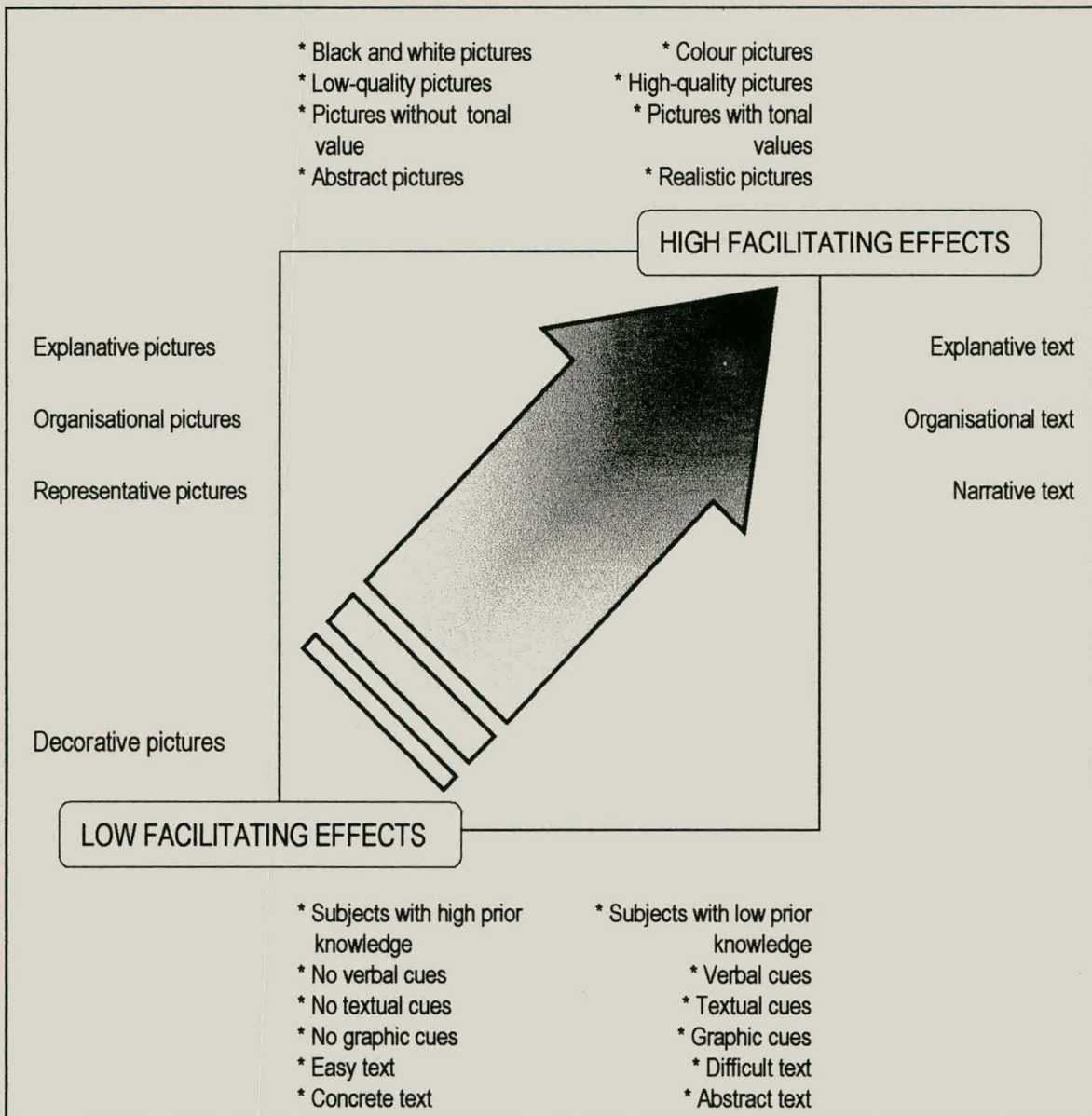
The preceding sections showed that several factors can influence and increase the general facilitating effect that pictures have when they are used in conjunction with instructional text. These factors are related to picture characteristics, learner characteristics, the text content, and evaluation methods. An indication of the direction of the factors that influence and extend the facilitating effect of pictures is graphically presented in Figure 2.8, as composed by the author, on the next page. The items in the figure that are tabled below and above the arrow and which are on the

¹ Examples of the second and third commandments are “*Pictures shalt honour the text*” and “*Pictures shalt not bear false witness to the text*”. The rules are followed by an explanation on how each rule was derived and how the rule can be applied.

right-hand side of the arrow contribute to facilitation. The type of text and the functions of the picture listed on the right- and left-hand sides of the arrow are tabled in the order of their facilitating effect. The conjecture from the model is that realistic black and white representational pictures, combined with organisational text, will show a facilitating effect. A larger facilitating effect is possible with explanative colour pictures with labels, combined with explanative text and verbal cues, which are read by learners with low prior knowledge of the content. Representative pictures with easy and concrete narrative text might show a low facilitating effect, or no facilitating effect whatsoever.

FIGURE 2.8

A graphic model of the factors that influence the extent of the facilitating effect of pictures in instructional text.



The factors and conditions that influence the facilitating effect that pictures have when they are combined with instructional text were discussed in Subsections 2.6.1 to 2.6.4. A synopsis of these factors is given in Table 2.3.

TABLE 2.3
A synopsis of the factors that influence the facilitating effect of pictures
in instructional text.

Factor	Reference
Picture Characteristic	
Pictures can facilitate learning when:	
1 they are relevant to the text, clear, interpretable by the learner and are not in conflict with the text;	Levie and Lentz, 1982; Dwyer, 1978; Levin <i>et al.</i> , 1987; Pettersson, 1993; Moore and Dwyer, 1994; Levin and Lesgold, 1978; Harring and Fry, 1979; Lowe, 1993.
2 they are central to the text and they present new information;	Schallert, 1980.
3 they are realistic;	Peeck, 1987; Dwyer, 1978 and 1994.
4 they are complemented by labels and graphic cueing devices;	Levie and Lentz, 1982; Peeck, 1993 and 1994; Beck, 1984.
5 colour is used to draw attention to detail in the picture;	Peeck, 1987; Dwyer, 1978; Lamberski and Dwyer, 1983.
6 realistic colour is used;	Lamberski and Dwyer, 1983.
7 the pictures are explanative and depict structural relationships;	Mayer, 1993; Schallert, 1980.
8 there is good overall organisation of the picture. Subjects find it difficult to process information from a picture if it is incoherent.	Levin (<i>et al.</i>), 1987
9 Subjects will fixate more on informative areas in a picture when an object has a low probability of being in the picture, when the object in the picture is less predictable, and when the object has a low probability of being part of the picture given the observer's visual referential background.	Yarbus, 1967; Macworth and Morandi, 1967; Loftus and Macworth, 1978.

TABLE 2.3 (continued)

A synopsis of the factors that influence the facilitating effect of pictures in instructional text.

Factor	Reference
<p>Instructional material and text content Instructional text will benefit from the inclusion of pictures when:</p>	
10 the material is interesting and at the same time difficult to comprehend or difficult to recall;	Beck, 1983; Peeck, 1993.
11 the text contains spatial-relational information;	Levie and Lentz, 1982; Peeck, 1987; Dwyer, 1978; Schallert, 1980.
12 the text contains cause-and-effect information.	Mayer, 1989 and 1993; Mayer and Gallini, 1990.
13 the text instructs the learner to attend to the picture;	Peeck, 1993 and 1994.
14 there are labels;	Mayer, 1989; Bernard, 1990; Pettersson, 1993.
15 the text is explanative in nature;	Mayer, 1993.
16 pictures or objects in pictures are mentioned in the prose passage. Subjects will involuntary fixate on objects mention in a prose passage;	Bernard, 1990; Weidenmann, 1989.
17 the text is difficult ² to comprehend.	Levin <i>et al.</i> , 1987; Peeck, 1993.

² The word "difficult" is used as a word in contrast to concrete and easy to remember passages. It does not mean that the text is beyond the grasp of the reader.

TABLE 2.3 (continued)

A synopsis of the factors that influence the facilitating effect of pictures in instructional text.

Factor	Reference
Learner characteristics and evaluation methods	
Learners will benefit from pictures in text when:	
18 they have low prior knowledge ³ of the subject;	Mayer, 1993.
19 they are prompted to make use of the pictures;	Peeck, 1993 and 1994.
20 the readers provide a description of the picture for themselves during the study process;	Kunen and Duncan, 1983.
21 they have adequate word-recognition and word-decoding skills;	Levin <i>et al.</i> , 1987.
22 the evaluation methods are appropriate. The post-test questions must test for items that were presented in the pictures. The questions must have internal validity.	Mayer, 1993.

The facilitating effect of pictures will only become apparent when the performances of subjects who use picture-text material are compared to a similar control group who use the same text material under the same experimental and post-testing conditions, but without the pictures in the text. The post-test questions must test for information that is in the text but which is also represented either in the pictures or by the pictures. The pictures must play a supporting role to the text and not vice versa. Text, for example in a vehicle repair manual, aids technical pictures of mechanical parts. It is obvious that a

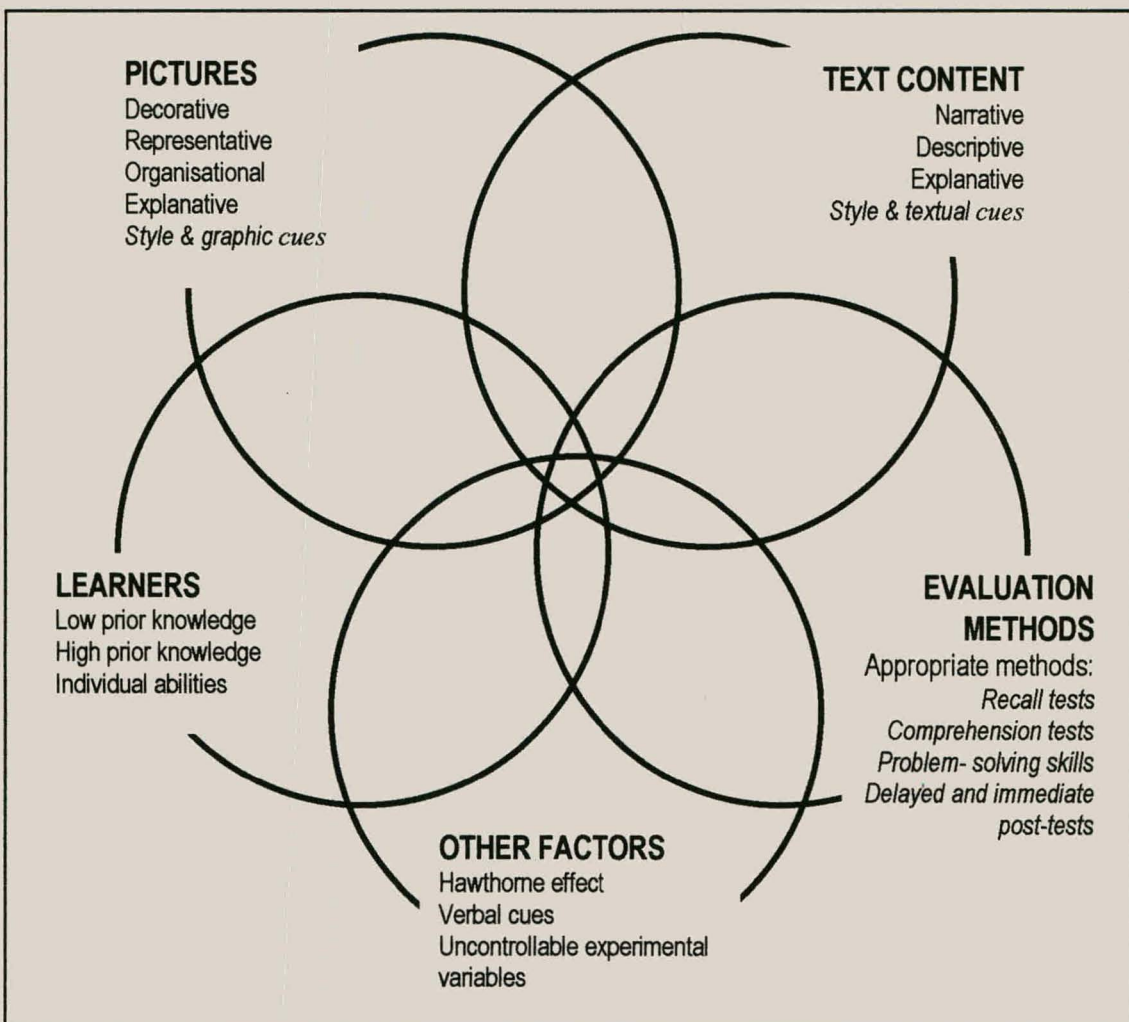
³ Dwyer (1978) found that subjects with higher levels of prior knowledge, when compared to subjects with lower levels of prior knowledge, performed better in his experiments.

reader can only understand a certain repair procedure by making primary use of the picture and referring to the text for support.

The factors that play a role in the process of learning from picture-text material are summarised in Table 2.3. These factors do not operate independently but influence and affect each other. Text content, pictures, learners and evaluation methods are in turn influenced by other known and unknown factors. The Hawthorne effect, for example, plays a role in experimental work, while explanative pictures are better to use than representative pictures when the text has an explanative nature. These factors are portrayed in Figure 2.9.

FIGURE 2.9

A graphic presentation of the main interrelating factors that can have an influence on the facilitating effect that pictures have on instructional text.



2.6.6 The utility value of a picture: a checklist

Researchers have, through psychophysical experiments, determined scientific boundaries in which typographical aspects of printed material can be manipulated for optimum legibility (Tinker, 1963; Zachrisson, 1965). Their findings provide parameters for the optimum use of typographic aspects in printed material, for example line length, line spacing, size, colour and letter type, to name but a few. An attempt to set similar parameters for the optimum use of pictures in printed material will prove to be complex, as it is not possible to quantify pictures in the same manner as typography.

Pettersson (1993) proposed a revised picture readability index that can be used to design material for instructional purposes. The variables in his rating scheme are, however, graphic variables, and exclude variables that are associated with the reader and text content. The term “legibility” traditionally refers to the graphic qualities of text. Small type printed without sufficient line spacing will, for example, be low in legibility, whilst the text content can be readable, depending on the style, words and sentence structure. Pettersson’s term “readability” in effect refers to legibility and not readability. Picture legibility in the context of this study concerns itself with the graphic qualities of a picture, and the readability of a picture concerns itself with the extent to which a person can comprehend the picture.

The addendum at the end of this chapter is an index in the form of a checklist that combines the BLIX-rating-scheme idea of Pettersson (1989:164) and the results of the aforementioned researchers (as summarised in Table 2.3, *Vide.* p.76) in a *utility value checklist*. This checklist can be used as a tool to evaluate picture-text learning material. It can provide an indication of the utility value of the picture-text material in its reader-text-evaluation environment. The more “yes” answers that a particular picture-text material provides, the higher the relative utility value or usefulness in terms of learning that the material will have.

2.6.7 Concluding remarks

Factors that influence the facilitating effect of pictures in instructional text cannot be seen as independent from each other. Explanative text required explanative pictures and not representative pictures. Text that is easy to understand does not require pictures, but the inclusion of pictures might benefit readers who have difficulty in understanding the text. Colour can assist the facilitating effect but is, for example, not always necessary in technical drawings of machine parts or a workshop manual. Text that is difficult to

understand can benefit from pictures depicting an analogy, but this will only be useful if the readers grasp the analogy.

Adding picture to text not only requires a careful consideration of picture characteristics, but also requires knowledge of the potential student and the learning conditions, comprehension of the text, and knowledge of the aims of the learning material. It is only when all these factors are considered as a whole that the development of effective text-picture learning material is possible.

The interrelating factors referred to in Table 2.3 and Figure 2.9 can have facilitating effects that range from no effect at all to a large facilitating effect. Pictures that decorate any text will not assist in recall, comprehension or problem-solving skills. Pictures that relate to the text and which just repeat narrative text are most likely to produce a small facilitating effect. Explanative text, with explanative pictures accompanied by labels and by text instructing the reader how to make use of the picture, will most probably show a much larger facilitating effect. It is, however, not possible to precisely quantify the values of these effects, as one variable can have an influence on the whole composition of the text, pictures, readers, evaluation methods and experimental conditions. An instructional designer might select the correct functional picture to support the text; there may be labels and cues, but a post-test might not show a facilitating effect if, for example, the learner has high prior knowledge of the material.

Significant picture facilitating effects are possible when most of the facilitating factors are combined into one experiment. An ideal situation would be when the text is explanative and contains spatial relationships. The text must not be too easy; it must present new information and must be of interest to the learner. The pictures accompanying the text must be realistic and must explain a procedure in the text or provide a picture analogy to aid the understanding of the text. Labels and graphic cues must compliment the picture. The learner must be visually literate, must have adequate reading and comprehension abilities, and must specifically be instructed to make use of the pictures.

The implications of some of these results could be hostile to the intuitive approach of a graphic designer or illustrator towards pictures for educational purposes. The pictures were mostly without imagination and colour, they consisted of simple outline drawings with little detail and they were poorly designed, and the motivational factor of pictures for education is also questioned. Taken as a guideline, it could mean that little artistic or

creative endeavour is required to develop pictures for educational purposes. A recurring reporting error is that not all the articles presented a visible form of their test material, or they described the material in too brief a manner.

2.7 FACTORS THAT INFLUENCE THE FACILITATING EFFECT OF PICTURES IN INSTRUCTIONAL TEXT AIMED AT DEVELOPING COMMUNITIES

The factors as discussed in the previous section, which influence the picture facilitating effect, can, in most situations, apply to subjects from developing communities. There are obvious situations where the factors cannot apply, or are restricted, for example subjects with lower verbal and visual literacy skills will be limited in the help that they might receive from pictures. Analogical pictures will not work if the learners do not know the analogy. Subjects who have difficulty in reading might not be able to utilise text-picture material independently from a teacher or other facilitator.

The same subsections that were used in the previous section, namely picture characteristics; type of instructional material and text content; learner characteristics; and evaluation methods, will provide the framework for this section. The factors that influence the facilitating effect of pictures in picture-text material aimed at developing communities are well documented in the literature by researchers. Developing communities in this section include subjects with a wide range of visual and verbal literacy skills, subjects from developing rural areas, mainly in Africa, South America and countries in the East, and subjects from peri-urban areas in developing countries like South Africa. These factors are briefly discussed and are summarised in table form at the end of this section (p. 89). Only those factors that apply specifically to subjects from developing communities are listed.

2.7.1 Picture characteristics

Researchers who focus on subjects from developing communities and on subjects with low levels of visual and verbal literacy, seem to concentrate more on picture characteristics than other categories when deliberating factors that facilitate learning with pictures.

2.7.1.(a) Realism

Realism in pictures is the most-cited factor that assists picture and picture-text comprehension and picture recognition by subjects of developing communities (Cook, 1980b; Brouwer, 1995; Zimmer and Zimmer, 1978; Holmes, 1968). Realism in pictures depends on the correct scale of images in the pictures, recognisable details and realistic colour usage.

An unrealistic scale of images in pictures can cause viewers to reject the image or to interpret the image incorrectly (Holmes, 1964).

Colour can improve picture communication material as long as it is realistic. Unrealistic colour is cited as a negative factor in picture communication material (Spaulding, 1956; Holmes, 1968; Van Aswegen and Steyn, 1987). The value of colour lies not only in the cognitive aspects, but also in the fact that people, whether from developed or developing communities, prefer colour in learning material (Dwyer, 1978; Cook, 1980b; Lamberski and Dwyer, 1983).

A multiple message in a picture, for example applying a light printing symbol across a picture of a person using pesticide incorrectly, or adding a symbol underneath the picture, should be avoided (Grieshop and Winter, 1988).

Objects in the pictures, and the messages depicted in the pictures, must be recognisable to viewers (Holmes, 1968; Van Aswegen and Steyn, 1987). A picture must be simple and familiar and must preferably contain only one message (Zimmerman and Perkin, 1982).

2.7.1.(b) Picture style

Researchers in pictorial communication used different styles in print media as test materials. Popular styles are simple line drawings, presumed for the ease of creation thereof as well as continuous tone illustrations, line drawings with detail, and photographs. Other styles are silhouettes of the pictures and block-outs from photographs. The block-out style consists of a photograph where unnecessary background is removed. Colour is less frequently used, but ranges from single colour to multiple colour in line drawings, full-colour illustrations and full-colour photographs. Researchers frequently asked which is the best style to use and investigated the question of whether colour holds an advantage over black and white pictures.

Fuglesang (1973) compared the effectiveness of line drawings, silhouettes, photographs and block-out photographs. He transformed seven daily-life scenes into four styles. The four styles were a simple line drawing of the object, a silhouette, a

continuous photograph, and a block-out photograph. The scenes were a walking lion, a woman cooking food, a man drinking beer, a woman carrying a container on her head, a kettle on a fire, a house with a woman in front, and a cooking pot on a fire. Sixty-three picture-illiterate subjects from a rural area in Zambia participated in the experiment. Fuglesang produced the pictures in black and white and in a format of ten by sixteen inches. The subjects viewed the pictures from left to right, with the different styles randomly mixed in each scene, and had to say what they saw; they were then requested to point at the style in which they saw the image first. Only two of the sixty-three subjects failed to see any picture at all. The results favoured the block-out style. Two hundred and thirty selections were made for the block-out style, one hundred and twenty-eight selections for the photographs, thirty for the silhouette and only fifteen for the line drawings. Fuglesang described his experiment as a "pilot study". He did not obtain results for all the tests on all the subjects and recommended that stronger control and a more systematic study is required. The results nevertheless suggest that deleting unnecessary background, as in the case with block-out pictures, is a variable that can improve pictures for communication purposes.

Hugo and Skibbe (1991), in a study to determine the ability of illiterate patients to interpret instructional pictures, found that the patients in the hospital were able to read and interpret the instructional illustrations despite their low levels of reading and writing skills. They suggested that this ability could be due to the patients' exposure to branded products, as the patients' ability to interpret pictures with abstract ideas were marginally lower. Hugo and Skibbe used sixty hospital patients between the ages of 18 and 40 for this study. With reference to this project, Hugo (1994:172) stated that the most effective graphic style was simple line drawings.

Mitton (1977) replicated Fuglesang's experiment with illiterate and low-literate subjects in Lesotho, but found no difference between outline drawings, block-out photographs and photographs. Mitton did not give any details of testing procedure, subjects, test material or quantitative data. He did report that he found the photo-strip with words the most successful and a line drawing comic strip without words, less successful. A drawing of a housefly, illustrated life size, was recognised by 61 percent of his subjects, and a housefly enlargement to seventeen centimetres was only recognised by 27 percent of his subjects.

The Fuglesang block-out experiment was repeated with more than 400 subjects from Nepal in 1975. Two additional styles were added, namely a three-tone drawing and a stylised drawing. The results were similar to those of Mitton (1977) and Fuglesang (1973) except that the photograph received a lower rating. The three-tone drawing received the highest recognition score of 72 percent, followed by the block-out photograph with a score of 67 percent, the line drawing with 62 percent, the silhouette

with 61 percent, the photograph with 59 percent, and the stylised drawing received a recognition rate of 49 percent (Fuglesang 1982:171). The results reported by Fuglesang (1973 and 1982) and Mitton (1977) support Pettersson's (1989:164) recommendation that a picture's legibility is better if there is no distracting background detail. Pictures that are realistic, familiar, not too complex, and which depict a single activity were found to be the most effective (Kwansa, Cannon, Belcher and Hosu-Porbley, 1972:394-395). One thousand and sixty respondents in rural Ghana participated in this experiment.

Colour pictures, followed by detailed drawings and black and white photographs, were preferred by more than four hundred subjects from Papua New Guinea (Cook, 1980b:97-81).

Cripwell (1988) reported success with the use of picture storybooks as a delivery medium for health care in Burma. Cripwell's work was not empirical in nature, but was rather a description of how he used the popular medium of comic books to produce a health care message that was accepted and which reached the community. The comic book was written, illustrated and pre-tested by a local author, an illustrator and health workers who were from Burma and who were familiar with the culture of the subjects.

Respondents judged cartoon characters in a health care poster that were drawn in a "scratchy" style, as "not good looking" or "ugly". This "scratchy" style is where the artist used multiple lines to indicate darker tones and depth (Tomaselli and Tomaselli, 1984:101-103).

Detailed realistic drawings and photographs are the two art styles that are best suited for communities with low levels of literacy and for people who cannot read (Cook, 1980b). PIACT¹ has found through experience that the best illustrations in most countries are photographs, with background detail removed, and shaded drawings (Zimmerman and Perkin, 1982).

2.7.1.(c) Borders

Borders, or implied borders, which cut off images and figures, can affect the level of realism, but Duncan, Gourlay and Hudson (1973:83), in an extensive study that used 1000 children from urban and rural backgrounds, found "... *no clear-cut evidence that the children in any of the groups had serious difficulty in dealing with pictures where figures and objects are cut off by drawn or implied borders.*" A study by Jahoda,

¹ PIACT = Program for the Introduction and Adaptation of Contraceptive Technology. This organisation has been helping to develop culturally appropriate print material for semiliterate subjects in Asia and Latin American countries.

Cheyne, Deregowski, Sinha and Collingbourne (1976), who used pictures without frames, found that school children in three African countries, as well as in India and Scotland, learned the material equally well. Researchers, however, found that comprehension is higher for people who do not read when pictures depict the whole person instead of only a part of a person. The quadrangular frame around pictures is, according to Pettersson (1982:44), a European tradition that is due to technical dictates, and is not a reflection of man's natural preference. He reported on a survey where most adults and children prefer pictures with soft edges, and stated that the preferences held true across different cultural groups.

2.7.1.(d) Western pictorial conventions

Western pictorial conventions, namely motion, movement and perspective, can cause problems for viewers unaccustomed to these conventions (Hudson, 1960 and 1967; Duncan *et al.*, 1973; Deregowski and Bentley, 1986; Winter, 1963). These difficulties have been well documented and are frequently referred to by other scholars (Brouwer, 1995; Boeren, 1994). Viewers can understand these conventions if they are exposed to them and are shown or taught how to interpret and use these conventions.

2.7.2 Type of instructional material and text content

The relatively lower levels of verbal literacy in developing communities is a factor that determines the picture and text composition in picture-text material as well as the circumstances in which it will be used. The writing style, the length of the text, the analogies used in the text, and the examples must all be transformed towards the specific target audience in a developing community.

2.7.2.(a) Captions

Captions beneath illustrations is a factor, cited by Spaulding (1956), Holmes (1968) and Van Aswegen and Steyn (1987) which can improve picture interpretation amongst subjects who are able to read. This is similar to the results of Mayer *et al.* (1995:39-41)

who used literate subjects in their experiments and who stated that annotations (labels and captions with pictures) can help with problem solving skills.

2.7.2.(b) Abstract and latent pictorial messages

Abstract, hidden and latent messages in text and pictures are not always understood (Van Aswegen and Steyn, 1987, Van Heerden and De Lange, 1998). Pictures must be literal and convey a direct message. Mothers from a rural area in Kenya found pictures useful in recalling procedural instructions when the instructions related to the picture sequence, and they appeared to understand the instructions in terms of the pictures (Patel *et al.*, 1990).

2.7.3 Learner characteristics

Subjects from developing communities come, more often than not, from a different socio-cultural background to those persons who develop communication and educational material. The research reports in the literature that provide information on learner characteristics are thus presented from the researcher's perspective.

2.7.3.(a) Individual abilities

Individuals, even from homogeneous backgrounds, can display meaningful differences in their ability to utilise pictures, and these differences are not necessarily attributable to training or cultural influences (Ausburn and Ausburn, 1983:121). Developmental workers also appear to suggest that some subjects require more time to recognise and interpret images, especially when the images in the pictures become less familiar (Holmes, 1968). There are indications in the literature that subjects from developing communities may benefit more from some pictorial learning material than subjects from more developed communities. Hugo (1995), for example, reporting on the development of a picture card game to prevent child accidents, found that a group of Xhosa children in his experiment benefited more from the picture-based material in that they achieved the highest average percent improvement. These children were from a developing community. This is in line with the findings of others who found that lower-ability learners benefit more from pictures than higher-ability learners (Levie and Lentz, 1982; Peeck, 1987; Holmes, 1987; Mayer, 1993). Learners from developing communities are

not low-ability learners per se, but they do have lower abilities due to lower visual literacy and inadequate educational opportunities.

2.7.3.(b) *The learners' environment*

Subjects from developing communities tend to interpret illustrations literally, and their interpretation of the picture messages is largely influenced by their past experience (Spaulding, 1956; Van Aswegen and Steyn, 1987), by their socio-economic-cultural environment (Ajayi-Dopemu, 1982; Tzeng and Trung 1990; Hugo, 1994), their level of urban influence (Duncan *et al.*, 1973), their level of exposure to Western culture (Cook, 1980b), their level of verbal literacy (Winter, 1963), and by their level of visual literacy (Ausburn and Ausburn, 1983; Goldsmith, 1986; Cripwell, 1989; Hugo and Skibbe, 1991; Peeck, 1993). People who cannot read need pictures to be explained to them in order to avoid misunderstanding (Winter, 1963).

Evaluation methods, as used with North American and European subjects, and administered by Eurocentric researchers, could cloud the results of experimental work due to cultural, language and educational differences. Differing social, economic and political conditions in developing communities are cited as reasons why pre-testing of the material is necessary when developing instructional picture-text material (Tomaselli and Tomaselli, 1984; Cook, 1995). Imported media and the use of unfamiliar expressions and inappropriate cultural symbols, cited by Hungwe (1989:22), are additional factors that contribute to the difficulty of using instructional material by developing communities.

Hugo (1995:12), writing from a health education and communication perspective, found that psychosocial and cultural factors, as external variables, determine how a message is understood. He further cites poverty, culture-based habits, values, beliefs, and levels of literacy as additional factors that affect the success of primary health education in developing countries. It is thus not just individual abilities and the learner's environment that, as isolated factors, influence the facilitating effect of pictures in learning material, but the blending of all these variables that creates an environment which determines the learner characteristics.

In conclusion, it can be argued that the learner, the message and the outcome of the message or learning material cannot be separated from the broad cultural, physical and social environment in which these take place.

The factors that influence the picture facilitating effect for subjects from developing communities are summarised in Table 2.4 on the next page.

TABLE 2.4

The factors that influence the picture facilitating effect for subjects from developing communities.

Factor	Reference
1 The picture must be realistic, it must use realistic colour, the scale of the image must be correct, and there must be recognisable detail in a picture.	Spaulding, 1956; Holmes, 1964 and 1968; Zimmer and Zimmer, 1978; Cook, 1980b; Van Aswegen and Steyn, 1987; Brouwer, 1995.
2 A picture must present a single message, and it must be simple and familiar.	Zimmerman and Perkin, 1982; Grieshop and Winter, 1988.
3 The messages depicted in the pictures must be recognisable to viewers.	Holmes, 1968; Van Aswegen and Steyn, 1987.
4 A picture's legibility is better if there is no distracting background detail. Detailed realistic drawings with tonal values, and photographs, are two suitable art styles.	Fuglesang, 1973 and 1982; Mitton, 1977; Cook, 1980b; Pettersson, 1993.
5 Borders, or implied borders, which cut off images and figures, can negatively affect the level of a picture.	Duncan <i>et al.</i> , 1973; Jahoda <i>et al.</i> , 1976; Pettersson, 1982.
6 Western pictorial conventions, namely motion, movement and perspective, can cause problems for viewers unaccustomed to these conventions.	Hudson, 1960 and 1967; Winter, 1963; Duncan <i>et al.</i> , 1973; Deregowski and Bentley, 1986.
7 Captions can improve picture interpretation amongst subjects who are able to read.	Spaulding, 1956; Holmes, 1968; Van Aswegen and Steyn, 1987.
8 Abstract, hidden and latent messages in text and pictures are not always understood. Pictures must be literal and convey a direct message.	Van Aswegen and Steyn, 1987.
9 Some subjects require more time to recognise and interpret images when the images in the pictures become less familiar.	Holmes, 1968.
10 Subjects' interpretation of the picture messages is largely influenced by: their past experience; their socio-economic-cultural environment; their level of urban influence; their level of exposure to Western culture; their level of verbal literacy; and their level of visual literacy.	Spaulding, 1956; Winter, 1963; Duncan <i>et al.</i> , 1973; Cook, 1980b; Ajayi-Dopemu, 1982; Ausburn and Ausburn, 1983; Goldsmith, 1986; Van Aswegen and Steyn, 1987; Cripwell, 1989; ; Tzeng and Trung, 1990; Hugo and Skibbe, 1991; Peeck, 1993; Hugo, 1994.

2.8 THEORETICAL EXPLANATIONS FOR THE PICTURE FACILITATING EFFECT

2.8.1 Introduction

This section will provide an overview of different theories that endeavour to explain the beneficial effect that pictures can have on learning when they are combined with text. Only those theories that have a functional approach to picture-text studies, and those that are relevant to this study, are mentioned. It appears as if no single theory can explain all the results that are reported from picture-text studies. It is rather a combination of theories or parts of theories that seem to be able to account for the beneficial effect that pictures have on learning when they are used in conjunction with instructional text.

This section will also look at some psychophysical aspects of picture processing as possible explanations for some of the results in picture-text studies. The theories are summarised at the end of this section in Table 2.5 (p. 100).

2.8.2 The cue summation theory

One of the earliest and most relevant theories is the cue summation theory, which predicts that learning will benefit if the number of cues and stimuli in reading material increases. Pictures are regarded as a cue and therefore contribute to the stimuli of the reading material (Hartman, 1961). Pictures that repeat narrative text and prose or which provide an example of an item mentioned in the text can act as a cue and reinforces the material that must be remembered and understood. This theory most probably underscores a didactic principle widely used by teachers in South African schools, where they instinctively add cues and stimuli to learning material by showing examples, by repeating the text, by asking questions, through learner participation, and through the use of other visual aids.

This theory can partially explain the results of Levin and Lesgold (1978), Anglin (1987) and Levin *et al.* (1987), where representative pictures were found to assist learners in recalling information that was presented in the material. The teacher read narrative text (a cue), while the picture acted as a reinforcement (a second cue) when the item depicted by the text was mentioned by the teacher whilst reading the text. The

recommendations by Lamberski and Dwyer (1983:18), Mayer (1989:244), Pettersson (1993:159) and Peeck (1994:297-298) that verbal cues, graphic cues and labels contribute to the picture facilitating effect, are in line with the cue summation theory. Beck (1984:215) found that a combination of interrelated cueing in pictures and text can result in increased facilitation over non-cued material, and that these cues have reinforcing and clarifying attributes. The attention and repetition effect of pictures mentioned in Section 2.6.1 (*Vide.* p. 61-62) would fall under the cue summation theory.

Pictures that repeat the text, which reinforce what was said or which the learner has read, and which are combined with various forms of verbal, textual and graphic cues, are all cues that contribute in a summative form to increased stimuli from which learners will benefit.

2.8.3 The dual coding theory

The dual coding theory is often given as one reason for the picture facilitating effect when pictures are used in educational and communication media. Picture-memory studies have shown that people can remember pictures better than words and that people have a large capacity to recall pictures (Kobayashi, 1985 and 1986; Hedman, 1995). Fleming and Sheikhan, (1972:423) cited one experiment where the subjects recognised between 85 and 95 percent of 2560 different slides previously seen. Subjects in one of their own experiments correctly recognised 177 pictures between 77.1 and 96.1 percent (*Ibid.* 1972:430-431). A frequently cited theory for this superiority effect of pictures in memory recall is the dual coding theory advocated by Paivio in 1971 (Paivio, 1971, 1983 and 1986; Clark and Paivio, 1991). This dual coding theory proposes two processing systems - one for words and one for pictures. These codes are independent of each other and interact with each other. Words or text are activated and stored predominantly in verbal codes, whilst pictures are activated and stored in predominantly imaginal or non-verbal codes. It is also possible for text to be stored in an imaginal code, but only for the concrete items that are named in the text. Pictures that are stored as imaginal codes are also stored as a verbalised copy and are more readily available in two codes than text (Molitor *et al.*, 1989:7). It is believed that pictures are easier to encode verbally and imaginally and that these codes are additive in their effect. Pictures are, therefore, postulated to be better remembered than words (Kobayashi, 1986:783).

The dual coding theory is one theory that can possibly explain why some factors contribute to the picture facilitating effect. It can also explain why pictures in certain

conditions do not facilitate or even interfere with learning. These factors and conditions are briefly discussed.

2.8.3.(a) *Dual coding and repetition*

This dual coding theory could in part explain why the facilitating effect of pictures is not just a repetition effect, and why pictures act also as independent facilitators in a dual coding capacity. People can produce a word faster for a picture than they can generate a mental picture for a word (Amrhein, 1994:451). Pictures are encoded imaginally or non-verbally and words are encoded verbally. Pictures can, however, be named and therefore have access to verbal and non-verbal storage. This provides pictures with the theorised dual coding capacity and makes them easier to recall and to remember than words.

2.8.3.(b) *Dual coding and concrete text*

An experiment conducted by Unnava and Burnkrant (1991) demonstrated the dual coding theory. They tested two hypotheses, namely: pictures do not increase recall when the copy in an advertisement is image-provoking, and pictures that exemplify information will increase recall when the advertisement copy is not image-provoking. Their two independent variables were high- versus low-imagery words, and the presence and absence of pictures in a consumer product advertisement. They found that their subjects' recall was unaffected when the text in the advertisement was high in imagery and accompanied by a picture, and that recall improved when low-imagery copy was accompanied by a picture. Their results are in agreement with the factors which were discussed in Section 2.6 (*Vide.* p. 60) and Section 2.7 (*Vide.* p. 82). Text that is concrete and easy to remember, and text that generates spontaneous visual imagery, can produce a ceiling effect and does not require pictures to increase its educational effect (Moore and Skinner, 1985; Levin *et al.*, 1987; Holmes, 1987).

The conjecture of the dual coding theory is that a student will encode easy-to-remember text and concrete text as an imaginal and a verbal code. Pictures accompanying the text will be stored in the same imaginal code as the concrete text. There might be two processing systems (concrete text = imaginal code and verbal code; picture = imaginal code), but there is no interaction between these two encoding systems. The picture already exists as an imaginal code in the verbal processing system, and a dual coding process therefore cannot take place.

2.8.3.(c) *Dual coding and difficult text*

One of the factors previously identified in Section 2.6 (*Vide.* p. 69) was that when text is difficult to remember, or text is of interest but not familiar to a learner, it will benefit from the inclusion of pictures (Beck, 1983; Mayer, 1993; Peeck, 1993).

Pictures are not only easier to recall and to remember than words, but can also increase the recall of verbal information through the suggested dual coding process. Text that is low in image-forming words (difficult and unfamiliar text) structures the first code in a verbal format. A picture that supports the text, structures the second code either in a verbal and imaginal format or in an imaginal format only. These two codes interact and will increase the recall or comprehension of a particular text-picture passage. Image-forming words or easy-to-remember text, for example *a red apple*, do not require a picture to assist in the recall of the words. The words *red* and *apple* are image forming and create a spontaneous image.

2.8.3.(d) *Dual coding and the interference effect of pictures*

The dual coding process is possibly one tentative explanation of why pictures do not facilitate sight-word learning for beginner readers. These readers are verbally illiterate and can, therefore, not form congruent codes for the picture and the word. They could form a code for the picture that is not the same as the word or letter that they are required to learn. Different codes for the word and picture could be one reason for the detrimental picture effects that researchers observe when children must learn sight-words (Solman *et al.*, 1992; Solman and Wu, 1995).

2.8.3.(e) *Dual coding and picture syntax*

Picture-text studies that are designed to approximate a dual code type process will be able to increase the facilitating effect of pictures. One example is the work of Brody and Legenza (1980), which was reviewed earlier in this chapter (*Vide.* p. 66). They found that a picture viewed after text is more beneficial than viewing a picture before text. Text read before viewing a picture will prime a reader to encode the picture more accurately than when a reader first encodes a picture and then reads the text. This is possibly an explanation for the improved picture facilitating effect when readers view pictures after reading the text.

2.8.3 (f) *Dual coding and developing communities*

Researchers used literate subjects in their experiments to develop the dual code theory and to demonstrate the picture superiority effect over words in recall and recognition. Unfamiliar words, unfamiliar pictures and low levels of visual and verbal literacy on the part of experimental subjects are, however, some factors that will weaken the dual coding effect of pictures.

This is a possible explanation of why the level of subjects' visual and verbal literacy is an important factor in the use of pictures in picture-text material aimed at developing communities. The dual coding effect cannot take place if a learner cannot sufficiently encode the text or the picture. There will thus be no interaction between two codes, and a picture facilitating effect might therefore not be effectuated.

2.8.4 Waddill and McDaniel's framework theories

Four broad frameworks, related to learner characteristics, are proposed by Waddill and McDaniel (1992:477) to predict and explain the compensatory effect that pictures have in text. These theories appear to be in conflict with each other, which could be an indication of the diverse research results in this arena.

The *general compensatory framework* states that skilled comprehenders do not need pictures in text, as they are capable of extracting information from text and remembering the information presented in the text. Pictures are supposed to help less-skilled readers and comprehenders, because the pictures can be used in place of the text, with which the less-skilled subjects have difficulty.

The *selective compensatory framework* suggests that pictures serve a compensatory role for subjects with reading deficits. Skilled comprehenders can form well-organised structures of the text, but focus less on detail in the text. Pictures depicting detail are supposed to assist skilled readers, and pictures depicting relational information will assist less-skilled readers and comprehenders. Less-skilled readers, however, need the necessary skills to use pictures.

The *general enrichment framework* predicts that skilled readers are able to use pictures to construct better memory of the text than with text alone. Less-skilled comprehenders have difficulty forming a coherent structure of the information, whether it is presented in pictures and text or in text alone. This framework predicts that pictures will be of benefit to skilled comprehenders but will not benefit less-skilled comprehenders.

The last approach, a *selective enrichment framework*, suggests that a picture enriches the kind of information that receives the attention of the reader. Good comprehenders focus on relational information rather than on detail, and with less-competent comprehenders the opposite is the case. Pictures with detail will therefore assist poor comprehenders and relational information in pictures will assist good comprehenders.

2.8.5 Motivational theory

The motivational theory effect is based on the argument that affective factors (attitude, interest and motivation) could influence the behaviour of learners and their ability to retain information (Solman and Wu, 1995:234). The motivational theory is related to the “*attentional*” and “*affective*” function of pictures (Levie and Lentz, 1982). That pictures can create interest, hold a person’s attention, arouse emotions and create a mood, for example scenes of food in a restaurant, is seemingly obvious. There are references in the literature (cited by Peeck, 1987:117) where affective-motivational effects seem to occur when pictures are combined with text.

Sless (1981:110), in a tentative generalisation, suggests that most students will treat pictures as incidental to learning unless the pictures have a context that can guide the students as to the use of the images. He ascribes this to the Western culture’s practice of mostly producing images with attentional roles, and states that this will influence students to view pictures designed for an educational purpose as attentional and not as explicative. He furthermore states that attentional pictures are a hurdle to the explicative and retentional use of pictures.

Pictures with emotive content, as found in propaganda and advertising material, can have affective-motivational effects, but these pictures fall into the functional category of decorative pictures and do not normally contribute to an increase in recall, comprehension and problem-solving skills. It could be, as stated by Peeck (1987:117), that because researchers considered the emotional benefits of pictures in text as too obvious for serious consideration, there is limited reported research in this area. There appears to be little evidence in the empirical educational literature that pictures with a motivational effect can actually increase recall and comprehension of the text. Hugo (1995:14), however, reported that an experiment with a picture card game not only increased children’s knowledge about accident prevention, but also had a “*stimulating effect*” on their children’s learning skills.

2.8.6 Principle of least effort

The reason for the interference effect of pictures in the learning-to-read process is ascribed to the principle of least effort. A subject will select that item from a complex stimulus that will require the least amount of effort to produce a correct response. This, according to Samuel (1970:400-401), explains why beginner readers attend more readily to a picture when they are presented with a word and a picture at the same time. The picture will require less effort to provide a response than a word that they still have to learn. The shift in attention from the picture to the word fails to materialise with some learners, however.

2.8.7 The Stroop effect theory

Researchers in the field of memory and cognitive theories tend to develop theories as opposed to the more functional approach of picture communication scholars. The locus of picture communication research is more on the effect of divergent experimental treatments with application in education, communication and developmental work. Picture-related studies in memory and cognitive research provide some understanding of human information processing and could explain some of the experimental results in picture-text studies that demonstrated picture-facilitating effects. One of these theories is known as the Stroop effect.

The “Stroop interference” or “Stroop effect” is a cognitive interference phenomenon established by Stroop in 1935 (Stroop, 1935). Subjects in Stroop’s original experiment were asked to name the colour of a word printed in a dissimilar colour or to read the printed name of a colour that was also printed in a dissimilar colour. The subjects made more mistakes and took longer when they had to name the colour than when they had to read the word. Naming the colour of the ink in which a word is printed will take longer when the word “yellow” is printed in red ink, for example, than it will take to read the word “yellow” when it is printed in yellow. The time difference between word-reading and colour-naming is the Stroop effect. The explanation for this effect is that subjects experience cognitive interference between processing visual and verbal information when the information is not congruent. This interference effect is consistent under different experimental conditions and research applications and is widely cited in the cognitive, psychology and educational literature (Benson, 1991). De Houwer and Hermans (1994:16-17), who reported on a review of some Stroop experiments, discuss Stroop-like effects in picture-word experiments. Subjects take

longer to name a picture if a distracter word is superimposed on the picture, but are unaffected when naming a word while a distracting picture is present.

Stroop-like interference can take place in pictorial communication when pictures, text and graphic elements in the pictures are incongruent. A picture facilitating effect is normally achieved when the pictures support or explain passages in the text. Decorative and irrelevant pictorial material normally produces a non-facilitating or distracting effect when combined with instructional text. This decorative or irrelevant material is referred to as “*distracting*” by pictorial researchers. The Stroop effect is time based and the distracting effect is based on comprehension and recall. The Stroop effect and distracting picture material in text are, however, similar in nature in that incongruent messages interfere with readers’ cognitive processes and do not facilitate the educational process.

2.8.8 Levin and Mayer’s explanations for the picture facilitating effect

Levin and Mayer are two scholars from North American universities who have published extensively in the field of picture-text research. In a combined article (Levin and Mayer, 1993:97-103) they provide seven explanations, or rather propositions, why pictures facilitate recall and comprehension. Their explanations are of a functional nature, they are competing, and complementary, and they are provided from an “... *armchair analysis* ...” (*Ibid.*, 1993:103) as testable hypotheses. Their seven explanations have value in that they appear to be in line with the previously discussed theories. Pictures are supposed to improve learning because they make the text more:

- * *concentrated* and focus the attention of the reader on critical text information;
- * *compact* by converting the text into a more informationally efficient form;
- * *concrete* by providing a concrete image that is mentioned in the text;
- * *coherent* by organising difficult text systematically;
- * *comprehensible* by turning difficult text into more understandable material;
- * *correspondent* by providing a pictorial relationship (pictorial analogy) between what the reader knows and that which is unfamiliar to the reader;
- * *codable* by using mnemonic techniques. This is a memory-enhancing technique that uses pictures to transform difficult names and terms into a more memorable form. The term “*angiosperm*”, which is a flower-bearing plant, for example, can be represented by a picture of an angel (similar word to *angio*) holding a bunch of flowers.

2.8.9 A note on psychophysical aspects of picture processing

Spoehr and Lehmkuhle (1982:162-199) reviewed research on how pictures are processed and remembered. Some of their generalisations are that subjects fixate on informative portions of a picture from where they can extract information, and that subjects are not necessarily drawn to the darkest or brightest areas or even those areas with the most detail. Detail will attract more fixations if it is informative, but the scanning patterns of people will change when they are required to extract specific information from a picture. Informative areas in a picture include objects with a low probability of being in the picture, when the object in the picture is less predictable, and when the object has a low probability of being part of the picture given the observer's visual referential background (Loftus and Mackworth, 1978). Subjects' eye movements also appear to be an automatic process when they listen to prose and are allowed to view pictures mentioned in the prose. Their eyes will involuntarily move to the items when the reader refers to them. Coherent pictures facilitate the identification of objects, they are processed more rapidly, and facilitate information extraction from the picture.

The preceding paragraph looked at how subjects process and remember pictures. The main points suggest that subjects fixate on informative points in pictures, that the organisation and content of a picture will affect information processing, and that the organisational factors affect both complex and simple pictures.

The implications of the above, when applied to instructional picture-text material, are that objects in pictures must have specific informational content and that subjects must be requested to extract this information, either through a verbal request or written text, before the picture will have educational value. An unpredictable object in a picture, or an object which appears to be foreign in the picture, has a high information content and will therefore have educational value. This appears to contradict the intuitive sentiment of graphic designers that an object must be familiar to a reader for it to have educational value. Familiarity with a picture might also create the false impression amongst viewers that they remember the detail in the picture accurately (Chandler, 1994:273).

2.8.10 A summary of the theoretical explanations for the picture facilitating effect

The explanations for the picture facilitating effect are closely related to the functions that pictures perform in text. Pictures which, for example, repeat information that is represented in narrative text, might facilitate recall because of the dual coding effect,

the cue summation theory or even the “*concentrated*” and “*compact*” explanation by Levin and Mayer (1993:98). The magnitude of this facilitating effect is in turn affected by interrelating factors of the learners, the text, pictures and evaluation conditions. A specific theory might predict that a certain measure of picture facilitating effect can be expected, depending obviously on certain pre-conditions, but this might not materialise if, for example, ineffective encoding of the material takes place (Weidenmann, 1989; Peeck, 1993).

Explanatory theories must rather be seen as hypothetical interrelating propositions, which are dependent on extrinsic factors that influence picture facilitating, rather than theoretical explanations. These theories can propose possible explanations but might not be as accurate in predicting certain outcomes. The names of the explanatory theories, except possibly for the dual coding theory and the Stroop effect, are more descriptive nouns and verbs rather than widely accepted theoretical terms.

A summary of the theories is presented in Table 2.5 on the next page.

2.9 RESEARCH ACROSS CULTURES IN PICTURE AND PICTURE-TEXT INSTRUCTIONAL MATERIAL

2.9.1 Introduction

Research across cultures, or cross-cultural research, in pictorial communication and education concerns itself with how pictures and picture-related messages are perceived and used by different cultural groups. Aid workers, communicators and researchers use these research results to develop and improve instructional material that contains pictures for application in education and communication. A model developed by Hugo (1997:276) in health education and communication is one example. This conceptual model can be used as guidance and for decision making when developing appropriate health care messages within a multicultural developing community. It appears as if the majority of the work that is published in English was done by European and American researchers, whilst South African researchers, to a smaller degree, also contributed to this field of study. Comparisons customarily took place between samples from their culture and samples from developing areas in Africa, South America and some countries in the East.

TABLE 2.5

A summary of the theoretical explanations for the picture facilitating effect.

1 The cue summation theory

This theory states that learning will benefit if the number of cues and stimuli in reading material increases. Pictures are regarded as a cue and contribute, therefore, to the reading material's stimuli.

2 The dual coding theory

Pictures are stored as non-verbal codes alongside the verbal code of the text and increase retrieval through this dual coding system.

3 General compensatory framework

Skilled comprehenders do not need pictures in text, as they are capable of extracting information from text and remembering the information presented in text.

4 Selective compensatory framework

Pictures serve a compensatory role for subjects with reading deficits. Pictures depicting detail are supposed to assist skilled readers, and pictures depicting relational information will assist less-skilled readers and comprehenders.

5 General enrichment framework

Predicts that skilled readers are able to use pictures to construct better memory of the text than with text alone. Pictures will be of benefit to skilled comprehenders but will not benefit less-skilled comprehenders.

6 Selective enrichment framework

A picture enriches the kind of information that receives the attention of the reader. Good comprehenders focus on relational information rather than on detail, and with less-competent comprehenders the opposite is the case. Pictures with detail will assist poor comprehenders and relational information in pictures will assist good comprehenders.

7 Motivational theory

The motivational theory is based on the argument that affective factors (attitude, interest and motivation) could influence the behaviour of learners and their ability to retain information.

8 Principle of least effort

The reason for the interference effect of pictures in the learning-to-read process is ascribed to the principle of least effort. A subject will select that item from a complex stimulus that will require the least amount of effort to produce a correct response.

9 The Stroop effect theory

Stroop-like interference can take place in pictorial communication when pictures, text and graphic elements in the pictures are incongruent.

Studies in this field appear to fall into three main categories, namely the influence of the subjects' sociocultural environment on their pictorial perception (Segall, Campbell and Herskovits, 1966; Bentley and Deregowski, 1987; Hugo, 1994); the difficulties that subjects have in understanding Western pictorial material (Hudson, 1960; Duncan *et al.*, 1973; Van Aswegen and Steyn, 1987; Van Heerden and De Lange, 1998); and methods on how to increase the effectiveness of pictorial material aimed at developing communities (Linney, 1985 and 1995; Mody, 1991; Melkote, 1991; Hugo, 1994). The subjects who are reflected in the literature range from people with a low level of education and with little exposure to visual material, to illiterate forest dwellers.

The picture-text material that researchers use for development work and for experiments with subjects from developing communities, tends to contain less text when compared to picture-text material that researchers use for subjects from Northern America or Western Europe. The subjects are, more often than not, convenience samples, and do not necessarily represent a wider population group. There is a wide variation in the subjects' literacy abilities, their educational differences and cultural backgrounds.

People who come from a background where they are exposed to a variety and an abundance of visual material, for example books, television, comics and magazines, learn at an early age to read and use the pictures in their visual environment. This learning process, unlike the formal process of learning to read and write, is incidental, and the variety and frequency of visuals affect an individual's learning process (Linney, 1995). Communicators assumed that illiterate people need visual material because they cannot read and they initially assumed that pictures are a universal intercultural language (Fuglesang, 1973:62). Scholars, working in the field of cross-cultural research, found, however, that pictures are not a universal language and that they are culture-dependent (Hagen and Jones, 1978; Green and Lascaris, 1990; Linney, 1995). Pictures are a part of the Western world's daily visual environment, but are less abundant in the rural and developing areas of the world. Fuglesang, who worked as a development worker in Africa, remarked that " ... *PICTORIAL ILLITERACY is almost as widespread as illiteracy itself.*" (Fuglesang, 1973:62). People from a picture-rich environment might be able to read most pictures within their visual culture, but could have difficulty in interpreting pictures from another culture. Developing communities with an oral tradition normally do not have a picture-rich environment and have greater difficulty in reading and using pictures. Higher levels of illiteracy in developing communities exacerbate this difficulty,

especially when communicators import pictures from a foreign visual environment or culture.

Hagen and Jones (1978) attribute the rise in cross-cultural research in pictorial perception to the realisation of researchers that pictures are not culture-independent. Literature in the field of cross-cultural research in pictorial communication and perception is not as abundant as the literature reviewed in the section on the facilitating effect of pictures. Goldsmith (1984:75), with reference to factors affecting the decision to use illustrations, stated that: *"It is rare to find a study which questions whether to use illustrations in a cross-cultural presentation"*.

It is sometimes difficult to generalise and apply the results of cross-cultural communication research to education, as additional factors are introduced as independent variables. Differences in culture, language, visual literacy, education and the manner in which experimental subjects respond to answers, are some factors that must be considered in interpreting such research results. Control and experimental groups are seldom equivalent, and the difference that researchers report is normally due to environmental, educational and socio-economic conditions. The purpose of most cross-cultural research in picture communication is to identify differences in picture perception and utilisation between subjects from diverse cultural backgrounds, and also to develop visually based material for application in health, education and communication.

This section will look at the influence of culture on pictorial perception; the influence of culture on pictorial preference; the use of pictures by developing communities; and the relative effectiveness of different picture styles. This will be followed by a remark on formative research and a critical discussion of the previous subsections, and will conclude with a summary.

2.9.2 The influence of culture on pictorial perception

An extensive study by Segall, *et al.* (1966), which took six years to complete, investigated the influence of culture on visual perception. One thousand eight hundred and seventy-eight subjects, from fourteen non-European locations and the United States of America, participated in the research project. The researchers hypothesised

that subjects from different cultures would be differentially susceptible to geometric illusions because they have learned different visual inference habits, and that these habits are based on environmental factors.

In the reprise of their hypotheses, Segall *et al.* (1966:212-213) reported that they found support for their hypothesis that Western people are more susceptible than non-Western people to geometric illusions, due to their carpentered environment. They also found that the presence of horizontal vistas in the subjects' environment makes them more susceptible to vertical-horizontal illusions. The results of Segall *et al.* show that cultural and environmental factors in a population's visual environment will influence their visual response habits and that human perception is influenced by their culture. They also stressed that the differences that they have observed across cultures are not "racial" differences but are as a result of differences in experience. Basic perception processes are the same for all populations. The direction of their findings is also confirmed later by other scholars (Cook, 1980b; Ausburn and Ausburn, 1983). Culture and experiences with visual stimuli play a significant role in a person's ability to read and use pictorial stimuli.

A review by Goldsmith (1984:410-420) synthesised recurring factors that play a role in cross-cultural pictorial communication, into twenty-six themes. These factors range from the acceptability of images, connotations of colours and depth perception, to the art styles of pictures. The guidelines that emerged from her twenty-six themes are limited in their generalisations, as most are based on one or two studies. The following are some factors that have a bearing on this study and which appear intuitively to have generalisation possibilities: Pictures are not always acceptable across cultures without modification; signs common in the Western world, for example crosses or ticks, are not universally interpreted in the same way; colour is not culture-independent; and people do not always scan a sequence of pictures from left to right and from top to bottom.

Work by Bagby (1957) indicated that subjects have a tendency to more readily identify pictures that are available in their environment, whilst Pettigrew, Allport and Barnett (1958) suggested that ethnic membership also plays a role in perceptual dominance. Both Bagby and Pettigrew *et al.* made use of stereoscopic projections where they projected pictures of dissimilar content to each eye of their subjects. In these experiments binocular rivalry occurred, leading to the perceptual dominance of one of the pictures. Segall *et al.* (1966:52) cite these studies as "provocative", but the results support the opinions expressed by Mangan (1978), Melkote (1991) and Mody (1991)

that cultural and environmental backgrounds play a role in how subjects perceive messages and pictures. Melkote also points out that people defend themselves against persuasive messages not only through selective perception, but also through selective exposure and selective retention. People's beliefs, values and needs are some factors that determine how messages are comprehended (Melkote, 1991:73). Prior expectations, assumptions and background knowledge can distort people's memory and recall of information (Baddeley, 1979), and individuals will recall information and events that are important to them (Gittins, 1979). People also tend to recognise faces from their own cultural group better (Shepherd, Deregowski and Ellis, 1974), and groups that have different cultural backgrounds process pictures differently (Ellis, Deregowski and Shepherd, 1975). From the notions expressed by Melkote, Mody, Baddeley, Gittins, Bagby, Ellis *et al.*, Shepherd *et al.* and Pettigrew *et al.*, it seems that a subject's cultural background is a common element that influences people's interpretation, recall and processing of visually-based messages and visual images.

2.9.3 The influence of culture on pictorial preference

The previous section showed that people have a tendency to more readily identify pictures that are available in their environment and also that people are partial to their own cultural visuals. People might recognise faces of people from their own cultural group better, but this does not imply that cultural similarities between a subject and the images in marketing or educational material will enhance sales or learning. Fullagar and Barling (1983:21) found, for example, that different genders and races responded differently towards visuals in an advertisement and that "*... racial similarities to the model did not necessarily facilitate recall or a desire to imitate the modelled behaviour*". In this study, a culturally modified visual (racial similarities) did not facilitate the recall of an advertisement.

People not only identify images from their own environment better, and display perceptual dominance towards their own cultural images, but also prefer pictures and graphics of their own culture (Pettersson, 1982; Tzeng and Trung, 1990). Cultural and environmental backgrounds not only play a role in how subjects perceive messages and interpret pictures, but also determine how they respond to them (Mangan, 1978; Melkote, 1991; Mody, 1991). Groups in developing countries process and use pictures differently (Ellis *et al.*, 1975) when compared to developed communities in Western

Europe and North America. Some developing communities tend to place the group before the individual, whilst decisions are more often than not influenced by the group rather than an individual's choice.

There is the opinion amongst researchers that mass media is not as effective in developing communities as in the Western world. This reduced effectiveness is due to the diverse cultures in developing communities. It is also recommended that messages must be adapted for specific cultural groups in order to be effective (Ajayi-Dopemu, 1982; Kalsi, 1990; Stacey, 1991; Stedler, 1992; Linney, 1995). This process of adaptation is described by Schiffman (1995 and 1996) as "visually translating", whilst Hugo and Smit (1998) use the terms "message modification" and "message appropriateness" to signify the same process. People in these developing communities can defend themselves against persuasive mass messages not only through selective perception, but also through selective exposure and selective retention. A group's beliefs, values and needs are factors that determine how these messages are perceived, retained and comprehended (Melkote, 1991:73). People will, for example, measure health information messages against their beliefs, customs and experiences. They will accept the new idea if it agrees with their custom, or they will reject it, unless they are prepared to change their opinion based on their experience and customs (Holmes, 1964:121). Prior expectations, assumptions and background knowledge are factors that can distort people's memory and recall of information (Baddeley, 1979). Individuals will recall information and events that are important to them (Gittins, 1979). It appears that people have difficulty understanding Western-oriented pictures if they are not adapted for their use. Researchers also found that symbols from one country could frequently generate opposite meanings if they are exported to other countries (Tzeng and Trung, 1990).

There is sufficient evidence to verify that a group's cultural environment is a major factor that plays a role in how they will perceive a picture, interpret the meaning of the picture, and respond to the message of the picture.

2.9.4 The use of pictures by developing communities

A false perception is that subjects from developing regions are incapable of, or have difficulty seeing pictures, whether the pictures are photographs or illustrations.

References by Segall *et al.* (1966:32-38) to other studies indicate that previous scholars contributed to this perception. Fuglesang (1982:145), described an incident where he gave an old woman in Zambia a printed picture of a woman feeding her baby. The person, when asked what she saw, was apparently mystified by the paper and “... *she lifted the picture to her nose, smelling it and feeling its smooth surface with her fingers. It was the intense whiteness of the paper, its straight edges and sharp corners which attracted her*”. Incidents like this might give a false impression that people from rural areas and those who are verbally illiterate cannot read pictures. Fuglesang, commenting on this incident, warned that the woman was concentrating on the strange material seldom available in her village, and not on the picture. People’s ability to read pictures is correlated to the number of pictures in their social environment. Hugo and Skibbe (1991) also found that their subjects, who had low levels of literacy, were able to read instructional illustrations. They attributed this ability to the possibility that their subjects had been exposed to these particular products. An incorrect impression can be formed that many of the studies degrade developing communities by showing that these groups have lower visual literacy skills than groups from the Western world. This impression and “neo-colonialism” is criticised by Cook (1980b) and Linney (1995).

Authors also created the paradigm that audiences in Africa are alienated from Eurocentric visual materials. Cultural differences between the developers of the material and their audience are then also implied as one of the reasons for this alienation. Graphic designers, mostly with a Eurocentric design training, assume that their visuals are understood by their intended audience. Their intuition of their work does not always concur with the consumers’ understanding of the material (Barnard and Marcel, 1978). The presumed solution to this problem is to culturally correct the visuals for better communication, marketing and educational material. In a paper on developing promotional material for contraceptives in developing countries, Zimmerman and Perkin (1982:119) state the necessity of: “... *modifying or adapting products to make them better suited to the cultural and physical characteristics of a country by changing package inserts ...*”. They also believe: “... *that contraceptive continuation rates will be increased by the availability of culturally responsive support materials...*” (*Ibid.* 126).

In spite of the apparent difficulty of pictorial perception by developing communities, pictures can increase learning under certain conditions (Levin and Lesgold, 1978;

Levie and Lentz, 1982; Goldsmith, 1984; Moore and Skinner, 1985; Pettersson, 1989; Peeck, 1994). These conditions were reviewed in Section 2.6 and are related to the learner, the text and pictures, and the assessment process. It is also known that subjects from developing communities and from societies with a low level of literacy could have difficulty in reading and understanding pictures. Researchers reported that subjects have difficulty in interpreting pictorial cues such as perspective, movement, relative size and overlapping (Hudson, 1960 and 1967; Schwitzgebel, 1962; Winter, 1963; Ajayi-Dopemu, 1982; Bentley, 1986; Herbst and Beukes, 1986). These difficulties appear to increase with lower levels of education, increased age, deprived physical and visual environments, and poor socio-economic conditions (Cook, 1980b). Poor picture quality, lack of experience with pictures, and lack of contact with the Western world are interrelated factors that Cook (1980b) cites as barriers to picture communication in preliterate societies.

Researchers do not all agree with the notion that subjects from less-developed communities have difficulty in perceiving depth in pictures. Some scholars found that subjects from visually deprived backgrounds can interpret depth in pictures (Deregowski, 1976; Nicholson and Sheddon, 1977; Deregowski and Bentley, 1986) and they suggest that the results of some of the depth-perception tests in cross-cultural research were affected by test procedures and instruments (Jahoda and McGurk, 1974; Leach, 1977; Cook, 1980b).

The work of Hudson, cited above, is widely referred to by scholars as examples where empirical work supported the notion that perspective conventions in pictures can cause difficulty amongst subjects who are not accustomed to this Western pictorial convention.

Eade (1993:271-275) repeated Hudson's depth-perception test using thirty-five literate and thirty-eight preliterate Lobi subjects from Burkina Faso. The literate subjects had previously been exposed to Western conventions of perspective in pictures. He showed four drawings to the subjects and asked them which animal was nearest to the man and which animal the man was going to kill. Only ten of the two hundred and seventy-nine responses from the literate subjects, and eleven of the three hundred and four answers from the preliterate subjects, were correct. He suggested that there is no relationship between the ability to read text and the ability to read Western conventions of

perspective. He cautioned against using text and pictures in perspective convention, as this could create a conflicting message.

There are, however, errors in the perspective of the illustrations used in Hudson's tests. These errors are illustrated in Plate 2.2 on the next page.

It is highly unlikely that a man in Africa would try to kill a full-grown elephant with a spear. The elephant depicted in Hudson's drawings is no bigger than a cow, which is if the animal is projected, according to Western perspective conventions, to the front of the picture. It is possible that some subjects viewed the animal as a baby elephant and correctly answered that the man wants to kill the elephant or that the elephant is closest to the man. The perspective conventions in the drawing are not correct. Another element is the straight road disappearing into the horizon. Straight roads with elephants standing in them, and antelopes standing still next to a road, waiting to be speared, are not common in Africa. It is also likely that some of the subjects in Hudson's test had never seen an elephant and were not aware of the dimensions of the animal. These inadequacies of Hudson's test material could actually have contributed to some correct answers by the subjects being interpreted as incorrect answers by the researcher.

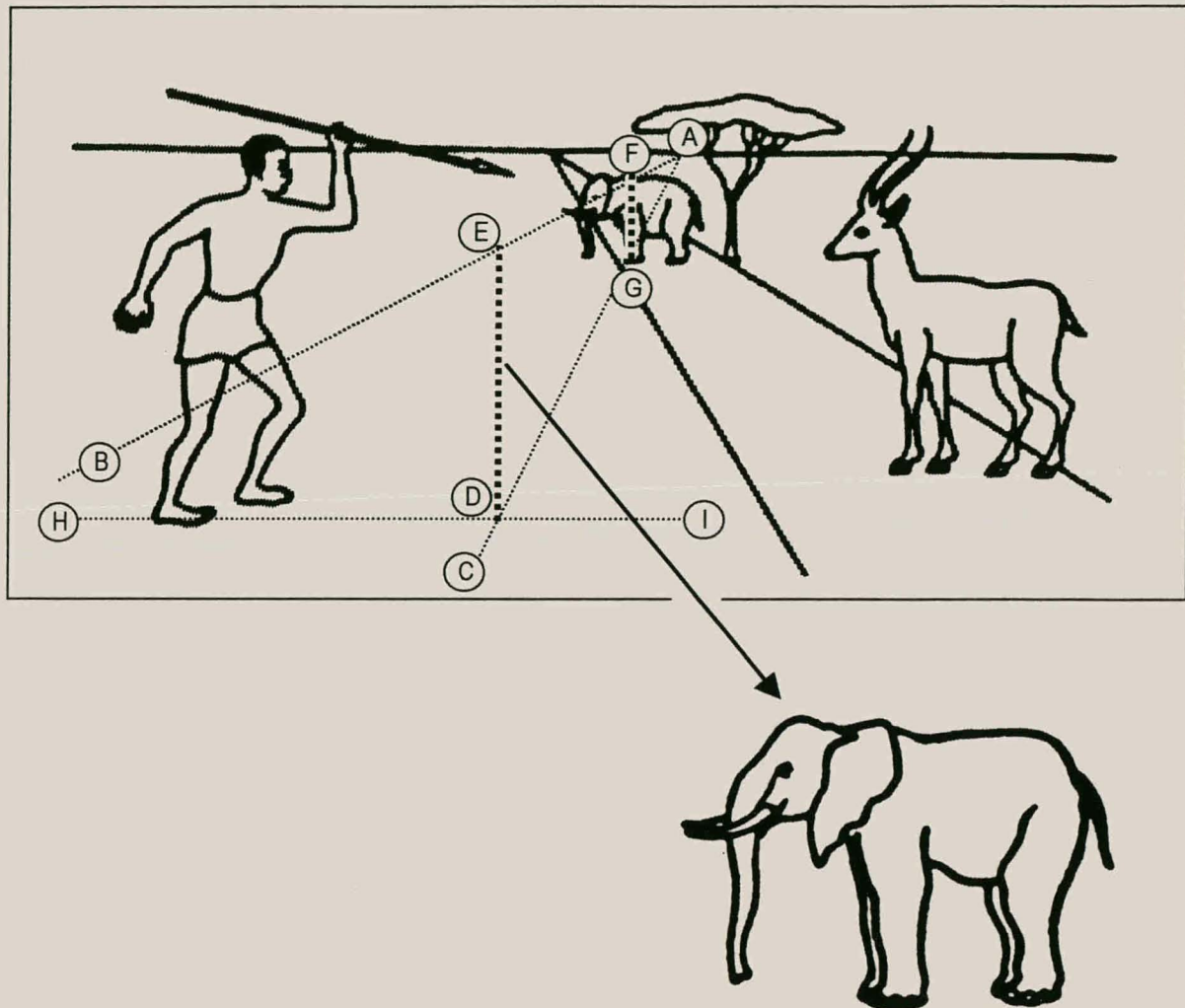
Cook (1980b) states that sequencing is a learned Western convention. Eade (1993) suggests that it is possibly not learned nor Western, but culturally and ethnically dependent. He suggests that possible environmental factors contributed to his results, for example linearity of wall designs in Lobi homes or strips of wood for construction purposes.

Researchers have also indicated that people who have difficulty interpreting Western pictorial conventions can easily learn these conventions through formal tuition (Nicholson and Sheddon, 1977; Fussell and Haaland, 1978; Mangan, 1978; Ausburn and Ausburn; 1983).

In a review of literature on literacy education, Cook (1980a:12) identified several cognitive factors as barriers to effective picture communication amongst illiterate subjects. Some of these are: people focus on details or parts of a picture rather than the whole; people have a tendency not to see implied motion; people make errors in sequencing; and people have difficulty in estimating dimensions.

PLATE 2.2

Picture number 4 from Hudson's "FIGURE 1, Horizontal Pictorial Space"
(from Hudson, 1960: 186).



The picture in the above rectangle is one of several pictures that Hudson used in his experiments on pictorial depth perception. The broken lines in the picture and the larger elephant outside the rectangle were added to explain the perspective errors in the picture. The lines AB and AC are projection lines that will give an indication of the size of the elephant, if the elephant were to be moved to the front. The size of the elephant at shoulder height (line FG) would translate to a size of line ED if the elephant were to be placed on the same plane (line HI) as the hunter. The elephant placed outside the rectangle is thus the actual size, in relation to the hunter, that Hudson depicted in his pictures.

Two development workers, Holmes (1964) and Fuglesang (1982), give an account of their learning experiences in Africa regarding cross-cultural communication in agriculture, education and health care. Their books are pragmatic in nature and are intended to assist health and agricultural extension workers to develop effective visual aids. Their recommendations regarding visual aids are not based on empirical work, but agree with the conclusions and recommendations of researchers who conducted experimental work with illiterate communities and those with a low level of literacy. The following factors, given by Holmes (1968:6,7,67) and Fuglesang (1982), will influence the effectiveness of visual aids in developing communities: pictures must be familiar to the subjects; pictures must be realistic; objects that are enlarged might be difficult for people to understand; use natural colours in pictures; keep unimportant detail out of the photograph or picture; show the whole object and not just a section thereof; keep compositions simple and the viewpoint natural; conventions of perspective and movement can cause confusion.

2.9.5 The relative effectiveness of different picture styles

It was mentioned in a previous section (*Vide.* p. 83) that pictures that are realistic, familiar, not too complex, and which depict a single activity, were found to be the most effective (Kwansa *et al.*, 1972). A picture storybook is an effective medium (Cripwell, 1988) and colour pictures, followed by detailed drawings and black and white photographs, seem to be preferred picture styles (Cook, 1980b).

Positive results are also reported by Esterhuysen (1991) and the *The Storyteller Group* (1991a) on the use of comic books to deliver social and health care messages to communities. These communities had a varied level of visual and verbal literacy. The images in these picture books portray the culture and the people at whom the messages are directed. Complex backgrounds and detailed illustrations did not appear to pose a problem. Kauffman and Dwyer (1974) also found cartoons to be more effective than photographs in immediate and delayed recall. They found that most of their subjects preferred the cartoons as an instructional aid rather than the photographs. A cartoon style is characterised by less distracting background detail when compared with a photograph.

Subjects find outline drawings sufficient to perceive objects in pictures, but detailed and realistic illustrations provide the best results with comprehension and recognition tests (Fussell and Haaland, 1978; Cook, 1980b; Goldsmith, 1984). Coloured

photographs, black and white photographs, and realistic illustrations with tonal values or textures, appear to be culture-independent. Localised colour in illustrations and colour in symbols are not culture-independent and can have a different meaning and significance amongst different cultures (Jacobs, Keown and Worthley, 1991; Hugo, 1994).

It is evident from the literature that realism with regard to colour and realism in pictures are the most important elements in effective picture communication in developing communities.

2.9.6 Formative research and picture assessment

Both Holmes (1964 and 1968) and Fuglesang (1973) found that the ability to read pictures is a learned process, and that visual aids cannot teach and can only assist teachers and health workers. They also emphasised the importance of formative research and of pre-testing the pictures before they are used by development workers. The principle of pre-testing is not only used to improve visuals, but also to involve potential receivers of the message in the design of the pictures (Haaland, 1984). This participatory pre-testing method is, however, severely criticised by Linney (1995) as an authoritarian and top-down method that produces one-way pictures. He believes that these pictures do not promote dialogue but convey messages where there is no discussion. Linney proposes a “*people-centred approach*” as an alternative method to improve messages aimed at developing communities. With this method the people’s knowledge and experiences are valued, and they look for the solutions to their problems. They suggest their own visuals and plan and produce the visual material. Similar suggestions are also made by Rogers, Eade, Edwards, Holland, Millican, Norrish, Skidmore and Street (1994:25), who stated that the “... *most effective way in which culturally appropriate post-literacy materials are produced is through programmes which provide opportunities for learners and other local groups to write and to produce what they feel is most appropriate in their specific context.*”

Post-testing pictures is a procedure that is employed after a design is released onto the market. The purpose of testing the effectiveness of pictures in post-testing is normally to improve subsequent designs or to determine differences in effectiveness amongst different groups that must use the pictures in the designs. Pre-testing is a part of the formative research process that takes place before the designs are released onto the

market. The aim of pre-testing is to develop pictures and designs that are acceptable to the intended market and which are effective.

One example of a post-test project was conducted by Grieshop and Winter (1988), who post-tested the comprehensibility of pictographs and illustrations and also pre-tested symbols associated with agricultural pesticides. Their work was motivated by the high incidence of pesticide poisoning reported in the Third World. Grieshop and Winter conducted three studies to determine the explicative role of nineteen pictographs, six symbols and twenty-two pictures by using Mexican and Ecuadorian farm workers and Ecuadorian farmers and rural residents. Thirty-three Mexican and thirty-seven Ecuadorian farm workers had to read and interpret the pictographs. The same Ecuadorian farm workers had to read and interpret the symbols, and ninety-eight rural subjects from Ecuador were asked to look at the pictures and then to sort them into three piles. The one pile was for the depiction of the correct use of pesticides, the second pile was for the incorrect use of pesticides, as depicted by the illustration, and the third pile was for when they were undecided as how to classify the illustration. A skull and crossbones sign, depicting poison and danger, which was one of the pictographs, a large X depicting a "NO", which was one of the symbols, and realistic detailed line illustrations of a farmer working with pesticides, constituted the pictures.

The percentage of correct identification of the pictographs ranged from 57 percent to 91 percent for the Mexicans, and from 45 percent to 95 percent for the Ecuadorian farm workers. The symbols were poorly recognised. A large X depicting No, a circle with a diagonal slash also depicting NO, and symbols of a thumbs-up and thumbs-down were only recognised between 14 percent and 43 percent of the time. The words "No" and "Si" were both recognised 92 percent of the time. The detailed line pictures were recognised between 48 percent and 92 percent of the time. The addition of symbols at the bottom of the picture or symbols superimposed over the pictures decreased the recognition rate. Pictorial materials that depicted a negative message, for example "do not apply on windy days" or "do not touch", posed difficulties for the subjects. Grieshop and Winter also recommended that more work is required to develop effective pictures of actions that depict something that must not be done. In their conclusion Grieshop and Winter stressed the importance of pre-testing pictorial images and stated that visuals will become mere curiosities if they do not become part of an integrated system of education and other programmes to reduce accidents due to pesticide poisoning.

2.9.7 A critical discussion of the previous subsections

A regular problem in cross-cultural pictorial studies is the dissimilar groups that were compared with each other. The groups from the developing communities generally had less education and less exposure to Western pictorial material. Groups from the West and the groups from developing communities were not always equivalent when it came to age and socio-economic conditions. Experimental conditions varied more in cross-cultural research conditions than in studies where cross-cultural factors were not investigated. A typical example is when British teenagers were compared with African adults in a picture recognition experiment. The scholars invariably obtained differences between the groups, but the lack of equivalence between the two groups makes it difficult to attribute the difference to cultural differences alone and not to other factors.

Applying the results from general pictorial studies to developing communities is questionable, as additional factors are introduced as independent variables that are normally not present in picture research with Western subjects. Differences in language, visual literacy, education, and method of responding to answers are some of these variables that are difficult to control with groups in developing communities. Primary-school children who grew up in picture-rich environments were frequently used for pictorial research in Europe and North America. These subjects can hardly be considered as representing groups in visually deprived areas in Africa or South America.

There are, however, results from general pictorial studies that are general in nature and which can be transferred to developing communities. These generalisable results appear to be intuitive, for example: pictures must be relevant to the text or to the situation in which they are used; quality and clarity of the graphic qualities are important; colour can be used as an effective cue in black and white drawings; and cues to use pictures can increase the value of pictures in developing communities.

Researchers who used subjects with lower levels of visual literacy, or subjects from developing communities, seem to agree that they generally perform more poorly in pictorial tests when they are compared to subjects from picture-rich environments. This can hardly be described as a significant discovery, as most practitioners in cross-cultural communication know this through experience. The studies have nevertheless demonstrated that subjects from developing communities can learn pictorial conventions easily. The subjects also have little difficulty in processing pictures and

understanding their messages when shown how to use the pictures. People who are seldom exposed to pictures and who do not receive training might never develop an effective picture-reading ability. There is also a strong recommendation in the literature that pre-testing is imperative for effective pictorial communication in developing communities.

It is evident from the literature that culture and environment play a significant role in how people perceive visual elements and interpret pictures. Urbanised people, for example, who are exposed to a visual environment of rectangular lines, are more susceptible to geometric illusions than people living in a rural area. People have an obvious affinity towards pictures that portray their own culture. The indications are that these preferences for one's own visual culture could possibly assist a person's cognitive processes if culture-relevant items are part of these visuals. People from developing communities not only have the same psychological and perceptual limitations as people from more developed countries, but must also contend with lower levels of visual and verbal literacy. They also have difficulty in using pictures that are outside their visual culture and learned experience. This makes the task of picture reading even more difficult for them. Whilst a universal picture language does not seem plausible, it is possible to make pictures more effective through pre-testing and instruction.

Irrelevant visual stimuli interfere with perceptual processing and cannot be ignored by a person's visual system. People take longer to process visual information when they have to compare two stimuli where irrelevant information is present. Research has also shown that objects are difficult to identify if they are placed in a context that is inappropriate. Researchers in the cognitive sciences seem to imply the same guidelines that are suggested by developmental workers and scholars who published on the functional applications of pictorial research. Pictures can facilitate a person's cognitive processes when the pictures are relevant and relate to the text they accompany. Irrelevant backgrounds and inappropriate objects in pictures can create confusion and must preferably be removed to improve picture communication. The above apply equally to subjects from developing and developed communities.

2.9.8 A summary of research across cultures in picture and picture-text instructional material

The preceding section reviewed pictorial-related research across cultures and looked at how culture influences people's use and perception of pictures. Culture in this context encompasses the subjects' visual environment, their physical environment and their visual and verbal knowledge.

One of the reasons for cross-cultural pictorial research is to develop and improve pictorial material that is used in educational material, health education and development programmes. The following nineteen principles, listed below, were raised in the preceding section and can be used as such. No references are given as they appear in the preceding section. The principles are general in nature and are not the same as those cited in Tables 2.3 and 2.4. It will be useful to consider these items and those listed in Tables 2.3 and 2.4 together when developing and improving picture-text instructional material.

1. Pictures are not a universal language and are culture-dependent.
2. Cultural and environmental factors in a population's visual environment will influence their visual response habits.
3. Culture and environment play a significant role in how people perceive visual elements, and read and interpret pictures.
4. People have an affinity towards pictures that portray their own culture.
5. The indications are that these preferences for one's own visual culture could possibly assist a person's cognitive processes if culture-relevant items are part of these visuals.
6. Modifying pictures to make them better suited to the cultural and physical characteristics of a country can be helpful.
7. Urbanised people, for example, who are exposed to a visual environment of rectangular lines, are more susceptible to geometric illusions than people living in a rural area.

8. The ability to read depth, movement, and foreign objects in pictures is a learned experience and is related to people's level of visual literacy and their skill and competence when it comes to reading and interpreting these conventions.
9. Subjects find outline drawings sufficient to perceive objects in pictures.
10. The ability to read pictures is a learned process.
11. Visual media cannot teach and can only assist teachers and health workers.
12. Subjects from picture-poor communities generally perform more poorly in pictorial tests when they are compared to subjects from picture-rich environments.
13. Subjects from developing communities can learn pictorial conventions easily if these conventions are explained to them.
14. Subjects also have little difficulty in processing pictures and understanding their messages when shown how to use and interpret the pictures.
15. People who are seldom exposed to pictures and who do not receive training in the use of media and the use of pictures might never develop an effective picture-reading ability.
16. Pre-testing of pictures and picture-text instructional material is imperative for effective pictorial communication in developing communities.
17. Pictures must be modified or visually translated to make them acceptable across cultures without modification.
18. Signs that are common in the Western world are not necessarily universally interpreted in the same way in other cultures.
19. Colour is not always culture-independent. Colour can have a specific meaning for one group but a different meaning for another group.

This section looked at research across cultures in picture and picture-text instructional material and isolated nineteen principles from the field that could be of value to developers of picture-text instructional material.

2.10 CRITICAL OBSERVATION OF SOME OF THE METHODS THAT ARE USED IN PICTURE-TEXT RESEARCH

This section will briefly look at some methods that the researchers used and also some of the faults that can be associated with these methods.

2.10.1 Cross-cultural research

Cross-cultural research is primarily concerned with measuring and explaining the differences in human performance, perception and opinion between different groups. Research in the field of learning from pictures and text was mainly conducted by European or American scholars and comparison customarily took place between samples from their own cultures and samples from less-developed and developing countries. A regular problem in these studies is the dissimilar groups that were compared with each other. The groups from the developing communities generally had less education and were less exposed to Western pictorial material, they were not always equivalent to the group with which they were being compared, and the experimental conditions were not always the same. The scholars invariably obtained differences between the groups, but the lack of equivalence between the two groups will make it difficult to attribute the difference solely to cultural differences and not to other factors. It is not only culture, but also wider social, economic and educational factors and the interaction between a researcher and the subject, which affect these outcomes.

2.10.2 Prose learning

Prose learning with pictures (Levin and Lesgold, 1978) is a particularly useful research method in visual communication. Decoding words and word-picture confusion effects can be eliminated and subjects' progress in an experimental situation can be controlled as illustrated by Hugo (1994:170), where the appropriateness of line illustrations with text captions was tested.

Prose learning, however, seldom occurs as the only didactic practice in a classroom in South Africa. The practice is rather that the teacher might not only read the material, but will also explain and comment on the material. The same material is then also used by the learners for study at home or in the classroom without verbal assistance from the teacher.

2.10.3 Evaluation methods

The researchers used a wide range of evaluation methods in text-illustration experiments. These methods include multiple-choice, cued recall, free recall, problem-solving transfer, sentence verification tasks, and testing in the visual mode. Experimenters who test for comprehension, recall and inference use immediate and delayed post-tests. Evaluation methods must be appropriate for the text and the illustrations used in the text. Tests that measure concept and problem solving, for example, will show picture facilitating effects when explanative text with explanative pictures are used. Tests that measure the number of facts recalled or a general comprehension of facts with explanative text and explanative pictures will, according to Mayer (1993:276-277), not show a picture facilitating effect.

Free recall, a method of measuring comprehension, is criticised by Levin and Lesgold (1978:236) as an inaccurate method of measuring children's comprehension during a visual stimulus task. Children may lack retrieval skills that are required for a free-recall task and they might make incorrect decisions about important and irrelevant information. *Cued recall* has the advantage that children can be probed for answers without having to give them leading questions, which will make it a more robust method of testing for comprehension. Cued recall can be prose-dependent or picture-dependent

Pre-testing is a widespread practice in educational research where the influence of one or more variables on subjects' learning performance is tested. Some pre-tests are used to select subjects for a particular experiment, for example to exclude subjects who have prior knowledge that could influence the effect of an experimental variable (Solman *et al.*, 1992; Solman and Wu, 1995). Pre-testing also allows for co-variance in data analyses and will help to equalise the control group with experimental groups. Pre-testing also allows for the pairing of control and experimental groups into equivalent groups.

An immediate recall or comprehension test, administered directly after exposure to visual stimuli, is the most frequent measuring device used by researchers. Researchers also employ delayed and repeated delayed tests, because the ideal outcome of educational practice is for subjects to retain the acquired information over a longer period. This method has been used in South Africa by amongst others, Hugo and Skibbe (1991) and Van Aswegen and Steyn (1987). A delayed comprehension and recall test can, however, introduce variables that are difficult to control and which can

influence the picture effect that is under investigation. Memory loss over time is well documented and occurs through spontaneous loss of memory traces and through interference effects (Baddeley, 1979). Retroactive interference is when subjects learn additional material before being tested on the first material that they learned. This additional material interferes with the recall of the first material and is compounded by the volume of material. The more additional material that the subjects learn after the first set of material, the greater the loss of memory (*Ibid.*).

It appears reasonable to assume that memory loss with regard to pictures will occur over time and that interference effects from other visual and text material are likely to occur in a delayed comprehension or recall test. This interference effect might differ between samples from different populations. Results from a delayed test will indicate how much information is retained, but will also suffer from interference factors, which will not be the same for all subjects. A delayed recall or comprehension test will not give the true value of the educational material and didactic practice under investigation, but will give a more accurate indication of the long-term effects of pictures that are under consideration.

The superiority of illustrated text compared to non-illustrated text appears to be more pronounced in a delayed recall test than in an immediate recall test. The review of Levie and Lentz (1982) found 6 studies that indicated this trend. In a series of four experiments, Peeck (1989) compared immediate testing procedure with a three- to seven-day delayed testing procedure using two illustrated text conditions. Peeck found that there was a substantial relative increase in correct answers in the case of a delayed testing procedure when the questions were based on the illustrations.

2.11 SUMMARY

In this chapter the focus was on reported research and theoretical propositions that were considered to be relevant to the study. Each new paragraph in this section is a summary of a main section in Chapter 2.

The first section showed that reported research in the field of the study appeared in diverse academic journals, of which educational technology, educational and educational psychology journals were the most prominent.

Section two reviewed communication models relevant to the focus of the study and looked at cultural aspects in picture communication materials. It showed that culture and communication are inseparably linked and that culture is a lens or a filter through which people receive, interpret and transmit messages. Communication is an open system and takes place within a cultural environment. The section concluded by presenting a simplified model that projected the picture-text-communication process as an open system, that takes place within a cultural environment.

The third section reviewed picture classification systems and proposed a taxonomy of pictures in instructional text for the study. The main categories in the taxonomy are: representative pictures; explanative pictures, organisational pictures, and decorative pictures. Decorative pictures appear not to have the potential to assist learning, whilst organisational and explanative pictures have the highest potential for assisting the learning task.

The fourth section looked at the conditions under which pictures do not assist learning. It found that pictures could impede beginner readers when they learn how to read and that decorative pictures do not have a cognitive value when they are used with instructional text. Decorative pictures are text-irrelevant and do not assist the information in the text.

The fifth section showed that there is sufficient empirical evidence that pictures can facilitate learning. This facilitation effect applies to the recall of information, the comprehension of information, and the answering of inferential questions. It is durable over time, and it applies to both young and older learners. The effect can range from small to large, whilst the text in the learning material, the experimental conditions, the pictures and the learners themselves affect the magnitude of the picture facilitating effect.

The sixth section isolated those factors that influence the facilitating effect that pictures have in instructional text. Factors that influence the picture facilitating effect can be grouped under picture characteristics, type of instructional media and text content, learner characteristics, and evaluation methods. The section provided a graphic model of the factors that influence the extent of the facilitating effect of pictures in instructional text. It provided a synopsis, in tabular format, of twenty-two factors that influence the facilitating effect of pictures in instructional text. The section concluded by providing a utility checklist, which can be used as an analytical instrument to evaluate picture-text learning material.

The seventh section was similar to the sixth section, but focused on those factors that are applicable to learners from developing communities. The main categories that influence the picture facilitating effect are picture characteristics, the learning material and content thereof, and the learners' characteristics. The section concluded with a summary of ten factors that instructional designers must consider when developing picture-text material aimed at subjects from developing communities.

Section eight provided an overview of different theories that explain the beneficial effect that pictures can have on learning when they are combined with text. Only those theories that have a functional approach to picture-text studies, and those that are relevant to the study, are discussed.

The ninth section examined cross-cultural research in pictures and picture-text instructional material. This section reported on the influence of culture on pictorial perception, preference, the use of pictures by developing communities, and the relative effectiveness of different picture styles. Nineteen principles were identified and listed, which instructional designers can use to develop and improve pictorial material that is used in educational material, health education and development programmes aimed at developing communities.

The last section made some critical observations on some of the methods that are used in picture-text research.

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ADDENDUM 2

A utility value checklist for pictures in instructional text.

	Questions with regard to the picture and the syntax of the picture	Yes
1	Is the picture realistic?	
2	Is the picture presented in a clear style?	
3	Does the picture agree with the content of the text?	
4	Does the picture provide information that is central to the text?	
5	Are there graphic cues in the picture, namely arrows or lines, directing attention to a particular area of the picture?	
6	Is the picture in colour?	
7	Does the colour emphasise important parts of the picture?	
8	Are there tonal values in the picture, that is if the picture is in black and white?	
9	Does the picture have a caption (name)?	
10	Does the picture have a legend with more information than just a name?	
11	Is the legend instructive in nature?	
12	Is the legend easy to understand?	
13	Does the legend relate to the picture?	
14	Is the picture explanative in nature (does it explain a certain procedure)?	
15	Does the picture present an analogy of some form?	
16	If the function of the picture is to act as an advanced organiser, does the picture appear before the text?	
17	If the function of the picture is to repeat information that is presented in the text, does the picture appear after the text?	
	Questions with regard to the text and the reader	
18	Does the text hold high interest for the reader?	
19	Is the text unfamiliar to the reader?	
20	Does the reader have low prior knowledge of the text?	
21	Does the reader have difficulty in understanding the text?	
22	Does the reader have the necessary reading skills to understand the text?	
23	Does the reader have the necessary visual literacy skills to interpret the pictures?	
24	Does the text instruct the reader to make use of the pictures?	
25	Does the text explain the pictures?	
	Questions with regard to the evaluation methods	
26	Does the post-test focus on information that is presented in the text and which is reflected by the pictures?	
27	Do the post-test questions ask the subjects to provide an explanation or a concept, or to demonstrate problem-solving skills, when the text and pictures are explanative or when the picture and text provide an analogy?	
28	Do the post-test questions ask the subjects to recall facts when the text and pictures provide factual information?	

The more **yes** answers, the higher the relative utility value of the picture.

CHAPTER 3

THE EFFECT OF CULTURALLY MODIFIED PICTURES IN A LEARNING SITUATION: EMPIRICAL EXPERIMENTS

3.1 INTRODUCTORY REMARKS

This chapter gives a report on the empirical work completed for this study. The empirical work consists of eight experiments. Each experiment is discussed in a separate section, giving an introductory section, the method, results, and a conclusion. Each section will commence on a new page to present the experiments as separate entities. The experiments are reported in the order in which they were conducted. The last three experiments are grouped together and reported under the heading of "Experiment 6", as they are similar except for small changes to the methods and experimental materials. The results and the conclusions of all the experiments are synthesised in Chapter 4.

3.1.1 Comments on the statistical analysis

The quantitative data of the experiments were analysed using Microsoft's Excel software, which also furnished the descriptive statistics. The group means were compared by using a single-factor Analysis of Variance (ANOVA). The data were tested for normality and further analysed with STATISTICA for Windows, as post-hoc analyses are not possible with Microsoft Excel. Tukey's post-hoc test was used to determine which group mean differed significantly from the other groups if the results of the ANOVA test indicated that there was a significant difference between the group means. The significance level was set at 0.05. The ANOVA statistical test and Tukey's post-hoc test appear to be the preferred statistical tests that researchers use in this field to compare the means between three or more groups (Beck, 1984; Anglin and Levie, 1985; Beveridge and Griffiths, 1987; Mayer *et al.*, 1996). Other post-hoc tests that are sometimes used are the *Scheffe*, the *Newman-Keuls* and the *LSD* (least significant difference) multiple-comparison tests; Bernard, Petersen and Ally (1981) [*Scheffe* test]; Reinking, Hayes and McEneaney, (1988) [*Newman-Keuls* and *Scheffe* tests]; McDaniel and Waddill, 1994 [*Newman-Keuls* test]). The manner in which the hypotheses are

stated for each experiment is comparable to the style and method that are used by researchers that publish in this field (Beck, 1990:146; Mayer and Anderson, 1991:486; Newton, 1994:222; Mayer, *et al.*, 1996:68).

Notations

The following notations were used to report on the descriptive statistics:

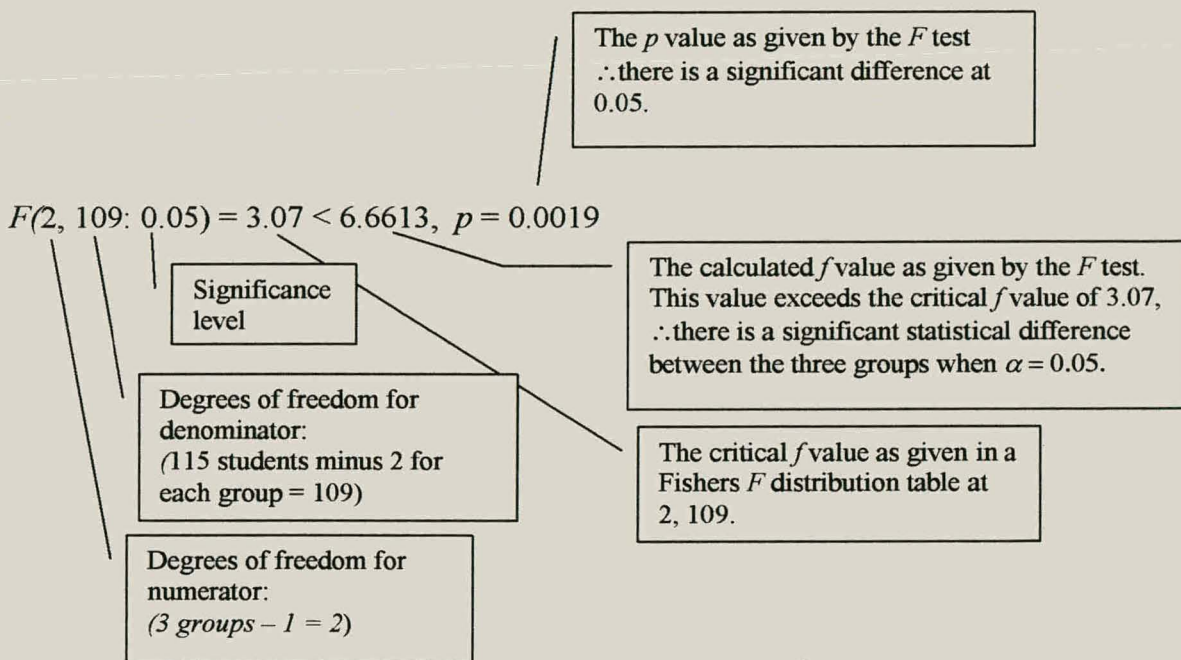
\bar{x} = Sample means

SD = Standard deviation

n = Number of subjects

ES = Effect size

Notations used to report on the ANOVA tests.



A note on the effect size

The effect size is, according to Levie and Lentz (1982:198), a "*useful alternative*" to significance levels in evaluating group means. It is a method proposed by Pillemer and Light (1980) and is used by some scholars in this field to report on group differences (Levie and Lentz, 1982; Levin *et al.*, 1987; Ogunyemi, 1990; Hayes and Reinking, 1991). The effect size of some of the experiments is supplied in order to place it in context with other completed studies in this field.

Each experiment is presented in the order in which they were conducted.

3.2 EXPERIMENT 1: The Khoikhoi

3.2.1 Introduction to Experiment 1

This section provides a report on the first experiment. This experiment acted as a pilot study to provide direction for the design and methods of subsequent experiments.

The need for research in South Africa on the use and effectiveness of pictorial elements in education is mentioned in the introductory section of the thesis. This experiment is based on the assumption that visuals will be more effective in instructional material if they are modified or graphically adapted for a specific group of learners. Such modifications could include images familiar to the group, and graphic images and styles that are preferred by the learners, for example the use of children in a cartoon style, as in the reading material for this experiment.

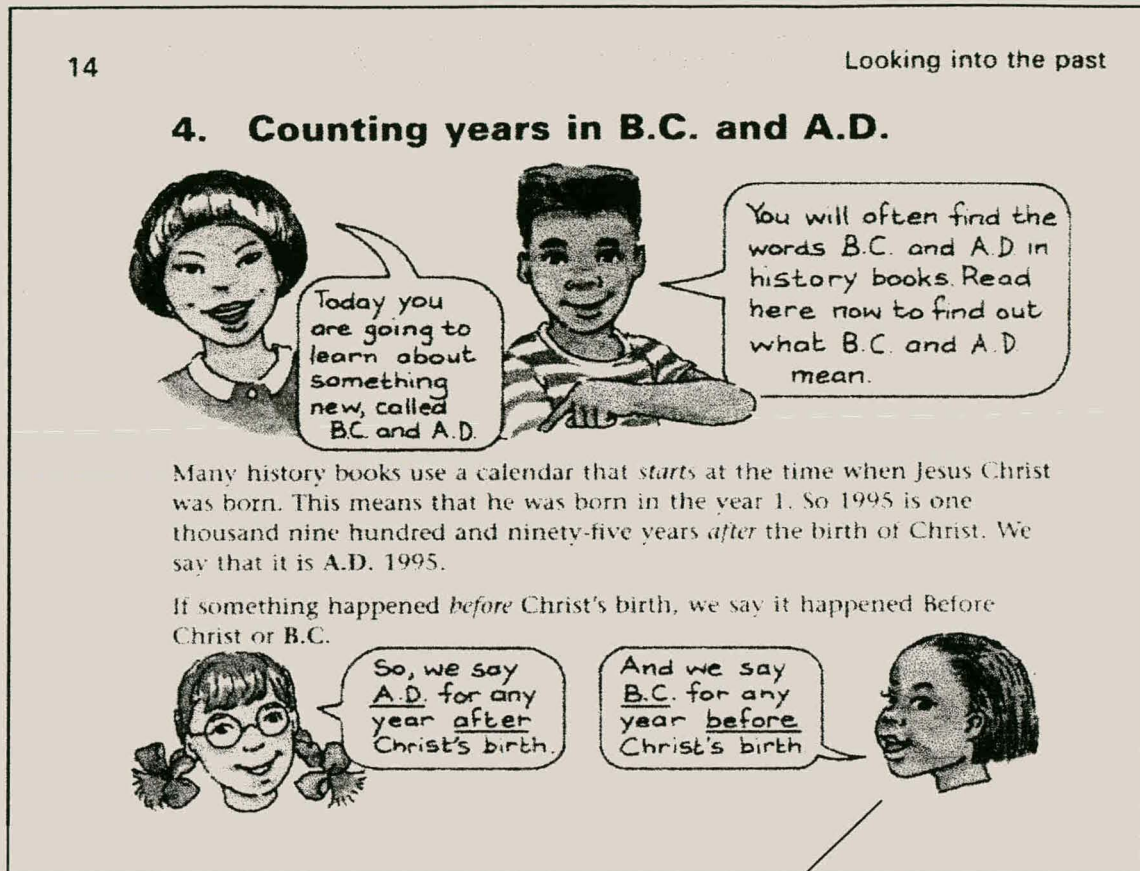
A well-known South African publisher recently produced a history textbook (Clacherty and Ludlow, 1995) for Grade 5 pupils in South Africa. This textbook is richly illustrated with full-colour photographs, illustrations, diagrams and tables. Self-evaluation questions are placed in strategic positions and accompanied by instructions on where to find answers to these questions. Illustrations of children's faces, acting as guides in the book, depict a multicultural society with relevant South African icons. This book is an example of a publisher's attempt to modify an academic textbook with a graphic language to appeal to South African school children. An example of a section of a page, with the faces of children, acting as guides throughout the book, is given in Plate 3.1 (p. 126).

3.2.2 The purpose of Experiment 1

From a graphic designer and educator's predisposed conviction it seems justifiable to assume that this visual approach to learning, illustrated with South African images or icons, will benefit children during learning and will assist in the recall of information. Typical South African images would be pictures or simplified images of Table Mountain, Shaka Zulu, the engravings and paintings made by hunter-gatherers that are found in rock shelters, vehicles used in the minibus taxi industry, and a learner's familiar visual environment. A picture of President Nelson Mandela is an example of a world-recognised South African image or icon.

PLATE 3.1

An example of a section of a page where the publisher attempted to modify an academic textbook by using faces of children that represent South African children (Clacherty and Ludlow, 1995:14).



The faces of the children act as guides and take the learner through the book. This is an example of a graphic cueing device.

The purpose of this experiment or pilot study was threefold:

- * to explore the possibility of using primary schoolchildren as subjects in a larger study,
- * to test the feasibility of a paired control group experimental design, and
- * to test the hypothesis that culturally modified pictures with supplementary educational text will help learning.

Other educational media, namely slides, audio and video, are regarded as less-suitable mediums for delivering educational material to developing communities than printed media. The lack of electrification in some rural and peri-urban schools makes the use of

media that require electricity unsuitable. The cost of overhead projectors and slide projectors is prohibitive to schools in these areas. Printed visual communication material, for developing communities, has a quality unequalled by audio, film and electronic media. Learners can take printed media to their homes and work and can review the material at their own convenience. Printed material does not need sophisticated delivery instruments, it is immediately available for repeated exposure, and it is quicker to transfer between targeted audiences. Printed material also serves as an ongoing reminder of a verbal message delivered by a teacher or health worker. It is, however, limited to still pictures, and audiences with low levels of visual and verbal literacy may experience difficulty with the material if they do not understand the pictures or have difficulty in reading the text.

3.2.3 The method of Experiment 1

The researcher subjected 31 Grade 6 children to a comprehension test in a paired control group experiment. These were all the Grade 6 children in the school. The children were from a private English school, but only 2 children stated that they used English as part of their home language. Most of the children, according to the teacher, came from homes with a parent or both parents in professional employment. The children were from the population of peri-urban and urban scholars. The school was situated in a light industrial area next to a peri-urban area.

The teacher at the school where the experiment was conducted divided the class into two groups and paired them according to their academic performance. Grade 6 children, rather than Grade 5 children, were used as it was assumed that their understanding of English and their ability to express themselves in writing were better than that of the children in Grade 5 (the textbook was designed for Grade 5 children). The teacher informed the researcher that the study material was new and that the children had not covered it in their syllabus the previous year.

Both the control and experimental groups received material on the Khoikhoi and their animals from the aforementioned history textbook (*Ibid.*:66-68). The readability statistics reported by Microsoft's Word for Windows was 84.3 percent for the Flesch Reading Ease, and 4.6 for the Flesch-Kincaid Grade level. The Flesch Reading Ease score is based on a 100-point scale; the higher the score, the easier it is to understand the document. The Flesch-Kincaid Grade Level score is based on a U.S. grade-school level. A score of 6.0, for example, means that an sixth grader in the U.S. can understand the document. The score of 4.6 for the Flesch-Kincaid Grade level implies that the material should be suitable for a child in Grade 5. The children for this experiment were in Grade 6. An example of a section of the learning material is given in Plate 3.2 (p. 128). All the

learning material and the evaluation questions for both the control and experimental groups are given at the end of this Chapter in Addendum 3 (p. 235-239).

PLATE 3.2

An example of some of the test material that was used in the first experiment.

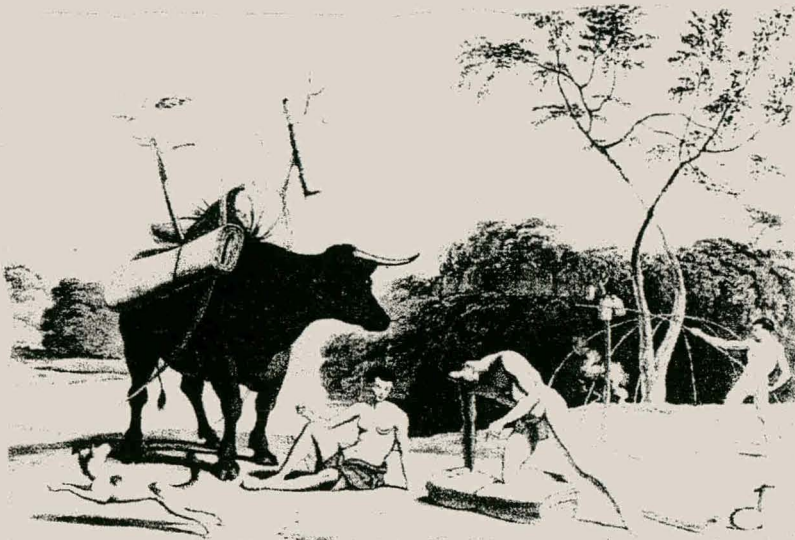
A = The experimental group received this text with the corresponding picture

B = The control group received this text without a picture.

A

They have no houses but live in little huts which they make from bent sticks or hoops. They hang reed mats on the sticks. They usually put these huts 10 or 12 together in a circle. As soon as they see their cattle have no grass, they take down their huts, put the hoops on their pack-oxen and set them up again where they find good grass.

(This was written by a European called Hoffman in 1672)



B

They have no houses but live in little huts which they make from bent sticks or hoops. They hang reed mats on the sticks. They usually put these huts 10 or 12 together in a circle. As soon as they see their cattle have no grass, they take down their huts, put the hoops on their pack-oxen and set them up again where they find good grass.

The Khoikhoi were indigenous people of Southern Africa who made their livelihood through trade, hunting and keeping livestock. This group of people disappeared as a separate group through assimilation with other tribes, disease, and war with colonialist and Black tribes. The self-evaluation questions, page numbers and references of where to find answers to the self-evaluation questions were, however, deleted from the experimental group's pages. The independent variable under investigation was the visuals, while the dependent variable was the recall of the information that was presented in the material. All the subjects were given ten minutes to study the material and they then had to answer two open-ended questions, one on what they knew about the Khoikhoi animals and the other on how the Khoikhoi lived. The children initially received ten minutes to answer the questions, but this was changed to twenty-five minutes due to their slow progress in writing the answers. Each child's answers were evaluated. One mark was allocated for each fact recalled from the material. Spelling and grammatical errors were disregarded.

3.2.4 The results of Experiment 1

Subjects from the experimental group gave a total of ten comments directly related to the animals in the pictures, for example their long horns, and the fact that that they were big and looked dangerous. They made only five factual references to the animals as contained in the text alongside the pictures. The control group made ten factual references to the animals as contained in the text.

The control group gave sixty-four points of information from the text, while the experimental group gave a total of seventy points of which fifty-three points were from the text and seventeen points were from the pictures. Some subjects were unable to complete the short questionnaire, possibly due to either a lack of English vocabulary or an inability to recall the information.

3.2.5 A discussion of the results of Experiment 1

The aim of this experiment was to explore the possibility of using primary schoolchildren as subjects; to test the feasibility of a paired control group experimental design; and to test the hypothesis that culturally modified visuals will help learning.

The experiment, initially designed to last no longer than twenty minutes, took forty-five minutes to complete due to the difficulty that the children had in expressing themselves in English. The process of dividing the class into two groups, explaining the procedure to the children and collecting the completed tests, added an additional fifteen minutes to the experiment. The Free State Department of Education had indicated to the researcher on a previous occasion that permission to use schoolchildren will be denied if experiments last longer than thirty minutes. The use of spelling and grammar by the children indicated that they had difficulty in understanding the text and expressing themselves in the English language. This variable could have obscured the potential facilitating effect of the pictures during the experiment. Analysing the written answers, and classifying the data as relevant to the text or to the pictures, was also difficult, as the grammar was not always clear and the intention of the subjects' answers was not always understood by the researcher. Schoolchildren with poor English skills are not considered as suitable experimental subjects due to the additional time that they take to read the material and write down the answers.

A paired control group experimental design is regarded to be feasible as long as the subjects are from a homogeneous group. The introduction of control questions, to duplicate an existing question in the questionnaire with different words, could give an indication of whether an individual has understood the question.

No inferential statistical test was applied to the data due to the non-representative nature of the sample and the sampling procedure, and the uncertainty surrounding the equivalence of the two groups. It appears, however, that the control group extracted more information from the text (seventy points) than the experimental group extracted from the pictures and the text (sixty-four points). This was not expected. The results could possibly be explained in terms of a floor effect due to a language barrier, as well as the inadequate verbal skills of the subjects. The pictures were also in a decorative format and could have been ignored as such by some of the children. The conclusion, in terms of the purpose of this experiment, is that these primary schoolchildren were not the ideal subjects due to a language barrier and the type of evaluation questions (open-ended questions) that were used. A paired control group experimental design is feasible as long as the equivalence of the groups can be verified. It was not possible to either reject or not to reject the hypothesis, as no inferential statistics were applied to the data for the above-mentioned reasons.

Questions, that are not printed in the subjects' mother tongue could pose a hinderance to the subjects. A possible solution to this problem is to shift the research design to a more qualitative approach, or to use older children where part of the language barrier could be removed, and to make use of multiple-choice questions and short factual questions.

Differences in language and culture, the response by subjects to experimental material, and the social interaction between researchers, fieldworkers and test subjects are variables that could influence the effect of a visual variable under investigation.

Multiple factors can influence the subjects' response to a picture and questions during an experiment. Some of these factors could be the visual literacy level of the subjects, the familiarity of the images, the context in which the visuals appear, the level of demand that the copy and visuals place on the viewers, cognitive processes and the level of symbolism, abstraction and realism of the visuals.

3.2.6 A summary of Experiment 1

Thirty-one Grade 6 children, divided into two groups, participated in a paired control group research design. This experiment acted as a pilot study for the possible design and future direction of the study.

One group received existing picture text material from a school textbook whilst the other group received the same text but without the pictures. The text consisted of 278 words. There were 10 pictures in the material. The primary schoolchildren were not the ideal subjects due to a possible language barrier and the type of evaluation questions (open-ended questions) that were used.

A paired control group research design is feasible as long as the equivalence of the groups can be verified. It was not possible to either reject or not to reject the hypothesis, as no inferential statistics were applied to the data for the above-mentioned reasons.

It was not possible to draw a conclusion from the results due to a possible language barrier. It appears that the language barrier created a floor effect and obscured the possible positive effect of the pictures in the picture-text material. The questions and test material were in English, while most of the subjects did not use English as their home language.

3.3 EXPERIMENTS 2 AND 3: The safety of electricity, and Plants are good for you

3.3.1 Introductory comments

The aim of these two experiments is to determine whether pictures in picture-text learning material, and which are modified for the learners, could increase their recall of the information that is presented in the learning material. This modification process is a process whereby the pictures are changed to reflect the physical features of the learners, the products that the learners use and the clothes that the learners wear. The expectation was that the subjects would associate themselves in a positive manner with the modified pictures of the children and the consumer products in the pictures, and that this would increase the facilitating effect that pictures have when combined with instructional text. It was hypothesised that learners would benefit more from picture-text material when the pictures in the learning material are modified to reflect visual items in their culture, than the same learning material but without pictures, or picture-text material where the pictures are not modified.

EXPERIMENT 2: The safety of electricity

3.3.2 The subjects for Experiment 2

One hundred and fifteen Grade 6 subjects from a primary school in Bloemfontein, South Africa, participated in the first experiment. Seventy-one subjects mainly used Tswana, South Sotho and Xhosa as their mother tongue. The rest came from English, Afrikaans and Chinese backgrounds. Subjects from the Afrikaans- and English-language backgrounds included both African and European subjects. Fifty-seven subjects were female and fifty-eight subjects were male. The subjects ranged in age from 11 to 13 years and had a mean age of 12 years. There was one subject of 14 years. The subjects had been divided by the school into three classes at the beginning of their academic year. This division was not according to the subjects' academic achievement or scholastic ability. One class was designated the control group, and the other two as experimental group 1 and experimental group 2 respectively.

3.3.3 The materials for Experiment 2 (the text, pictures and questions)

The text for the first experiment came from a science textbook: *Successful Science 4* (Press and Macgregor, 1992), which is a Science textbook aimed at subjects of this age. The experiment used text material that consisted of 364 words on safety with regard to electricity (Unit 7, pages 66 and 67). The readability statistics reported by Microsoft's Word for Windows was 80.5 percent for the Flesch Reading Ease, and 4.9 for the Flesch-Kincaid Grade level. The score of 4.9 for the Flesch-Kincaid Grade level implies that the material should be suitable for a child in Grade 5 and should not pose a problem for Grade 6 children. The first section of the text described the dangers of electrical faults in a home; how these faults can cause a fire; the colours in an electric plug; and where the wires must be connected in the plug. The second section of the text gave 11 electricity safety rules on what not to do, for example, "*Never try to fix a plug or machine, or the wiring in the house, by yourself*". A copy of some of the original material (text and pictures) from which the experimental material for Experiment 2 was developed, is given in a reduced format in Addendum 3.6 (Press and Macgregor, 1992:67) at the end of Chapter 3 (p. 240).

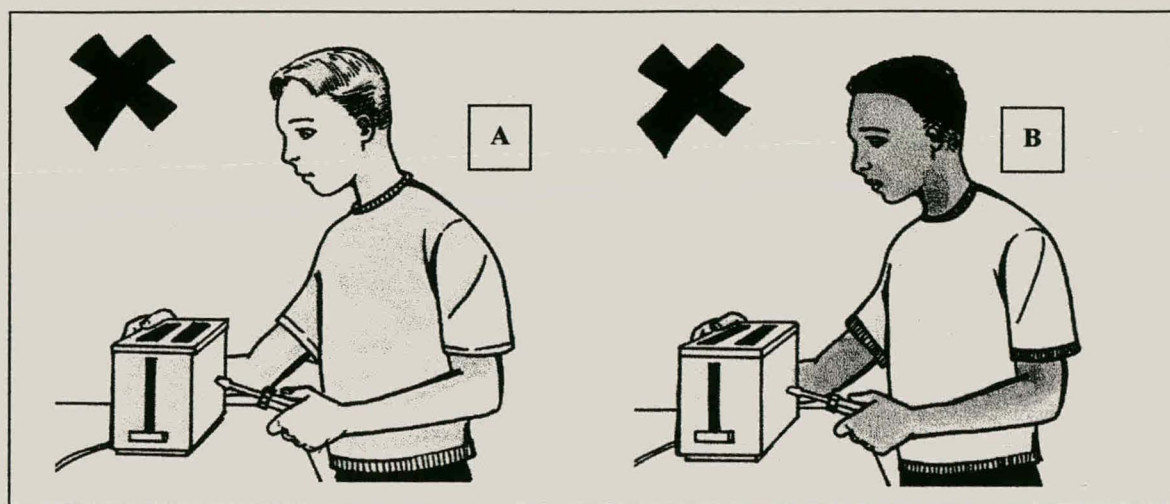
Three different versions of the test material were developed. One version contained just the text; one version contained text and pictures that explained and repeated the information in the text; and the third version contained the text with the same pictures, except that these pictures were modified to represent the majority of the subjects that participated in the experiment. These culturally modified pictures reflected the physical features of the majority of subjects in the school. For example the modified picture accompanying the rule: "*Never try to fix a plug or a machine, or the wiring in the house, by yourself*" showed an African child of the same age as the subjects with a screwdriver trying to repair a toaster. The unmodified picture, or original picture, for this rule showed a child with Caucasian features of the same age as the subjects. A large cross was placed next to the picture to emphasise that this was an undesirable action. Examples of the original picture and the modified version are given in Plate 3.3 (p. 134).

The pictures were shaded, black and white illustrations, printed with a laser printer and duplicated with a high-quality photocopier. There was one picture that illustrated an electrical plug and 11 pictures that illustrated 11 electricity safety rules. Seven of the 12 pictures in the picture-text material were modified. Five pictures, for example an overloaded wall plug and a heater in the bathroom, were the same for the picture-text and the modified picture-text condition. The height of the pictures ranged between 5 and 6 centimetres. Examples of all the pictures are given in a reduced format in Addendum 3.7 at the end of Chapter 3 (p. 241-242). The pictures were positioned directly beneath

the text. There was no difference in the text layout for the control group and for the two experimental groups, except that the 11 safety rules were on 3 pages for the experimental groups and on 1 page for the control group. The added pages for the experimental groups were to accommodate the pictures. The pages were all A4 (210 x 297 millimetres) in size.

PLATE 3.3

An example of the original picture and the modified version for one of the safety rules that was used in Experiment 2. A = Original (unmodified), B = Modified.



The recall test consisted of three questions. Two questions tested recall on the wiring of an electric plug (6 marks) and the third question asked the subjects to recall and to write down the 11 safety rules (11 marks). Spelling and grammatical errors were ignored.

The text was set in 12 points *Times Roman* with 3-point line spacing, justified to a width of 145 millimetres.

Copies of all the material that was used by the control group and the two experimental groups, as well as the questions, are given in Addenda 3.8 – 3.11 at the end of Chapter 3 (p. 243-256).

3.3.4 The experimental design and procedure of Experiment 2

The experiment used a post-test only control group design with two experimental conditions. One experimental group received the text with non-modified or original

pictures, the second experimental group received the text with the modified pictures, and the control group received the text-only material. The independent variable was the illustrations in the text, and the dependent measure was the subjects' factual recall of the information presented in the text.

The experiment was conducted during normal class hours at the school and in the classroom where the subjects receive their normal Science lessons. The subjects received the learning material, placed upside down on their desks, at the beginning of a 30-minute period. Their Science teacher began the class by reviewing a previous lesson. He asked the subjects several questions based on a previous lesson on electricity and encouraged them to provide short, factual answers. The teacher then asked the subjects to turn the worksheet around and to follow him whilst he was reading the material aloud. The teacher followed an instructional method whereby he stopped after reading a small section, asking questions and allowing the subjects to reply. The first section on *Safety Rules* deals with a building that might burn down due to a short-circuit. For example, the teacher asked how many of them knew of someone's house that had burned down or someone who had been injured in a fire. The subjects were allowed to interact with the teacher by telling him about incidents that related to sections in the text. The teacher also held up an electric plug in the front of the class and explained the importance of correctly wiring a plug. The subjects received 2 minutes to review the 11 safety rules on their own before the teacher collected the material. This process took approximately 20 minutes. The only difference in the procedure was that the two experimental groups were specifically instructed to look at the pictures during the lesson. The three groups received the material on the same morning and wrote an unannounced 25-minute recall test the following day.

The recall test consisted of three questions. Two questions tested recall on the wiring of an electric plug (6 marks) and the third question asked the subjects to recall and to write down the 11 safety rules (11 marks). Spelling and grammatical errors were ignored. Subjects could score a maximum of 17 marks.

3.3.5 The results and a discussion of the results of Experiment 2

The data were analysed using a single factor Analysis of Variance (ANOVA). A comparison was made between the mean recall scores of the control group and the two experimental groups for all the questions, for Questions 1 and 2, and for Question 3 (the 11 safety rules). This was followed by a post-hoc analysis to determine which of the

means were significantly different from the others. The results are given in Table 3.1 (p. 137) and graphically illustrated in Figure 3.1 (p. 138). A post-hoc analysis (Tukey's HSD test) was only performed on the data if the ANOVA test found a significant difference between the mean scores of the three groups.

There was a significant difference between the mean scores of the text-only condition, the picture-text condition and the modified picture-text condition for all the questions, $F(2, 112; = 0.05) = 3.07 < 6.222, p = 0.0027$. The unmodified picture group scored significantly better than the text-only group ($p = 0.025$) and the modified picture group scored significantly better than the text-only group ($p = 0.0035$).

There was a significant difference between the mean scores of the text-only, the picture-text condition and the modified picture-text condition for Question 3 (the 11 electricity rules), $F(2, 112; = 0.05) = 3.07 < 7.219, p = 0.0011$. The unmodified picture group ($p = 0.02$) and the modified picture group ($p = 0.0013$) performed significantly better than the text-only group. The text-only group scored a mean of 5.65 whilst the picture-text group and the modified picture-text group scored 7.11 and 7.61 respectively. This translates into a 9 percent increase for the picture-text group and a 12 percent increase for the modified picture-text group over the control group. The two groups that received pictures with the text were able to recall the 11 safety rules on electricity better than the group that received a text-only version. The group that received the modified pictures did not score significantly higher than the group that received the unmodified pictures.

The difference between the mean scores for the three groups for all the questions is due to mean differences in Question 3 (the 11 electricity rules). There was no difference between the three groups when the mean scores of the first two questions were compared with each other; $p = 0.53$.

Effect size:

This effect size is obtained by subtracting the control group's mean from the mean of the experimental group and then dividing by the standard deviation of the control group. A value of 0.66, for example, would indicate that the experimental group was better by an amount of two-thirds of the standard deviation of the control group. The effect sizes are given in Table 3.2 on the next page (p. 137).

TABLE 3.1

Means and standard deviations of the subjects' recall scores
by condition and by question (Experiment 2).

CONDITION									
	Text only			Pictures and text			Modified pictures and text		
QUESTIONS	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	38	11.18	3.28	38	12.87	2.47	39	13.29	2.48
Questions 1&2	38	5.53	0.98	38	5.75	0.85	39	5.68	0.85
Question 3	38	5.66	2.76	38	7.12	2.02	39	7.62	2.19

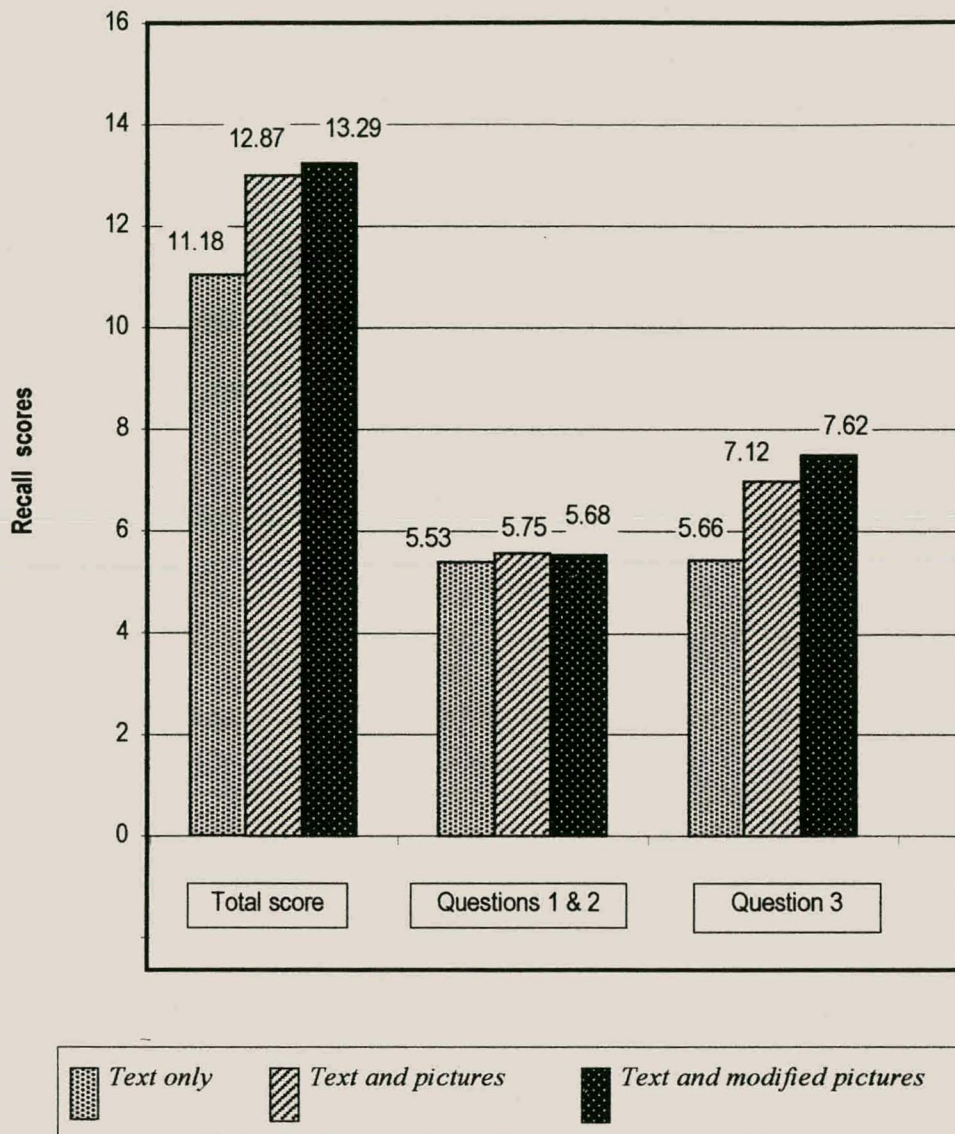
TABLE 3.2

Effect size (ES) of the picture-text and modified picture-text conditions (Experiment 2).

CONDITION				
	Pictures and text		Modified pictures and text	
SAMPLE	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	38	0.52	39	0.64
Questions 1 & 2	38	0.22	39	0.15
Question 3	38	0.53	39	0.76

FIGURE 3.1

A graphic representation of the mean recall scores of the subjects by condition (Experiment 2).



The findings indicate that the pictures facilitated the recall of information that is presented in the text and which is accompanied by appropriate pictures. This is in agreement with the general research findings in this field.

The effect sizes of the picture-text condition and the modified picture-text condition are 0.52 and 0.64 for all the questions, and 0.53 and 0.76 for Question 3. This is similar than

the average effect size of 0.55 reported by Levie and Lentz (1982) and the 0.50 (for representational pictures only) reported by Levin *et al.* (1978).

A ceiling effect was obtained with the answers to Questions 1 and 2 (*Text-only*: $\bar{x}=5.53$, $SD=0.98$; *Picture-text*: $\bar{x}=5.75$, $SD=0.85$; *Modified picture-text*: $\bar{x}=5.68$, $SD=0.85$; *the median and mode for all three conditions = 6*). The maximum mark for Questions 1 and 2 is 6. These two questions required the subjects to name the colours of the three wires inside an electrical cord and to name the letters that represent these three wires. This ceiling effect was possibly due to previous knowledge or the demonstration effect of the teacher when he held up a plug in class and explained the correct procedure for wiring a plug. The third question asked the subjects to write down the 11 safety rules of electricity. It was with this longer question, where the subjects had to recall 11 steps, where the pictures assisted in the recall of the information.

The null hypothesis that there is no difference between the text-only version, modified pictures and text, and pictures and text material, is rejected in favour of the alternative hypothesis that there is a difference. A possible explanation for the weak facilitation effect of the modified picture version, when compared to the picture-text version, is that the children that are portrayed in the pictures fulfil, to a certain extent, a decorative role. The children in the pictures can be replaced by a picture of any child without altering the message in the picture or the information in the text. The effect of the teacher leading the class in the learning process could also have contributed to the non-significant effect between the modified and unmodified versions.

3.3.6 A summary of Experiment 2

One hundred and fifteen Grade 6 children with a mean age of 12 years, and divided into three groups, participated in a post-test only, control group research design. One group received text-only learning material, the second group picture-text material, and the last group modified picture-text material. The text consisted of 364 words on the safety of electricity. There were 12 representational pictures in each of the modified picture-text and picture-text materials. Both groups that received pictures with the text scored significantly higher with a recall test than the text-only group. The group that received the modified pictures did not score significantly higher than the group that received the unmodified pictures. Modified pictures in picture-text material failed to increase the picture facilitating effect when compared to the same experimental material containing unmodified pictures.

EXPERIMENT 3: Plants are good for you

This experiment was similar to the previous experiment, except that the text for this experiment was different and longer than that which was used in the second experiment, and the teacher did not conduct a lesson with the material. The subjects studied the material on their own. The expectation again was that the subjects would associate themselves in a positive manner with the modified pictures of the children and the consumer products in the pictures, and that this would increase the facilitating effect that pictures have when they are combined with instructional text.

3.3.7 The subjects for Experiment 3

The subjects who participated in the second experiment came from the same classes and school as the subjects that completed the first experiment. Sixty-six subjects used mainly Tswana and South Sotho as their mother tongue and forty-nine used Afrikaans, English and Chinese as their mother tongue. Fifty-six of the one hundred and fifteen subjects were male and fifty-nine were female. The difference between the male, female and language composition between the first experiment and the second experiment is due to different subjects that were absent during the days that the experiments were conducted. There was no change in the allocation of the classes to the control and experimental groups.

3.3.8 The materials for Experiment 3 (the text, pictures and questions)

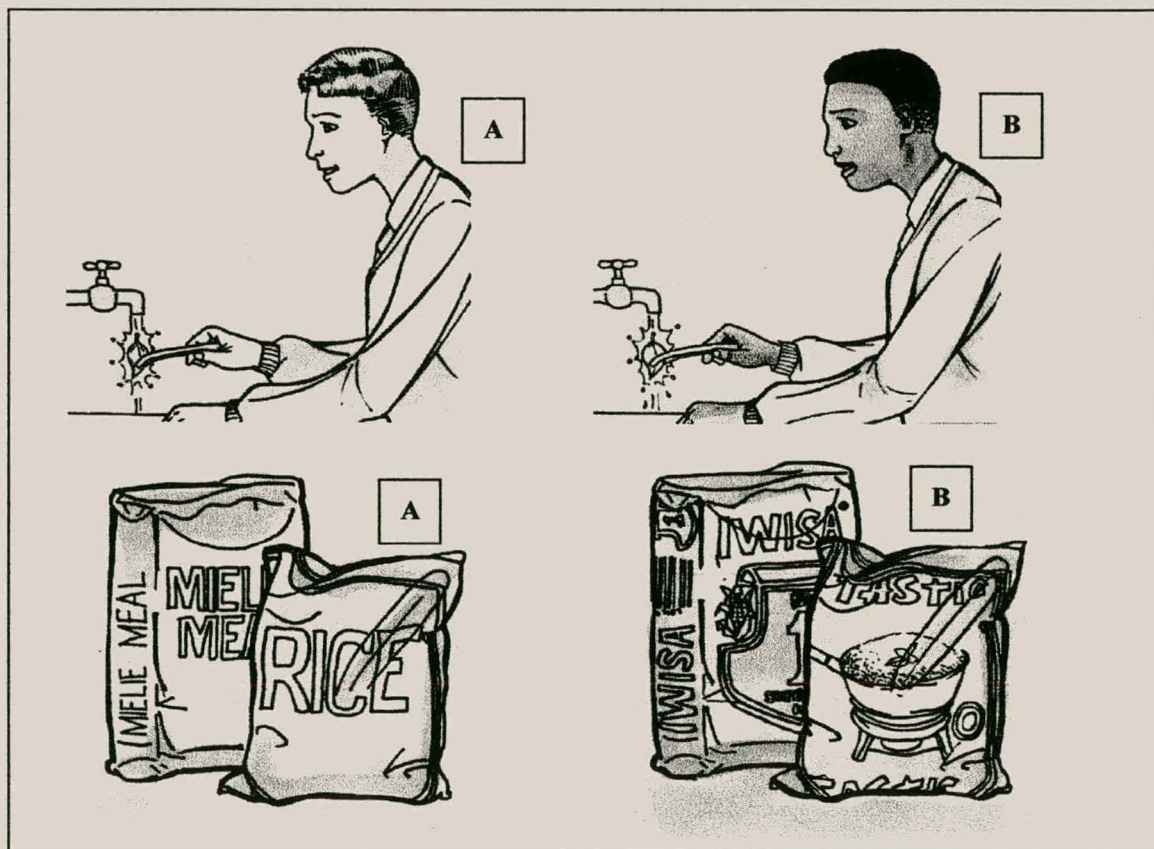
The text for the second experiment came from the same textbook as the first experiment (*Successful Science 4* by Press and Macgregor, 1992). The text was 709 words long and consisted of two units: *storing food* and *plants are good for you* (Units 5 and 6, pages 80 - 83). The readability statistics reported by Microsoft's Word for Windows was 89.8 percent for the Flesch Reading Ease, and 2.3 for the Flesch-Kincaid Grade level. The score of 2.3 for the Flesch-Kincaid Grade level is lower than the score of 4.9 of the previous experiment and should not pose a problem for Grade 6 children. The first unit discussed how plants store food and where plants store food, and described a seven-step experiment to test whether there is starch in a leaf. The second unit discussed nutrients in plants, starch, carbohydrates, fats, proteins and the importance of a balanced diet. A copy of some of the original material (text and pictures) from which the experimental

material for Experiment 3 was developed is given in a reduced format in Addendum 3.12 (Press and Macgregor, 1992:81) at the end of Chapter 3 (p. 257).

Three versions of the test material were developed: one with just the text, one with text and pictures, and one with modified pictures and text. These modified pictures reflected the physical features of the subjects in the school and popular branded consumer products. The picture next to a text section on starch, for example, was of a drawing of two packets, one with “rice” and the other with “mealie meal” written on the front of the packet. The modified picture was a drawing of packets of popular brands of rice and mealie meal. Pictures with the seven steps on how to test for starch used a child with Caucasian features as a model, while the modified pictures used an African child. Examples of these two pictures are given in Plate 3.4. The illustration style of the pictures was the same as that which was used for the previous experiment. Examples of all the pictures are given in a reduced format in Addendum 3.13 at the end of Chapter 3 (p. 258-259).

PLATE 3.4

An example of two original pictures and two modified pictures that were used in Experiment 3. A = Original (unmodified), B = Modified.



The text was again set in 12 points *Times Roman* with 3-point line spacing, except that the line length was now shorter as it did not exceed 100 millimetres. The pictures were placed next to the text. There was no difference in the text layout for the control group and the 2 experimental groups, except that the material for the experimental groups used 5 pages and the material for the control group used 4 pages. The extra page for the experimental groups was to accommodate the extra vertical space required by the pictures.

Seven questions required the subjects to give short one- or two-word answers, and one question (the third question) asked the subjects to write down the steps that they would use in an experiment to test for starch in a leaf. All the questions were based on the text. There was a picture next to each section of text on which the questions were based. Subjects could score a maximum of 18 marks.

A copy of the experimental material and the post-test questions that were used by the control group and the two experimental groups is given in Addenda 3.14 – 3.17 at the end of Chapter 3 (p. 260-275).

3.3.9 The experimental design and procedure of Experiment 3

The second experiment used the same experimental design as the first experiment. One experimental group received the text with unmodified pictures, the second experimental group received the text with the modified pictures, and the control group received the text-only material.

The experiment was conducted during normal class hours at the school and in the classroom where the subjects receive their normal Science lessons. The subjects received the learning material, placed upside down on their desks, at the beginning of a 30-minute period. Their Science teacher asked the subjects to turn the paper around and to study the material for the rest of the period.

The subjects had approximately 25 minutes to study the material. The two experimental groups were again specifically instructed to look at the pictures. The three groups received the material on the same morning and wrote an unannounced 25-minute recall test the next day. The recall test consisted of eight questions. Seven questions tested recall and required the subjects to write down one- or two-word answers (11 marks). One question (Question 3) required the subjects to write down the steps that they would

use in an experiment to test whether there is starch in a leaf (7 marks). Spelling and grammatical errors were ignored.

3.3.10 The results and a discussion of the results of Experiment 3

The data were analysed using a single factor Analysis of Variance (ANOVA). A comparison was made between the mean recall scores of the control group and the two experimental groups; for all the questions; for the seven questions that required one- and two-word answers; and for Question 3 (how to test for starch). This was followed by a post hoc analysis to determine which of the means were significantly different from the others. The results are given in Table 3.3 (p. 144) and graphically illustrated in Figure 3.2 (p. 145). A post-hoc analysis (Tukey's HSD test) was only performed on the data if the ANOVA test found a significant difference between the mean scores of the three groups.

There was a significant difference between the mean scores of the text-only, the picture-text condition, and the modified picture-text condition for all the question, $F(2, 112; = 0.05) = 3.07 < 5.206$, $p = 0.007$. Tukey's HSD test showed that it was only the modified picture group who scored significantly better than the text-only group (modified picture group, $p = 0.0054$).

There was a significant difference between the mean scores of the text-only condition, the picture-text condition, and the modified picture-text condition for Question 3 (the seven steps on how to test for starch), $F(2, 112; = 0.05) = 3.07 < 9.3$, $p = 0.00018$. Tukey's HSD test showed that both groups that received the pictures with their text scored significantly better than the text-only group (unmodified picture group, $p = 0.047$; modified picture group, $p = 0.00024$).

The difference between the mean scores for the three groups for all the questions is, as in the previous experiment, due to the mean differences of Question 3, in this case the seven steps on how to test for starch in a leaf. The text-only group scored a mean of 2.45 whilst the picture-text group and the modified picture-text group scored 3.56 and 4.39 respectively. This translates into a 15 percent increase for the picture-text group and a 27 percent increase for the modified picture-text group over the control group. The two groups that received pictures with the text were able to recall the seven steps on how to test for starch in a leaf better than the group that received a text-only version. The group that received the modified pictures scored significantly higher than the group that received the unmodified pictures.

TABLE 3.3

Means and standard deviations of the subjects' recall scores
by condition and by questions (Experiment 3).

QUESTIONS	CONDITION								
	Text only			Pictures and text			Modified pictures and text		
	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	<i>x</i>	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	40	8.76	4.1	37	10.16	3.48	38	11.53	3.75
Questions 1-2 & 4-8	40	6.31	2.51	37	6.59	2.38	38	7.14	2.50
Question 3	40	2.45	2.33	37	3.56	1.89	38	4.39	1.7

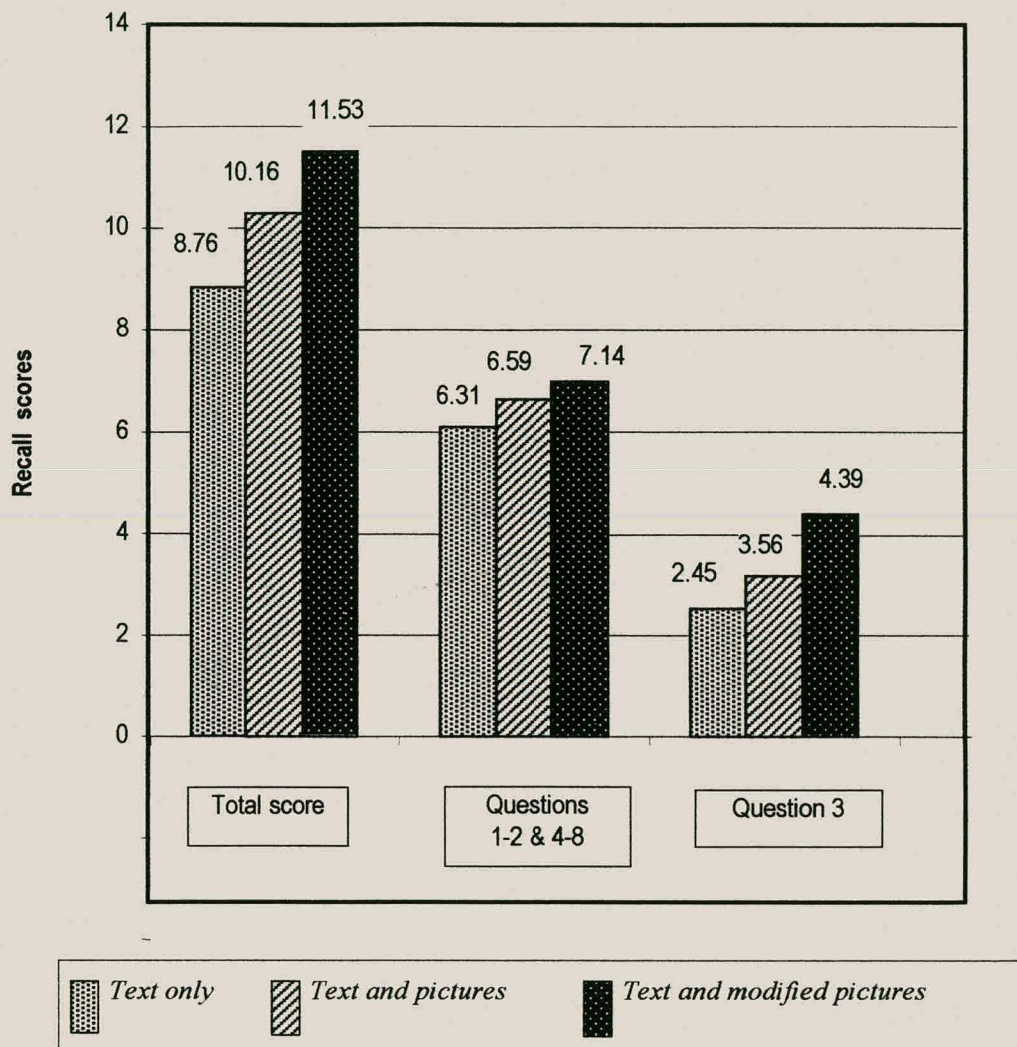
TABLE 3.4

Effect size (ES) of the picture-text and modified picture-text conditions (Experiment 3).

Sample	CONDITION			
	Pictures and text		Modified pictures and text	
	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	37	0.34	38	0.67
Questions 1-2 & 4-8	37	0.11	38	0.33
Question 3	37	0.47	38	0.83

FIGURE 3.2

A graphic representation of the mean recall scores of the subjects by condition (Experiment 3).



The difference between the mean scores for the three groups for all the questions is due to the mean differences of Question 3 (the 7 steps on how to test for starch). There was no difference between the three groups when the mean scores of the other eight questions were compared with each other; $p = 0.32$.

Effect size

The effect sizes (ES) are given in Table 3.4 (p. 144). The effect sizes of the picture-text condition and the modified picture-text condition for all the questions are 0.34 and 0.67, and for Question 3 they are 0.47 and 0.83 respectively. The effect sizes for the modified versions are similar to the sizes obtained in the first experiment.

The research hypothesis that modified pictures can increase the picture facilitating effect is not rejected when compared to the text-only version, and is rejected in favour of the alternative hypothesis when compared to the unmodified picture version.

3.3.11 The conclusion of Experiments 2 and 3

The aim of these two experiments was to determine if pictures, in picture-text learning material, which are modified for the learners, could increase their recall of the information that is presented in the learning material. This modification process is a process whereby the pictures are changed to reflect the physical features of the learners, the consumer products that the learners use and the clothes that the learners wear.

The mean recall scores of the subjects in the two experiments increased significantly when representational pictures (pictures that represent information in the text) were added to the text. This increase was for the modified picture group as well as for the unmodified picture group. Subjects who received modified picture-text material in the first experiment (electricity) did not obtain a mean score that was significantly higher than the mean scores of subjects who received the picture-text material. The subjects in the second experiment who received modified picture-text material (food and how to test for starch) obtained a mean score that was significantly higher than the mean scores of subjects who received the picture-text material.

Modified pictures did increase the picture facilitating effect, but only in the second experiment and only for a question that required the subjects to recall steps of a scientific procedure. This facilitation effect was due to a long question where the subjects had to write down seven steps on how to test for starch in a leaf. The difference in the outcome of the two experiments requires further discussion. The text in the second experiment was double the length of the text in the first experiment, and the teacher did not conduct a lesson with the material in the second experiment. The subjects were more dependent on the text and pictures, and could not rely on the teacher to assist them as they had done in the first experiment. Dwyer (1979:23), reporting on the results of research over a period of 10 years, involving more than 12000 students, found that oral instruction combined with printed instruction without visualisation is just as effective as printed instruction with pictures. The verbal instruction of the teacher could possibly account for a lower picture effect in the first experiment. The second experiment was also not independent of the first experiment, as it used the same subjects, type of material and testing method. The first experiment could have influenced the subjects in the second

experiment to pay more attention to the material and pictures in anticipation of a test the next day.

Hugo (1997:272) proposed a model whereby a particular health education programme or health learning materials can be evaluated and rated from poor, average and above average to excellent. This model uses a scale of one to five for appropriate media usage on an x-axis and the same scale for sociocultural sensitivity on a y-axis. The five variations of the 5-point sociocultural sensitivity scale are:

- * A programme with a broad focus on the community.
- * A programme that is focused on different target groups with different characteristics.
- * A programme that attends partially to the sociocultural differences of different target groups.
- * A programme that reflects the general sociocultural characteristics of a specific target group.
- * A programme reflecting the essential sociocultural characteristics and factors of a specific target group.

Such a model could be useful in a formative process when the results of these experiments are evaluated and explained. In this case, Hugo's "appropriate media usage" on the x-axis is, however, not appropriate, as the material for all the experiments is printed material. The media for this study is consequently a variable without change and cannot similarly be rated on a scale. Rating the pictures and the text on a readability scale from easy to difficult is, however, possible. Replacing the appropriate media usage scale on the x-axis with the actual results of each experiment should make it possible to position the level of sociocultural sensitivity of each picture at a certain level of facilitation.

Hugo's model, the proposed changed model, and an analysis of the pictures with the aid of the changed model, are given and fully discussed in Chapter 4.

The positive results of the last experiment could be explained in terms of the cue summation theory where pictures are regarded as a cue and therefore contribute to the reading material's stimuli. It is known that verbal and graphic cues contribute to the picture facilitating effect (Lamberski and Dwyer, 1983; Mayer, 1989; and Peeck, 1994). Pictures that are culturally modified to make them more acceptable might be regarded as a cue that could possibly assist subjects to recall procedural steps as presented by such pictures and the corresponding text.

3.3.12 A summary of Experiment 3

One hundred and fifteen Grade 6 subjects with a mean age of 12 years, and divided into three groups, participated in a post-test control group research design. One group received text-only learning material, the second group received picture-text material and the last group received modified picture-text material. The text consisted of 709 words on storing food and how to test for starch in a leaf. There were 14 representational pictures in each of the modified picture-text and picture-text materials. Both groups that received pictures with the text scored significantly higher with a recall test than the text-only group. The group that received the modified pictures scored significantly higher than the group that received the unmodified pictures. Modified pictures in picture-text material increased the picture facilitating effect when compared to the same experimental material containing unmodified pictures.

3.4 EXPERIMENT 4: Plants are good for you: a variation of Experiment 3

3.4.1 Introductory comments

This experiment used the same material that was used for the control group and for the modified picture-text group in Experiment 3. There were, however, changes in the pictures for the unmodified picture-text group and changes in the evaluation procedures. The subjects for this experiment were from a different school, but came from a similar socio-economic background to the subjects that were used in Experiments 2 and 3. This experiment also determined the subjects' preference for a particular picture in the learning material. The pictures of children with Caucasian features in one set of the experimental material (unmodified material) were changed to pictures of Chinese children, dressed in traditional Chinese clothing.

The aims of this experiment were to determine if modified pictures would have a positive outcome on the subjects' recall ability, to pilot a preference testing method, to test the viability of a shorter learning and testing time, and to pilot a delayed post-test. Shorter learning and testing times would make it easier to conduct an experiment at a school and would also make it easier to obtain permission from the school principal and the teacher concerned.

The delayed testing method would bring an added dimension to the study and would make it possible to explore a trend mentioned by Peeck (1989:269-275), who found a substantial relative increase in correct answers in a delayed testing procedure when the questions were based on the illustrations.

The expectation was that the subjects who received the modified version would perform better than subjects who received the text-only version and the unmodified version, and that the delayed testing would indicate results similar to those as indicated by Peeck (1989).

3.4.2 The subjects for Experiment 4

Twenty-seven Grade 6 subjects from a primary school in Bloemfontein, South Africa, participated in this experiment. The subjects were heterogeneous concerning their mother tongue. Three subjects used English, two used Afrikaans, ten used a combination of English and Tswana/South Sotho, nine used Tswana or South Sotho, and two used a combination of English and Afrikaans as their mother tongue. Two subjects were immigrants and used a Chinese language as their mother tongue. The subjects had a mean age of 11.3 years and ranged between 11 and 13 years of age. One subject was 10 years old. These subjects came from similar socio-economic backgrounds to those subjects who were used in Experiments 2 and 3.

The conditions and infrastructure of the two schools whose pupils participated in the previous two experiments, and those that participated in this experiment were comparable. The only variables that were expected to change the results of this experiment, when compared to the previous experiments, were the testing methods and the time allocated to the studying and completion of the questionnaire.

The subjects were divided into three groups with similar academic abilities. This division was based on their position in the class and by using random numbers. The teacher provided the researcher with each student's average marks in English and Science as well as their position in the class. There was a positive correlation ($r = +0.51$) between the subjects' English mark and their position in the class and a high positive correlation ($r = +0.89$) between their Science mark and their position in the class. This high positive correlation between their Science mark and their position in the class was the motivation to use their position in the class as a basis to randomly allocate the subjects to one of the three groups because the test material was of a scientific nature. The subjects' position in the class was regarded as a better criteria for selecting three equivalent groups than just

their Science mark, as their position in the class was moderated by the other academic skills and could possibly provide a better rating of the student than just an English or a Science mark. A set of random numbers was used to allocate the first three subjects to either the control group or one of the experimental groups. This procedure was repeated with the next three subjects until all the subjects had been allocated to a group.

These three groups were then randomly designated as the control group, experimental group one or experimental group two. The mean Science mark for the three groups was 56 percent, 55.2 percent and 52.7 percent respectively. These means are not statistically different from each other $F(2, 24; 0.05) = 0.044 < 3.402, p = 0.95$.

Randomly dividing subjects into groups is a procedure whereby bias is removed in allocating a subject to a group. The underlying assumption is that this randomisation process will provide comparable groups and that the results of the dependent variable in an experiment emanate from the independent variable that is being manipulated - that is, of course, if all other external variables are constant and are controlled. It is, however, also logical that small convenience samples, as in the case of Experiment 4, can, even with a randomisation process, produce groups with differing abilities, which in turn will affect the outcome of an experiment. It is for these reasons that the researcher decided to use the above-mentioned procedure to divide the subjects into three groups with similar academic abilities.

3.4.3 The material for Experiment 4 (the text, pictures and questions)

The text for this experiment was the same as that which was used in Experiment 3 (*Successful Science 4* by Press and Macgregor, 1992:80-83). The text was 709 words long and consisted of two units: *storing food* and *plants are good for you* (Units 5 and 6, pages 80 - 83).

A copy of some of the original material (text and pictures) from which the experimental material for this experiment was developed, is given at the end of this chapter in Addendum 3.12 (p. 257).

Three versions of the test material were developed: one with just the text, one with text and pictures, and one with modified pictures and text. These pictures and the layout were the same as those in Experiment 3 except that the pictures of the Caucasian in experiment three were substituted with pictures of Chinese children. The pictures of the consumer products, for example the sweets and rice were used unchanged from Experiment 3. An example of the pictures of Chinese children, which substituted the

Caucasian children in this experiment, is given in Plate 3.5. The questions were the same as those used in Experiment 3.

Examples of all the pictures are given in a reduced format at the end of this chapter in Addendum 3.18 (p. 276-277). The test material with unmodified pictures that was used for the first experimental group is given at the end of this chapter in Addendum 3.19 (p. 278-282). The test material that was used for the control group, the test material with the modified pictures and the questions are the same as those that were used in Experiment 3. These items are given at the end of this chapter in Addenda 3.14 – 3.17 (p. 260-275).

PLATE 3.5

An example of the pictures of the children that were used in Experiment 4.

Pictures of Chinese children substituted for the pictures of Caucasian children that were used in the same material in Experiment 3.

A = Examples of the type of pictures that were used in the unmodified experimental material.

B = Examples of the type of pictures that were used in the modified experimental material.



3.4.4 The research design and procedure of Experiment 4

The experiment used the same research design as Experiment 2 and Experiment 3. One experimental group received the text with unmodified pictures, the other experimental group received the text with the modified pictures, and the control group received the text-only material.

The experiment was again conducted during normal class hours at the school and in the classroom where the subjects receive their normal Science lessons. The researcher explained the research project to the subjects and informed them that they would be writing a test directly after having read the material. A verbal instruction was given that those who received pictures with their text must look at the pictures. The subjects received only 15 minutes instead of 25 minutes to study the material and 15 minutes instead of 25 minutes to answer the seven questions. The subjects participated voluntarily in the experiment. They were informed that their results would not be used for or against them. The subjects were also informed that they would receive a sweet as a token of appreciation for their participation seven days later; that they would receive their results, and that they would be asked to indicate their preference for one of two versions of the learning materials. They were not told that they would have to write a second recall test.

The researcher visited the class seven days later and asked the subjects if they were prepared to write a last test based on the material that they had studied the previous week. The subjects agreed and each received a blank sheet of paper. They were then asked to write down the steps used to test for starch in a leaf. The subjects were given approximately ten minutes to write down their answers. Their answer sheets were collected and replaced with an A3 sheet of paper on which page four of the two experimental groups' material was duplicated. The left-hand side contained the modified version and the right-hand side contained the version with Chinese children in the pictures. The subjects were asked to indicate on the paper which version they preferred or liked and had to provide a possible reason for their choice. They were also requested to write comments on the sheet, relating to whether they liked the illustrations, how they would like to change the illustrations or if they had difficulty in understanding the illustrations.

The subjects were given ten minutes to write down their comments. The A3 sheets were collected and the subjects were thanked for their participation. The teacher received a small piece of chocolate for each child, which she then gave to the subjects during their break.

3.4.5 The results of Experiment 4

The data were analysed using a single factor Analysis of Variance (ANOVA). A comparison was made between the mean recall scores of the control group and those of the two experimental groups.

The mean scores of the three groups were 14.2, 14.44 and 14.12 respectively. There was no significant difference between the mean scores of the text-only condition, the picture-text condition, and the modified picture-text condition $F(2, 24; 0.05) = 0.037 < 3.40$, $p = 0.96$.

There was, however, only a significant difference when the differences between the mean scores of Question 3 in the immediate recall test and the mean scores of Question 3 in the delayed recall test were compared with each other $F(2, 24; 0.05) = 4.58 > 3.40$, $p = 0.02$. The two groups that received the picture-text versions scored only 0.22 and 0.5 respectively less in their delayed post-test, whilst the group that received the text-only version scored 2.0 less in their delayed test. Tukey's test showed that the unmodified picture group forgot significantly less than the text-only group ($p = 0.03$) and that the modified picture group also forgot significantly less than the text-only group ($p = 0.095$).

The null hypothesis that there is no difference between text-only, modified pictures and text, and unmodified pictures and text learning material, is rejected in favour of the alternative hypothesis that there is a difference but only for the differences between the immediate and delayed post-test scores of Question 3.

The results are given in Table 3.5 (p. 154), Table 3.6 (p. 154) and graphically illustrated in Figure 3.3 (p. 155).

3.4.6 The results of the subjects' preference for the pictures in Experiment 4

Each subject wrote his or her comments on the A3 sheet of paper next to a picture or in an open space on the paper. The comments on a sheet ranged from one short sentence to a comprehensive comment with each picture. The summary below contains either one or more comments per individual or several sentences of a subject synthesised into one comment.

TABLE 3.5

Means and standard deviations of the subjects' recall scores by condition and by questions (Experiment 4).

QUESTIONS	CONDITION								
	Text only			Pictures and text			Modified pictures and text		
	<i>N</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{X}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	10	14.2	3.08	9	14.44	1.74	8	14.13	2.64
Question 3 Immediate post-test	10	5	1.09	9	5.11	1.27	8	5.38	2.2
Question 3 Delayed post-test	10	3	1.76	9	4.89	1.69	8	4.88	2.42
Question 3 Difference between the immediate and the delayed tests	10	-2	1.63	9	-0.22	1.56	8	-0.5	0.53

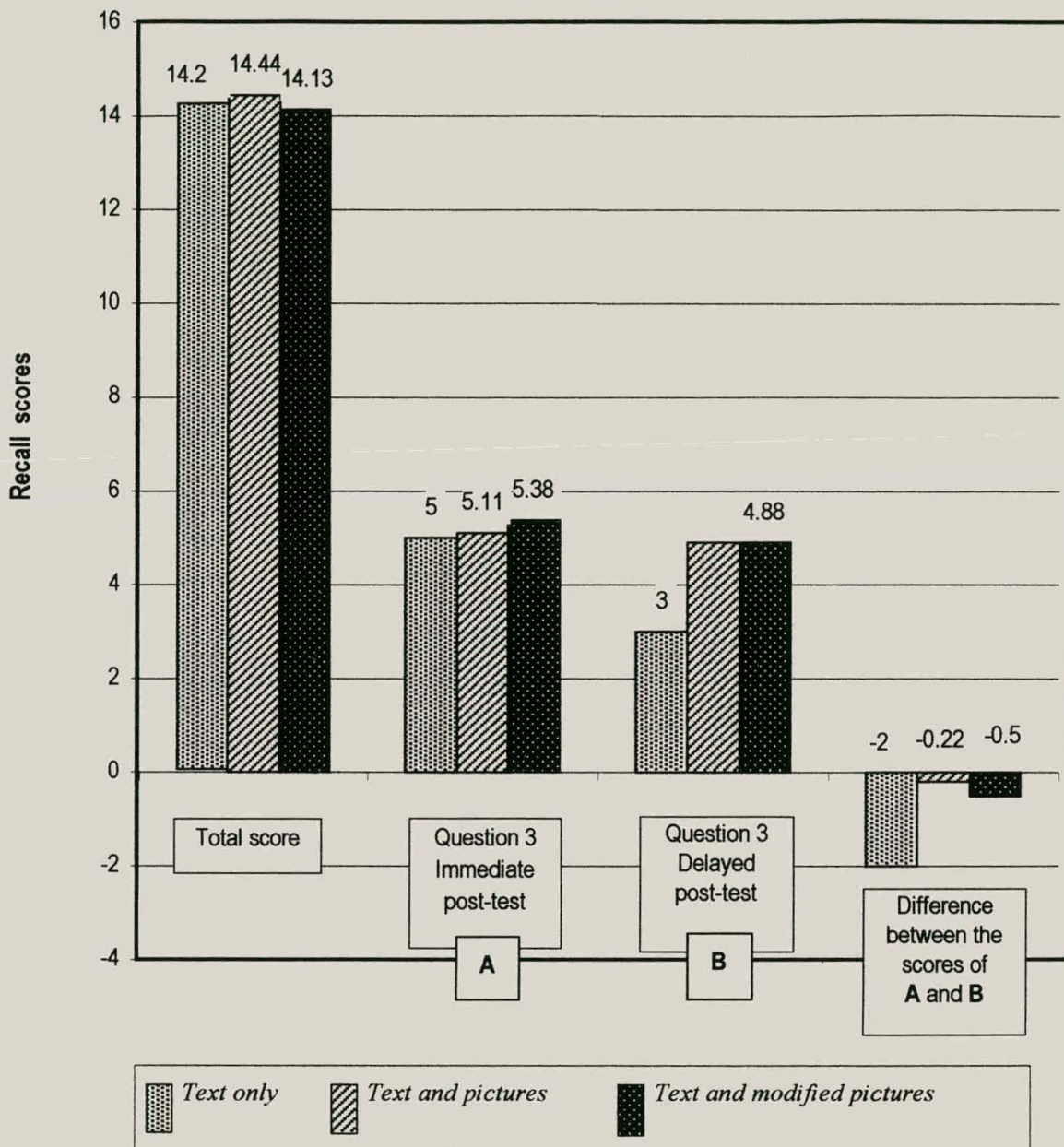
TABLE 3.6

Effect size (ES) of the picture-text and modified picture-text conditions (Experiment 4).

Sample	CONDITION			
	Pictures and text		Modified pictures and text	
	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	9	0.077	8	-0.02
Question 3. Immediate post-test	9	0.10	8	0.34
Question 3. Delayed post-test	9	1.07	8	1.06
Question 3. Difference between the immediate and the delayed tests	9	1.36	8	1.54

FIGURE 3.3

A graphic representation of the mean recall scores of the subjects by condition
(Experiment 4).



The following is a descriptive summary of the comments:

- * Nine subjects made comments to the effect that they have no preference, that they like both sets; that the pictures are the same or look similar; that it does not matter which picture is used.

- * Eight subjects commented on the “*unhappy*”, “*scared*”, “*surprised*”, “*sad*” and “*worried*” expression on the face of the African boy and also that the boy was not smiling.
- * Eight subjects stated that they preferred or liked the pictures of the Chinese children as they looked “*happy*”, they were “*smiling*” and because the boy was “*sure*” of what he was doing.
- * Two subjects did not like the facial expression of the Chinese boy and stated that they did not like the “*grin*” on his face and that the child looked “*ugly*”. The “*ugly*” comment came from one of the Chinese children in the class.
- * One subject commented on the expressions on the faces of all the children in the pictures.
- * Four subjects commented positively on the clothes that the Chinese children were wearing.
- * One person did not like the Chinese boy, in the picture because he was wearing a hat and the subjects are not allowed to wear a hat in the classroom.
- * Two subjects commented positively on the clothes of the African child.
- * One subject commented negatively on the clothes of the African child.
- * Two subjects did not like any of the pictures and wanted more “interesting” pictures.
- * One subject commented on the activities depicted in the pictures.
- * One subject stated that he liked the pictures of Chinese children as “... *it shows that we are al so inviting other nations*” (*sic*).
- * One subject preferred the pictures of Chinese children because “... *you can see that a schoolboy is doing it ...*”

- * One subject felt that that the hand pouring the iodine on the leaf in the first set was too dark.

The proportion of preferences for the modified pictures was 26 percent. The proportion of preferences for the unmodified pictures was 74 percent which was significantly higher at 0.05 than the proportion of dislikes for the pictures ($Z_{0.05} = 2.06 > 1.645$). The null hypothesis of equal preference for the modified and unmodified pictures is rejected in favour of the alternative hypothesis.

The cumulative preferences and dislikes for the modified and the unmodified pictures are graphically illustrated in Figure 3.4. The number of preferences, equal preference and dislikes per picture are given in Table 3.7 (p. 158).

FIGURE 3.4

A graphic representation of the cumulative preferences and dislikes for the modified and the unmodified pictures (Experiment 4).

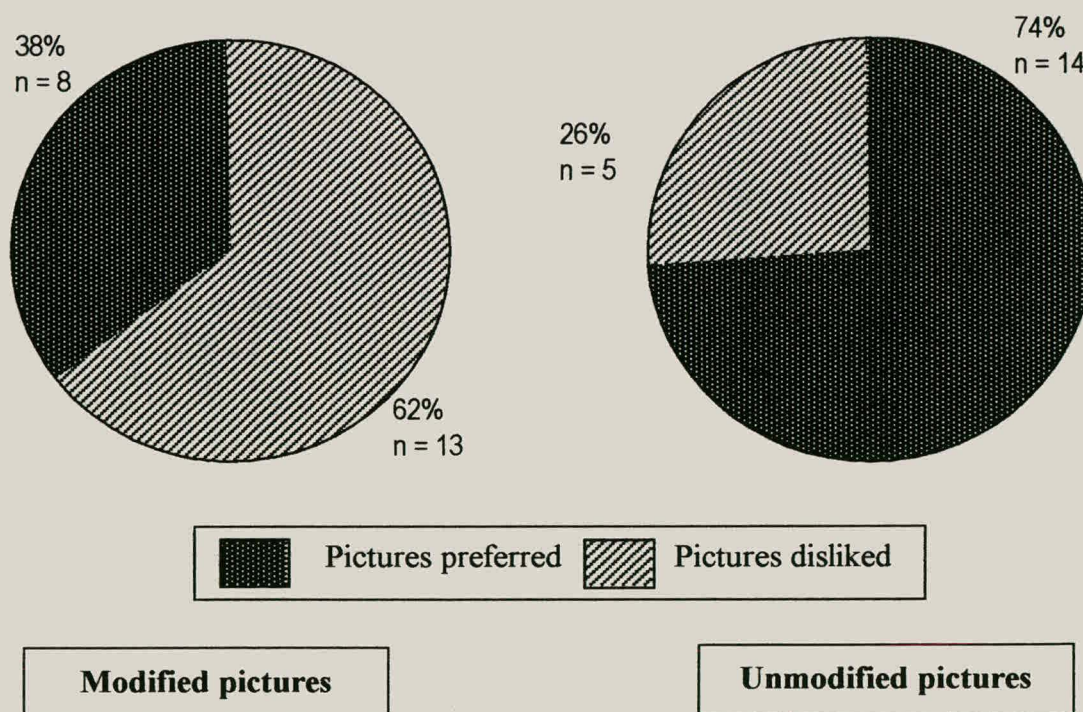


TABLE 3.7

Number of times that a subject indicated his or her preference or dislike for a particular picture (Experiment 4).

	Preference	Dislike	Equal preference
	6	3	8
	6	3	8
	2	10	8
	8	2	8
		1	15
			15

3.4.7 A discussion of the results of Experiment 4

Comparison of the means

The non-facilitating effect of the picture-text versions when compared to the text-only version was not expected. A discussion with the teacher revealed that the subjects had covered a similar module earlier in the term. This is a possible explanation for the relatively high mean scores of the three groups. The mean scores of these three groups range from 14.1 to 14.4, whilst the mean scores of the previous experiment ranged between 8.8 and 11.5 for the same questions. A picture facilitating effect is not possible if subjects have a high prior knowledge and if the subject matter is easy to understand (Levin *et al.*, 1987; Mayer, 1993; Peeck, 1993). The notice given of the immediate post-test and the delayed post-test is a procedure that was different from the procedures of Experiments 2 and 3. This invariably affected the results when the results of this experiment are compared with the results of Experiments 2 and 3. The groups' prior knowledge of the subject is a possible explanation for the ceiling effect of this experiment.

The differences between the mean scores of the delayed post-test and the immediate post-test were, however, statistically significant. The group that received the text-only version scored on average 2 points less, which is 40 percent lower than their immediate post-test. The group that received the modified version scored 0.5 points less which is 9 percent lower than in their immediate post-test and the group that received the unmodified version scored 0.22 points less, which is 4 percent lower than their immediate post-test. The two picture groups were therefore able to retain more information over a period of seven days, or if phrased differently, forgot less when compared to the text-only group. The results of the differences between the immediate and delayed post-test seem to support the earlier findings of Peeck (1989), who found that there was a substantial relative increase in correct answers in a delayed testing procedure when the questions were based on the illustrations.

These data support only part of the experimental hypothesis and only when the differences between the immediate and delayed post-tests are compared with each other.

The subjects' preferences.

Nineteen comments were about the facial expressions of the children, eight comments about the children's apparel, two comments about the aesthetic value of the pictures (more interesting pictures) and five comments about other matters. Nine subjects indicated through their comments that they did not have a particular preference for the African-child version or the Chinese-child version of the experimental reading material. It appears that the expressions on the children's faces in the pictures, and then the clothing

of the children in the pictures were the main factors that determined the subjects' comments and their indicated preferences. The significant proportion of subjects who preferred the unmodified pictures was also against expectations. The small sample size, the heterogeneous sample and the limited amount of pictures could have contributed to this result.

3.4.8 Concluding remarks on Experiment 4

The aim of this experiment was to determine if the modified picture would have a positive outcome on the subjects' recall ability, to pilot a preference testing method, to test the viability of a shorter learning and testing time, and to pilot a delayed post-test.

The modified pictures did not facilitate recall of information that was presented in the text when compared to the text-only or the unmodified picture-text group. Both groups, however, which received pictures with the text, were able to retain significantly more information than the text-only group, but only when the scores of Question 3 were compared with each other. The answer for Question 3 is the seven steps on how to test for starch.

The preference testing method was not entirely satisfactory. The subjects did not comment on all the pictures and they were not forced to make a definite choice between modified and unmodified pictures.

The shorter learning and testing times did not appear to affect the outcome of this experiment and were regarded as adequate.

The delayed post-test indicated a trend, namely that pictures could assist a learner to remember more information from instructional text (or forget relatively less) over a period of time, than a similar learner who does not use pictures with the same instructional material.

There are several possible explanations for the non-significant effect between the modified picture-text, the unmodified picture-text and the text-only groups. The subjects who received the text versions were possibly able to read the text several times. The repetition effect of reading a text several times could possibly have had the same learning effect as reading the text-picture material once or twice. There were also subjects in this experiment who were from different cultural backgrounds, including two Chinese subjects. Opposing individual results, due to a heterogeneous sample, could have had a

neutralising effect on the possible positive effect of the modified pictures. There was, however, a significant difference between the immediate and the delayed post-tests. This points in the same direction as the results of Peeck (1989) who found that the superiority effect of pictures is more pronounced in a delayed recall test than in an immediate recall test. The picture superiority effect in a delayed test when compared to an immediate test could possibly be explained in terms of a combination of differential forgetting rates for pictures when compared to text, that pictures are better remembered than words (Kobayashi, 1985 and 1986) and the dual-coding theory (as discussed in Section 2.8, p. 91).

The shorter learning and testing times did not create an obstacle during the experiment. The subjects were able to complete the learning material and the answers in the allotted times. The delayed post-test showed an important trend, namely that the learning effect of pictures could, when compared to a text-only version of learning material, be more noticeable after a few days. The method of testing the subjects' preferences was limited, as the subjects only compared two pairs of pictures. Their comments were valuable, as they hinted that other variables, namely facial expressions and type of clothing, are important in such learning material.

3.4.9 A summary of Experiment 4

Twenty-eight Grade 6 subjects with a mean age of 11.6 years, randomly divided into three groups with equal ability, participated in a post-test control group experimental design. One group received text-only learning material, the second group received picture-text material, and the last group received modified picture-text material. The text consisted of 709 words on storing food and how to test for starch in a leaf. There were 14 representational pictures in each of the modified picture-text and picture-text materials. The two groups that received pictures with the text did not score significantly higher with a recall test than the text-only group when all the questions were compared with each other. The modified picture group did not perform better than the unmodified picture group. The two picture-text groups, however, forgot significantly less when the differences between the immediate and the delay recall tests on Question 3 (how to test for starch in a leaf) were compared with each other. There was no significant preference for the modified pictures by the subjects. Small details in the pictures, namely the facial expressions of the children and their clothing appear to have attracted the subjects' attention.

3.5 EXPERIMENT 5: Plants are good for you

3.5.1 Introductory comments

This experiment is similar to Experiment 4, except that it used subjects from a developing community. The school was situated in a peri-urban area. This experiment also tested the subjects' preference with a wider range of pictures. Four illustrations were used to test the subjects' preference in Experiment 3, while twelve illustrations were used in this experiment.

The aims of this experiment, in addition to determining whether culturally modified pictures will assist the learning process, were to test a more comprehensive preference testing method where more pictures are used, and to test the materials, methods and questions with subjects from a developing community.

The expectation was that the subjects who received the modified version would perform better than subjects who received the text-only version and the unmodified version, that the subjects would prefer the modified pictures to the unmodified pictures, and that the delayed testing would indicate results similar to those as indicated by Peeck (1989). It was also expected that the majority of the subjects would prefer the modified pictures above the unmodified pictures.

3.5.2 The subjects for Experiment 5

Fifty Grade 6 subjects from a primary school situated in a peri-urban area in Bloemfontein, South Africa, participated in this experiment. The subjects were more homogeneous in their mother tongues and cultural backgrounds than any of the samples that had participated in previous experiments. Three subjects used Xhosa, three used Tswana and forty-four subjects used Sesotho as their mother tongue. The subjects had a mean age of 12.9 years and ranged between 11 and 16 years of age. The subjects for this experiment came from a lower socio-economic background if compared to the backgrounds of the subjects who had participated in the previous experiments.

The subjects were divided into three groups with similar academic abilities. This division was based on their position in the class and by using random numbers. There was, as in the previous experiment, also a positive correlation ($r = +0.82$) between their Science

mark and their position in the class. The mean Science marks for the three groups were 50.4 percent, 52.2 percent and 46.5 percent respectively. These means were not statistically different from each other $F(2, 48; 0.05) = 0.501 < 3.19$, $p = 0.608$. The mean Science marks for the three groups were obtained by using all fifty subjects on the class list. One subject was absent during the experiment and another subject was absent when the delayed post-test was conducted.

3.5.3 The material for Experiment 5 (the text, pictures and questions)

The text for this experiment was the same as that used in Experiment 3 and Experiment 4 (*Successful Science 4* by Press and Macgregor, 1992). The text was 709 words long and consisted of two units: *storing food* and *plants are good for you* (Units 5 and 6, pages 80 - 83).

Three versions of the test material were developed: one with just the text, one with text and pictures, and one with modified pictures and text. These pictures and the layout were the same as those used in Experiment 4. An example of a picture of a Chinese child, which substituted for the European children in this experiment, is given in Plate 3.5 (p. 151) in the previous section. The questions were the same as those used in Experiment 4. The test material that was used for the control group, the modified picture-text material and the questions are given in Addenda 3.14, 3.16 and 3.17 (p. 260-263, 269-273, 274-275) at the end of Chapter 3. All the pictures that were used in this experiment are given in Addendum 3.18 (p. 276-277) at the end of Chapter 3. The unmodified picture-text material is given in Addendum 3.19 (p. 278-282) at the end of Chapter 3.

3.5.4 The experimental design and procedure of Experiment 5

The experiment used the same experimental design that was used in Experiment 4. One experimental group received the text with unmodified pictures, the other experimental group received the text with the modified pictures, and the control group received the text-only material.

The experiment was again conducted during normal class hours at the school and in the classroom where the subjects receive their normal Science lessons. The researcher explained the research project to the subjects and warned them that they would be writing a test directly after having read the material. A verbal instruction was given that

those who received pictures with their text must make use of the pictures. The subjects received 20 minutes to study the material and 20 minutes to answer the seven questions. The subjects in the previous experiment had received 15 minutes to study the material and 15 minutes to write the answers down. The extra 5 minutes were given since it was anticipated that the subjects would have more difficulty with the English language, as this is not their mother tongue. The subjects participated voluntarily in the experiment. They were informed that their results would not be used for or against them. The subjects were also informed that they would receive a sweet 7 days later, that they would obtain their results, and that they would be asked to indicate their preference for one of two versions of the learning materials. They were not told that they would have to write a second recall test.

The subjects received a blank sheet of paper 7 days later. They were then asked to write down how they would test for starch. They were given approximately 15 minutes to write down their answer. Their answer sheets were collected and replaced with an A3 sheet of paper. This sheet of paper contained six sets of pictures, with two pictures per set. Three sets contained pictures of consumer products and three sets contained pictures of children. These pictures are given in a reduced format in Table 3.11 (p. 169-170). The subjects were asked to indicate on the paper which pictures they preferred or disliked and were encouraged to provide a possible reason for their choice. The subjects took approximately 30 minutes to write down their comments. The A3 sheets were then collected and the subjects were thanked for their participation. The teacher received one sweet for each child, which she then gave to the subjects during their break.

3.5.5 The results of Experiment 5

The data were analysed using a single factor Analysis of Variance (ANOVA). A comparison was made between the mean recall scores of all the questions, between the mean recall scores of Question 3 in the immediate and delayed recall tests, and between the differences in the immediate and delayed post-tests of Question 3. Question 3 required the subjects to write down the steps that they must follow to test for starch in a leaf. The results are given in Table 3.8 (p. 165) and graphically illustrated in Figure 3.5 (p. 166). The effect sizes are given in Table 3.9 (p. 165).

TABLE 3.8

Means and standard deviations of the subjects' recall scores by condition and by questions (Experiment 5).

	CONDITION								
	Text only			Pictures and text			Modified pictures and text		
QUESTIONS	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{X}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	17	6.53	3.24	16	7.63	2.83	17	7.47	2.85
Question 3 Immediate post-test	17	1.59	1.46	16	3.06	1.61	17	2.94	1.85
Question 3 Delayed post-test	17	1.53	1.33	16	2.56	1.36	16	2.50	1.79
Question 3 Difference between the immediate and the delayed tests	17	-0.06	0.83	16	-0.50	1.63	16	-0.31	1.20

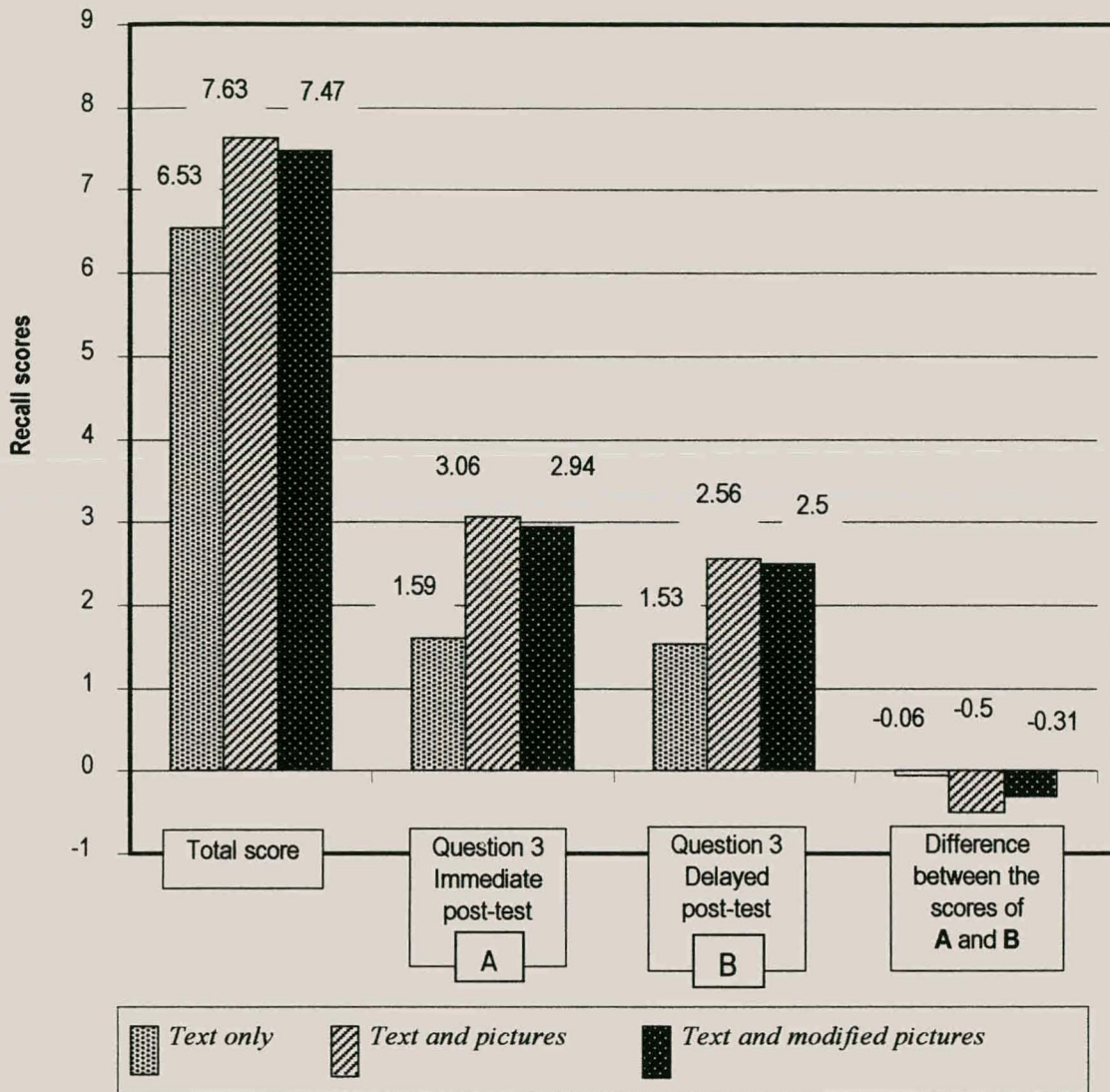
TABLE 3.9

Effect size (ES) of the picture-text and modified picture-text conditions (Experiment 5).

	CONDITION			
	Pictures and text		Modified pictures and text	
Sample	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	17	0.33	17	0.29
Question 3. Immediate post-test	17	1.00	17	0.92
Question 3. Delayed post-test	17	0.77	16	0.79
Question 3. Difference between the immediate and the delayed tests	17	-0.13	16	-0.44

FIGURE 3.5

A graphic representation of the mean recall scores of the subjects by condition (Experiment 5).



The three groups' mean scores were 6.53, 7.62 and 7.47 respectively. There was no significant difference between the mean scores of the text-only condition, the picture-text condition, and the modified picture-text condition $F(2, 47; 0.05) = 0.66 < 3.195$, $p = 0.52$. There was a difference between the mean scores of Question 3 in the immediate post-test $F(2, 47; 0.05) = 4.12 > 3.2$, $p = 0.022$. Tukey's test showed that the unmodified picture group performed significantly better than the text-only group ($p = 0.036$), and the modified group performed better than the text-only group ($p = 0.054$).

The difference between the mean scores of the immediate and delayed tests of Question 3 was not significant $F(2, 46; 0.05) = 0.515 < 3.2, p = 0.6$.

The null hypothesis that there is no difference between text-only, modified pictures and text and unmodified pictures and text learning material, is rejected in favour of the alternative hypothesis that there is a difference but only for the immediate and delayed post-test scores of Question 3.

3.5.6 The results of the subjects' preference for the pictures in Experiment 5

Each subject wrote his or her comments on the A3 sheet of paper alongside a picture. The difference between this experiment, when compared to the previous experiment, is that there were now two sets of six pictures (twelve in total) instead of eight pictures as in the previous experiment. Six pictures were modified pictures (branded products and pictures depicting an African child) with six corresponding unmodified pictures (no-name brand products and pictures of Chinese children). The subjects' comments were categorised either as a picture disliked, a picture preferred, or as a picture that is as equally preferred as its corresponding picture. Pictures that did not receive a comment were ignored. The cumulative preferences and dislikes regarding the modified and the unmodified pictures are given in Table 3.10 (p. 168) and graphically illustrated in Figure 3.6 (p. 168). The amount of preferences, equal preferences and dislikes per picture are given in Table 3.11 (p. 169-170).

There was a good distribution of dislikes and preferences for three of the six pictures that depicted children in the material. The subjects had a strong preference for the pictures of the African boy putting Iodine on a leaf and the African girl pinching herself. Twenty-four subjects indicated a preference for the former picture and only five indicated a dislike for this picture. Twenty-one subjects indicated a preference for the picture of the African child pinching herself and only five subjects disliked this picture. The preferences for the remaining four pictures (two of African children and two of Chinese children) were fairly equally distributed.

Preferences for the pictures of food were more polarised into preferred or disliked items. The subjects indicated a strong preference for pictures depicting the modified products (branded products) and an equally strong dislike for the unmodified products (unbranded products). The modified products received seventy-six choices with only twelve choices against them. The unmodified products similarly received fifty-seven choices against them and only eighteen choices for them.

TABLE 3.10

The cumulative number of preferences and dislikes for the modified and the unmodified pictures as indicated by the subjects (Experiment 5).

	PREFERENCE	DISLIKE
Three modified pictures depicting the children (African children).	63	23
Three modified pictures depicting the consumer products (Branded products).	76	12
TOTAL MODIFIED PICTURES	139	35
Three unmodified pictures depicting the children (Chinese children).	33	50
Three unmodified pictures depicting the consumer products (Unbranded products).	18	57
TOTAL UNMODIFIED PICTURES	51	107

FIGURE 3.6

A graphic representation of the cumulative preferences and dislikes for the modified and the unmodified pictures (Experiment 5).

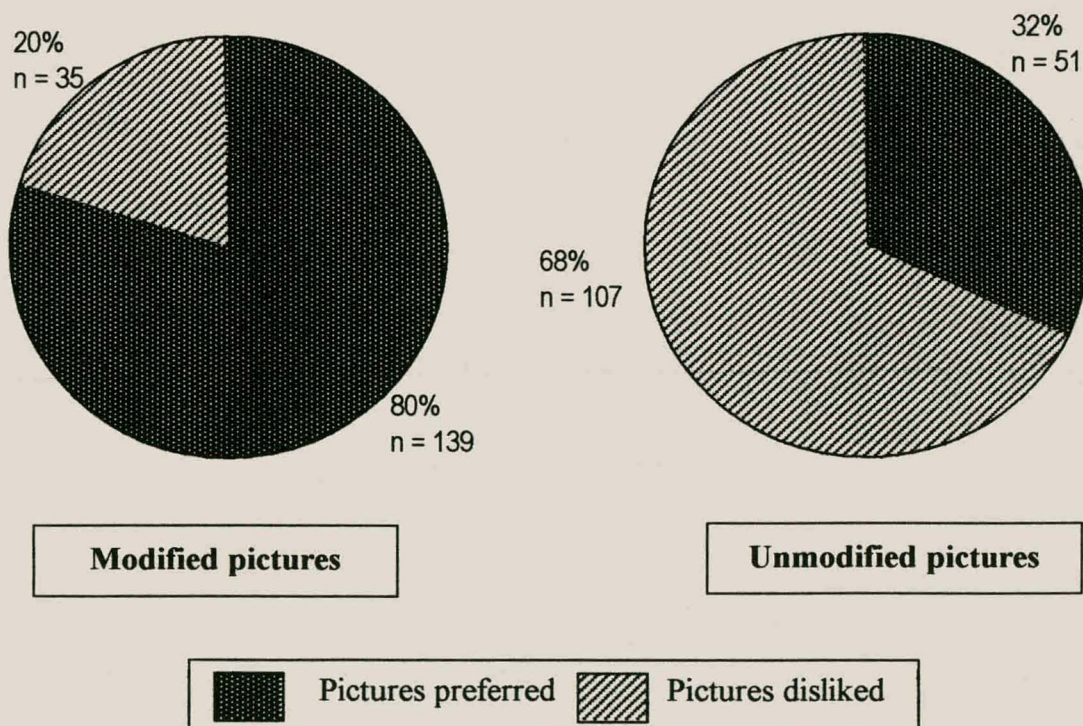






TABLE 3.11

Number of times that subjects indicated their preference or dislike for a particular picture (Experiment 5).

	Preference	Dislike	Equal preference
	13	18	9
	24	13	10
	24	5	8
	14	18	8
	17	5	12
	2	14	12

TABLE 3.11 (continued)

Number of times that subjects indicated their preference or dislike for a particular picture
(Experiment 5).

	Preference	Dislike	Equal preference
	34	2	10
	7	23	10
	9	20	12
	25	5	12
	6	14	7
	21	5	3

Typical comments in favour of the modified products were: “*Iwisa is the best ...*”, “*It is better ...*” and “*I like Iwisa and Tastic ...*”. The corresponding comments next to the unmodified products were: “*I only eat Tastic and Iwisa*”, “*I don’t like it*”, and “*I don’t like mielie miel and rice ...*” (*sic*). The proportion of preferences for all the modified pictures was 80 percent which was significantly higher at 0.01 than the proportion of dislikes for the pictures ($Z_{0.01} = 7.88 > 2.328$). The proportion of dislikes for the unmodified pictures, which was 68 percent, is likewise significantly higher than the proportion of preferences for the unmodified pictures ($Z_{0.01} = 4.455 > 2.328$). The null hypothesis of equal preference for the modified and unmodified pictures is rejected in favour of the alternative hypothesis that there is a difference. The subjects preferred the modified pictures to the unmodified pictures.

3.5.7 A discussion of the results of Experiment 5

Comparison of the means

Both groups that received pictures with the text obtained a higher mean score than the text-only group. These small differences were, however, not statistically significant. A non-significant effect had also been obtained with the same material and questions during the previous experiment. The explanations that were given for the results of Experiment 4 were that the subjects possibly had a high prior knowledge and that the subject matter was easy to understand. The mean scores of the subjects in Experiment 5 were, however, significantly lower than the mean scores of the subjects in Experiment 4. It is unlikely that the subjects of Experiment 5 had prior knowledge or that the subject matter was easy to understand. The subjects who participated in this experiment seem to have had more difficulty in expressing themselves in English when their answers are compared to the answers of the subjects in Experiment 4. Another possible explanation for the non-facilitating effect is that seven of the fourteen pictures in the experiment were representative in nature. Representative pictures have a lower facilitating effect than pictures with an explanatory or organisational nature (Levin, 1981; Mayer, 1993). The effect sizes of the picture-text condition and the modified picture-text condition for all the subjects are 0.33 and 0.29 respectively. This is lower than the average effect size of 0.55 reported by Levie and Lentz (1982) and the 0.50 (for representational pictures only) reported by Levin *et al.* (1978). The effect sizes for the immediate and delayed tests for Question 3, where there was a significant difference if compared to the text-only group, ranged between 0.77 and 1.0.

Seven pictures in the material accompanied the text on how to test for starch. These pictures are representative in appearance but also explain the text in visual form, which has an explanatory function. The differences between the means of the three groups when answering the question (Question 3) on how to test for starch was significant at 0.02 in the immediate post-test and significant at 0.96 in the delayed post-test. There was, however, no significant difference between the difference in the delayed and the immediate post-test scores achieved in Question 3. This might indicate a similar rate of forgetting for all three groups irrespective of the presence or absence of pictures. The modified pictures did not facilitate or hinder the recall of information, or the understanding of a process in this experiment or in the previous experiment. These data support only part of the experimental hypothesis and only when the means of Question 3 are compared with each other.

The subjects' preferences.

An analysis of the data presented in Table 3.10 and Table 3.11 indicates that the proportion of preferences for pictures of consumer products (86 percent), which were modified for the target group, is higher than the proportion of preferences for modified pictures (73 percent) containing children. Twenty-one subjects commented that they preferred the drawings of the African children, whilst twenty subjects had no particular preference. There were four negative comments about the unsmiling faces of the African children and six positive comments about the happy faces of the Chinese children. There were only four subjects who did not like the drawings of the Chinese children because of their eyes and hair. Three commented on the apparel of the children in the drawings.

It appears that the depiction of African children in illustrations is an important consideration, but that Chinese children in the illustrations would not be a negative factor. Happy expressions on the children's faces are, as it was also indicated in the previous experiment, a meaningful graphic element.

Twenty-six subjects indicated a preference or liking for the modified drawings (branded products) of the consumer products. There were ten subjects who indicated no particular preference for the modified or unmodified drawings of the products. The depiction of familiar items (modified to the subjects' visual culture) appears to an important element in the learning material for this particular sample.

3.5.8 Conclusion of Experiment 5

The aims of this experiment were to test a longer preference testing method where more pictures are used, and to test the materials, methods and questions with subjects from a developing community. It was expected that the subjects who received the modified version would perform better than subjects who received the text-only and the picture-text versions, and that the subjects would prefer the modified picture version to the unmodified version. It was also expected that the groups that received the picture-text versions would forget relatively less than the text-only group after 7 days.

The longer preference testing method where a wider range of pictures was used, was regarded as satisfactory, as it enabled an analysis of more of the subjects' comments.

There were no difficulties with the test materials, methods and questions when these subjects, who came from a developing community, were used.

The non-significant difference between the picture, the modified-picture and the text version in the immediate post-test for all the questions was the same as the results obtained in the previous experiment. The significant difference between the groups with regard to Question 3, which tested a procedure and not just factual recall, might be an indication that representative pictures, which have a lower potential to facilitate learning than explanative pictures, are more useful when learners are tested to recall a procedure in chronological order than when they are tested on the recall of one- or two-word answers. The preference that the subjects showed for the modified pictures and a significant dislike for the unmodified pictures was expected. These subjects came from a more homogeneous background than any of the other subjects and are possibly less exposed to foreign visual material.

Two limitations were identified with the material that was used in Experiments 3, 4 and 5. The pictures are representative in nature, and representative pictures have a low potential facilitation effect, thus limiting the extent of the possible facilitating effect that can be measured. The second limitation was that the questions did not test problem-solving transfer skills but merely tested factual recall and the recall of a procedure. The next experiment is designed to address these issues.

3.5.9 Summary of Experiment 5

Fifty Grade 6 subjects with a mean age of 12.9 years, randomly divided into three groups with equal ability, participated in a post-test control group experimental design. One group received text-only learning material, the second group received picture-text material and the last group received modified picture-text material. The text consisted of 709 words on storing food and how to test for starch in a leaf. There were 14 representational pictures in each of the modified picture-text and picture-text materials. The two groups that received pictures with the text did not score significantly higher with a recall test than the text-only group when the mean scores of all the questions were compared with each other. The two picture-text groups, however, scored significantly higher with Question 3 (how to test for starch) in the immediate post-test ($p = 0.02$) and in the delayed post-test ($p = 0.096$). The modified picture group, however, did not score significantly higher than the unmodified picture group with all the questions, with Question 3, or in the delayed post-test with Question 3. The subjects showed a significant preference for the modified pictures and a significant dislike for the unmodified pictures at 0.01.

3.6 EXPERIMENT 6a: The fire extinguisher

3.6.1 Introductory comments

Experiment 6a is the first of the last three experiments. The last three experiments were similar except for small changes in the material and procedures, and are labelled as Experiment 6a, Experiment 6b and Experiment 6c. Each of the last three experiments is discussed under a separate section. The materials, questions and procedures of these last experiments are shaped and influenced by the results of the preceding five experiments. The outline and the results of the last five experiments are given in Table 3.12 (p. 175) and Table 3.13 (p. 176) in order to provide a retrospective summary of the preceding five experiments.

Experiments 6a, 6b and 6c were conducted at a peri-urban and rural schools in the Bloemfontein region. The specific changes to each sub-experiment are described in full under the heading of each sub-experiment. The results of Experiment 6a are summarised at the end of Section 3.6 in Table 3.21 (p. 203).

TABLE 3.12

A summary of the outline of Experiments 1- 5 in tabular format.

Experiment	Aim	Hypothesis	Subjects	Research design	Materials
Experiment 1 Khoikhoi	This experiment acted as a pilot study.	CMP* will assist the learning process	31 Grade 6 subjects	Paired control group research design	278 words on the Khoikhoi for the control group. The same text and 8 representational pictures for the experimental group.
Experiment 2 Electricity	To determine whether CMP could assist the learning process.	CMP will improve recall.	115 Grade 6 subjects	Control group research design with 2 experimental groups.	364 words on electricity for the control group. The same text and 14 representational pictures for each of the experimental groups.
Experiment 3 Food and plants	To determine whether CMP could assist the learning process.	CMP will improve recall.	115 Grade 6 subjects	As above	709 words on food for the control group. The same text and 14 representational pictures for each of the experimental groups.
Experiment 4 Food and plants	To determine whether CMP could assist the learning process. To pilot a preference testing method, a delayed post-test, and a shorter learning and testing time.	CMP will improve recall. Subjects will prefer modified pictures.	27 Grade 6 subjects	As above	As above
Experiment 5 Food and plants	To determine whether CMP could assist the learning process, and to test a more comprehensive preference testing method and to test the materials, methods and questions with subjects from a developing community.	CMP will improve recall. Subjects will prefer modified pictures.	50 Grade 6 subjects. 49 subjects for the delayed test	As above	As above

* CMP = Culturally modified pictures

TABLE 3.13

A summary of the results of Experiments 1- 5 in tabular format.

p = the probability value, ES = the effect size, n.a. = not applicable to the experiment, * = results that indicated that there is no difference between the control and experimental groups or no significant preference for modified pictures.

Experiment	All the questions	Question 3. Immediate post-test (electricity rules; exp. 2) (testing for starch; exp. 3-5)	Question 3. Delayed post-test (testing for starch; exp. 3-5)	Difference between the immediate and delayed post-tests of Question 3	Subjects' preference for modified pictures
Experiment 1 Khoikhoi	No reliable results are available. The English language appears to have been the barrier.	n.a.	n.a.	n.a.	n.a.
Experiment 2 Electricity	A significant difference. $p = 0.0027$	A significant difference. $p = 0.0012$	n.a.	n.a.	n.a.
Experiment 3 Food and plants	A significant difference. $p = 0.007$	A significant difference. $p = 0.00018$	n.a.	n.a.	n.a.
Experiment 4 Food and plants	*	*	A significant difference. $p = 0.073$	A significant difference. $p = 0.02$	*
Experiment 5 Food and plants	*	A significant difference. $p = 0.022$	A significant difference. $p = 0.096$	*	A significant preference for the modified pictures at 0.01.

The picture facilitating effect within an educational context is an interactive process between the text, the pictures and the subject (Molitor *et al.*, 1989). The four conditions that are required before the addition of pictures can theoretically facilitate learning are: the text must be explanative; the text must present cause-and-effect systems; the tests must be sensitive enough to measure the subjects' understanding; and the pictures must be explanative, with the learners being inexperienced in the learning material (Mayer, 1989; Mayer and Gallini, 1990). Dwyer (1978) also mentioned the importance of realism, the method of presentation, the student characteristics, the level of the educational objective to be achieved, cueing techniques and assessment tests.

The non-significant results in some of the previous experiments and the reasons cited in the previous paragraph were used to write a different portion of text for these experiments. Different evaluation methods and cueing techniques and new illustrations were employed to bring about a possible increase in the picture facilitating effect.

The expectation for this series of experiments was that the modified picture group would score better than the unmodified picture group and that both groups would produce better results than the text-only group and the text-with-one-picture group. It was also expected that the delayed testing would indicate similar results to those obtained by Peeck (1989) who found that picture-text groups forgot relatively less in a delayed test than groups without pictures.

It was also expected that the majority of the subjects would prefer the modified pictures to the unmodified pictures.

3.6.2 The subjects for Experiment 6a

Two different groups of secondary scholars participated in this experiment. One group, consisting of one hundred and sixty-nine subjects, came from a secondary peri-urban school in Bloemfontein, and were all the Grade 9 and Grade 11 pupils at the school. They had a mean age of 16.4 years. One hundred and fifty-seven listed Sesotho as their home language, whilst twelve listed some other African language as their home language. There were eighty-one male and seventy-eight female subjects. The second group for this experiment consisted of seventy-four subjects from two rural or farm schools in the Bloemfontein region. These subjects constituted the entire Grade 7 to Grade 9 student body of the school.

These subjects had a mean age of 17.4 years. Forty-one subjects were boys and twenty-three subjects were girls, whilst the rest of the subjects did not provide this information. Forty-six subjects listed their home language as Sesotho, while the rest gave other African languages as their mother tongue. The data that is reflected in the results indicate different numbers of subjects as certain subjects, were absent for the immediate or the delayed post-test.

3.6.3 The materials for Experiment 6a (the text, the questions and the pictures)

The experimental material for this experiment consisted of a text-only version, the same text with one picture, and a modified and unmodified version with the same text and with thirteen pictures each. All the pictures that were used in this experiment are given in a reduced format in Addendum 3.20 (p. 283-284) at the end of this chapter. The test material and the questions that were used for this experiment are given in Addenda 3.22 – 3.26 (p. 286-301) at the end of this chapter.

3.6.3(a) *The text*

The text-material for this experiment consisted of a written portion about a fire extinguisher. The text explained the different parts of a fire extinguisher and how a fire extinguisher works. The text was 415 words long, had a Flesch Reading Ease score of 80.6 (rated on a 100-point scale) and a Flesch-Kincaid Grade Level score of 5.1. The reading level of this portion of text is relatively easy, as a Grade Level of 5.1 means that a learner with 5.1 years of schooling, measured on a U.S. grade-school level, should be able to understand the material. Standard documents normally have a Reading Ease score of 60 to 70. The higher the score, the easier a document is to understand. This text on the fire extinguisher with a Reading Ease score of 80.1 should be easier to understand than a standard document.

The final structure of the text and questions was finalised only after it was pre-tested and discussed with eighteen first-year Technikon students, two secondary-school children, one primary-school child and a remedial schoolteacher. The text is regarded as suitable as it fulfils three of the criteria listed by Mayer (1989) and Mayer and Gallini (1990) for appropriate text in picture-text experiments. The text explains the working of a system (how the fire extinguisher operates) and presents cause-and-effect (what happens when you use a fire extinguisher). The subjects or learners for these experiments are inexperienced in the working and construction of a fire extinguisher.

The purpose of the low readability scores of the text is to avoid a language barrier between the subjects and the material and to make it easy for the subjects to extract the information from the text, which was in English. The medium of instruction at the schools is supposed to be English, but the subjects do not use English as their mother tongue. Some of the explanations and conversations between pupil and teacher take place in Sesotho, the mother tongue of most of the subjects who participated in this experiment.

3.6.3.(b) *The pictures*

Twelve pictures, with a representative and explanative function, accompanied the text material for the modified and unmodified experimental groups. A thirteenth picture with a decorative function was included at the end of the text to enable a question to test the subjects' attention to detail in a picture. The twelve pictures contained a fire extinguisher and a girl pointing to a specific part of the extinguisher or using the extinguisher. The girl in the drawings acted, in effect, as a graphic cue and had the potential to effectuate facilitation during learning (Levie and Lentz, 1982; Peeck, 1993 and 1994). All the activities portrayed in the pictures are mentioned in the text.

The accompanying text was presented in a rectangular block beneath or alongside the picture. The text and one-picture version contained the text and one picture of a fire extinguisher with labels for each part of the fire extinguisher. The drawing of the fire extinguisher was simplified and showed only the main parts of a fire extinguisher and only those parts mentioned in the text. The working and schematic drawing of the fire extinguisher was verified with employees of a fire station before the drawing was finalised.

The pictures consisted of black and white line drawings in the same style as the pictures in the previous experiments. Shading in these illustrations was achieved by means of thin lines and not through continuous tone as in the previous illustrations. The girl in the modified version was depicted as an African girl, dressed in a school uniform with school shoes and with a hairstyle that was regarded as fashionable. The girl in the unmodified version was a Chinese girl, dressed in typical Chinese clothing, a Chinese worker's hat and long plaited hair. Both girls were given friendly, smiling faces, except in two pictures where it was more appropriate to show a serious expression. One picture included a Chinese building in the background, whilst the corresponding modified picture depicted a peri-urban background.

The thirteenth picture depicted a taxi rank: the modified picture showed a Bloemfontein taxi rank with people, and the corresponding unmodified picture depicted a taxi rank with foreign-looking vehicles and Chinese people. A fire extinguisher was shown on a central pillar. The text accompanying this picture stated "*There are also other places where you will find fire extinguishers*", implying that you might find fire extinguishers hanging on some pillars at certain taxi ranks.

Examples of two modified pictures and two unmodified pictures are given in Plate 3.6.

PLATE 3.6

Examples of four of the pictures that were used in Experiment 6a.

A = Examples of the types of pictures that were used in the unmodified experimental material.

B = Examples of the types of pictures that were used in the modified experimental material.



3.6.3.(c) *The questions*

The questions were finalised after being tested with two secondary-school children, one primary-school child, eighteen Technikon students and a remedial schoolteacher. The testing of the questions and the text-alone material with the Technikon students showed that it is difficult to obtain a high score whilst reading the text in the absence of a picture. The mean score for these students was 8.6 out of a maximum score of 18, while the highest was only 12 and the lowest was 3. The text is short and easy to read, but difficult to comprehend without a picture

The immediate post-test consisted of fourteen multiple-choice questions (fourteen marks), a fifteenth question that required three answers (three marks) and three additional questions where a picture was used in combination with the question (five marks). Each multiple-choice question provided five alternative answers, with the subjects having to underline the correct answer. Seven of the fourteen multiple-choice questions tested factual recall, seven questions tested problem-solving transfer skills, and one question tested problem-solving skills where the subjects were required to write down three answers. A typical problem-solving question was: "*What will happen if you remove the safety pin?*" with five possible answers being provided. The subjects had to choose and then underline the correct answer. These questions not only tested the subjects' understanding of the working of the fire extinguisher, but also their ability to infer what would happen given a specific problem with a fire extinguisher. The subjects not only had to be familiar with the parts of a fire extinguisher, but also had to understand the working of the device in order to select the correct answer.

Three more questions used a method where pictures were used in combination with the questions. Two of these questions asked the subjects to complete an incomplete picture, for example to draw the gas and powder that comes out of a fire extinguisher. The pictures that they had to complete were the same pictures they had received in the immediate post-test. The purpose of these two questions (one mark each) was to see whether the subjects had paid attention to the pictures and if they were able to recall detail presented in the drawings. The final question required the subjects to label two parts of a fire extinguisher (two marks). A drawing of the fire extinguisher accompanied the question.

The delayed post-test consisted of eight questions. The first question asked the subjects to label different parts of a fire extinguisher. Arrows pointed to different parts of an extinguisher and provided 8 different answers. The subjects had to choose and underline the correct answer for that part of the fire extinguisher (eight marks). The next four

questions tested the subjects' relative visual literacy (one mark each). Four pictures, taken from the previous week's learning material, were duplicated in the delayed post-test. These pictures repeated and explained the information that was presented in the learning material. Subjects had to choose and then underline the correct sentence (multiple choice) that described the picture or what was happening in the picture. The purpose of these questions was to obtain a measure of the subjects' relative visual literacy and to determine if there is a relationship between subjects' understanding of a picture and their delayed post-test score. It was expected that the priming effect, when the subjects read the material with pictures, would positively influence their relative visual literacy or understanding of the pictures and then have a positive effect on their post-test scores. Question six determined the subjects' preference for the modified, unmodified or text-only version of the learning material, the next question tested their preference for a modified or an unmodified picture, and the last questions asked the subjects what they liked or did not like in a modified or unmodified picture. These last three questions (Questions 6-8) were also used to determine their preference for modified or unmodified pictures.

There was a small change in the questions with Experiment 6b and Experiment 6c due to shorter times that were available for the experiments. These changes are fully discussed in the report of these experiments.

3.6.4 The research design and procedure of Experiment 6a

This experiment used the same research design that had been used in the previous experiment. One group of subjects received the text with unmodified pictures, one group received the text with the modified pictures, one group received the text-only material, and one group received the text with one picture. Students were allocated to the different groups through random numbers as well as the designation of the four groups to a control group and the three experimental groups. The research design is graphically portrayed in Table 3.14 on the next page.

There was no text-with-one-picture group with the subjects from the rural area due to the limited amount of subjects that were available. Adding another experimental group would have decreased the number of subjects in each group. The experiment was conducted at the end of a school day in the classrooms where the subjects received their normal lessons. The researcher explained the research project to the subjects and warned them that they would be writing a test directly after having studied the material.

TABLE 3.14

A simplified tabular and graphic representation of the research design of Experiment 6.

Group

Text-only group.

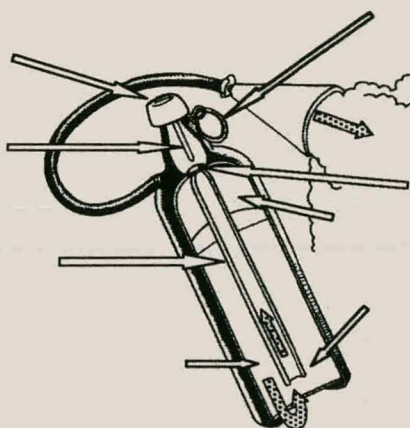
This group received only text and acted as the control group.

This group was expected to score lower than the other three groups.

Text and one-picture group.

This group received the text and one picture of a fire extinguisher with labels indicating the different parts of the extinguisher. The labels have been removed from this picture due to a lack of space.

It was expected that this group would score better than the text-only group but not better than the other two picture groups. This group also acted as a control group. Subjects from rural schools were excluded from this group due to the low number of subjects available.



Unmodified picture group.

This group received the text and 13 pictures of a Chinese girl and the extinguisher depicting the information in the text.

It was expected that this group would score better than the previous group but not better than the modified picture group.



Modified picture group.

This group received text and 13 pictures of an African girl and the extinguisher depicting the information in the text.

This group was expected to score better than any of the other three groups. Labels were added to these pictures for Experiment 6b and Experiment 6c to create an additional experimental group.



The subjects received fifteen minutes to study the material and fifteen to twenty minutes to answer the eighteen questions. The subjects participated willingly in the experiment. They were informed that their results would not be used for or against them. The subjects were also informed that they would be writing a second test on the same material seven days later. The delayed post-test took approximately fifteen minutes to complete. The subjects were not specifically instructed to make use of the pictures or to look at the pictures. Each subject was thanked for their participation and received a sweet after each test as a token of appreciation.

3.6.5 The results of Experiment 6a and a discussion of the results

The results of Experiment 6a are tabulated in Tables 3.14 to 3.20 (p. 183-198) and in Figures 3.7 to 3.10 (p. 189-199).

Comparisons were made between the means of the different experimental groups and the control group and between the differences in the immediate and the delayed post-tests. The subjects' preferences for modified or unmodified pictures are tabulated and their comments on what they like or do not like in the pictures are summarised.

The results for the rural subjects and the peri-urban subjects are given separately in different tables as their environment, and educational and socio-economic conditions differ. No comparison was made between the peri-urban subjects and the rural subjects. The data were analysed using a single factor Analysis of Variance (ANOVA) and the Z-test for proportions.

The results of the immediate post-test are given as a mean for all the questions combined (Questions 1-18), for the questions that tested factual recall (Questions 1-7), for the questions that tested problem-solving skills (Questions 8-15), and for questions where the information was only available in a picture and where one question was based on a picture (Questions 16-18).

The results of the delayed post-test are given as a mean for the first question. The subjects' relative visual literacy is expressed as a percentage. Their preferences for modified or unmodified pictures are given as the number of choices that they have made.

The differences between the immediate and delayed tests for the different groups are expressed as a percentage, because the maximum scores for the post-tests were different and the questions were not the same.

The large number of separate results are discussed under subheadings and are summarised in a table at the end of this section to provide a logical and sequential presentation of the results.

3.6.5.(a) *The results of the immediate and the delayed post-tests of the peri-urban subjects* (Table 3.15 (p. 187), Table 3.16 (p. 188), Figure 3.17 (p. 191), Figure 3.18 (p. 192).

The immediate post-test

The Grade 9 text-only group obtained a mean of 6.95 for all the questions, whilst the other three Grade 9 groups that received pictures with their text scored 8.22, 8.82 and 9.45 respectively. This difference was not significant ($p = 0.22$).

The Grade 11 text-only group obtained a mean of 8.45 for all the questions, whilst the other three Grade 11 groups that received pictures with their text scored 11.25, 11.45 and 11.32 respectively. This difference was, however, only significant at 0.057.

The means of the four groups of the Grade 9 and the Grade 11 subjects did not differ significantly from each other when the questions, that tested the subjects' recall ability (Questions 1-7) and problem-solving skills (Questions 8-15) were compared with each other. All the picture groups from Grade 9 and Grade 11 obtained higher mean scores for recall and problem-solving questions than their respective control groups, but these higher scores were not statistically significant at 0.05. The modified picture groups did not perform better than any of the other picture groups.

There was only a significant difference between the control group and the picture groups when the mean scores of the last three questions were compared with each other. The control group of the Grade 9 subjects obtained a mean of 1.23, whilst the one-picture group, the unmodified picture group and the modified picture group scored 2.7, 2.35 and 3.09 respectively $F(3, 86; 0.05) = 3.72 > 2.72$, $p = 0.014$. Tukey's test, however, showed that it was only the mean of the modified picture group that differed statistically significantly from the control group at 0.05 ($p = 0.011$). The difference between the unmodified group and the control group is only significant when $p = 0.23$, and the difference between the one-picture group and the control group is only significant when $p = 0.067$.

The control group of the Grade 11 subjects obtained a mean of 1.23, whilst the one-picture group, the unmodified picture group and modified picture group scored 2.7, 2.35 and 3.09 respectively $F(3, 75; 0.05) = 3.72 > 2.72$, $p = 0.015$. Tukey's test, however showed that it was only the mean of the unmodified picture group that differed statistically significantly from the control group at 0.05 ($p = 0.011$). The difference between the modified group and the control group is only significant when $p = 0.055$ and the difference between the one-picture group and the control group is only significant when $p = 0.055$.

The delayed post-test

There was no significant difference when the means of the four groups of the Grade 11 subjects were compared with each other $F(3, 71; 0.05) = 0.687 < 2.73$, $p = 0.56$. There was, however, a significant statistical difference, but this was higher than 0.05 only when the mean differences of the Grade 9 groups were compared with each other $F(3, 85; 0.07) = 2.53 > 2.43$, $p = 0.063$. The text-only group scored 2.5 whilst the picture groups obtained scores between 3.13 and 4.26. Tukey's test showed that it was only the group that received one picture with their text that scored significantly better in the delayed post-test than the control group ($p = 0.039$).

There was a significant difference, but only for the Grade 9 subjects when the difference between the immediate post-test (Questions 1-15) and the delayed post-test (Question 1) were compared with each other $F(3, 84; 0.05) = 3.56 > 2.72$, $p = 0.018$. The control group obtained a relative score of -5.78 percent, the one-picture group scored +16.47 percent, the unmodified picture group scored -1.83 percent, and the modified picture group scored -3.22 percent. These values are only relative to the other groups. Tukey's test showed that the group that received the one picture with their text forgot significantly less than the control and the other picture groups ($p = 0.026$). The difference between the unmodified picture group and the one-picture group, the modified picture group and the one-picture group, was only significant at 0.1 and 0.06 respectively

There was no significant difference between the means of the Grade 11 subjects when the differences between the immediate and the delayed post-tests were compared with each other.

TABLE 3.15

Means and standard deviations of the subjects' scores on the immediate and the delayed post-tests by condition (or code format) and by questions (Experiment 6a, peri-urban subjects).

The first row in each cell represents the scores of the Grade 9 subjects.

The second row in each cell represents the scores of the Grade 11 subjects.

QUESTIONS	Text only			Text and one picture			Text and unmodified pictures			Text and modified pictures		
	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{X}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	22	6.95	2.97	23	8.22	4.6	23	8.82	3.73	22	9.45	4.86
	20	8.45	3.53	20	11.25	4.26	20	11.45	3.85	19	11.32	4.31
Questions 1-7 Factual recall	22	2.73	1.24	23	2.7	1.67	23	3.22	1.28	22	3.09	1.44
	20	2.7	1.22	20	3.3	1.03	20	3.1	1.12	19	3.31	1.34
Questions 8-15 Problem-solving	22	3	1.07	23	2.82	2.15	23	3.26	1.66	22	3.27	2.47
	20	3.6	1.85	20	4.15	2.54	20	4.35	2.18	19	4.16	2.34
Questions 16-18 Picture-based	22	1.23	1.48	23	2.7	1.94	23	2.35	1.95	22	3.09*	2.35
	20	2.15	1.6	20	3.8	1.77	20	4*	2.22	19	3.84	2.39
Delayed post-test (7 days)	23	2.52	1.97	23	4.26*	2.32	21	3.38	2.16	22	3.13	2.23
	19	3.63	2.19	17	4.05	2.54	19	4.42	2.22	20	4.6	2.13
Differences between the immediate and delayed tests	22	-5.8	22.7	23	16.47*	25.3	21	-1.83	23.78	22	-3.22	30.3
	19	4.7	26.5	17	1.34	35.4	19	6.5	26.9	19	8.85	23.9

* A significant difference when compared to the text-only group

TABLE 3.16

Effect size (ES) of the immediate and the delayed post-tests by condition and by questions (Experiment 6a, peri-urban subjects).

The first row in each cell represents the scores of the Grade 9 subjects.

The second row in each cell represents the scores of the Grade 11 subjects.

	Condition					
	Text and one picture		Text and unmodified pictures		Text and modified pictures	
QUESTIONS	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	23	0.43	23	0.68	22	0.84
	20	0.79	20	0.85	19	0.81
Questions 1-7 Factual recall	23	-0.02	23	0.4	22	0.29
	20	0.49	20	0.33	19	0.5
Questions 8-15 Problem-solving skills	23	-0.17	23	0.24	22	0.25
	20	0.28	20	0.41	19	0.3
Questions 16-18 Picture-based questions	23	0.99	23	0.76	22	1.26
	20	1.03	20	1.16	19	0.77
Delayed post-test (7 days)	23	0.88	21	0.44	22	0.31
	17	0.19	19	0.31	20	0.44
Differences between the immediate and delayed tests	23	0.98	21	-0.17	22	-0.11
	17	-0.13	19	0.08	19	0.16

FIGURE 3.7

A graphic representation of the mean scores of the Grade 9 subjects on the immediate and delayed post-tests (Experiment 6a, peri-urban subjects).

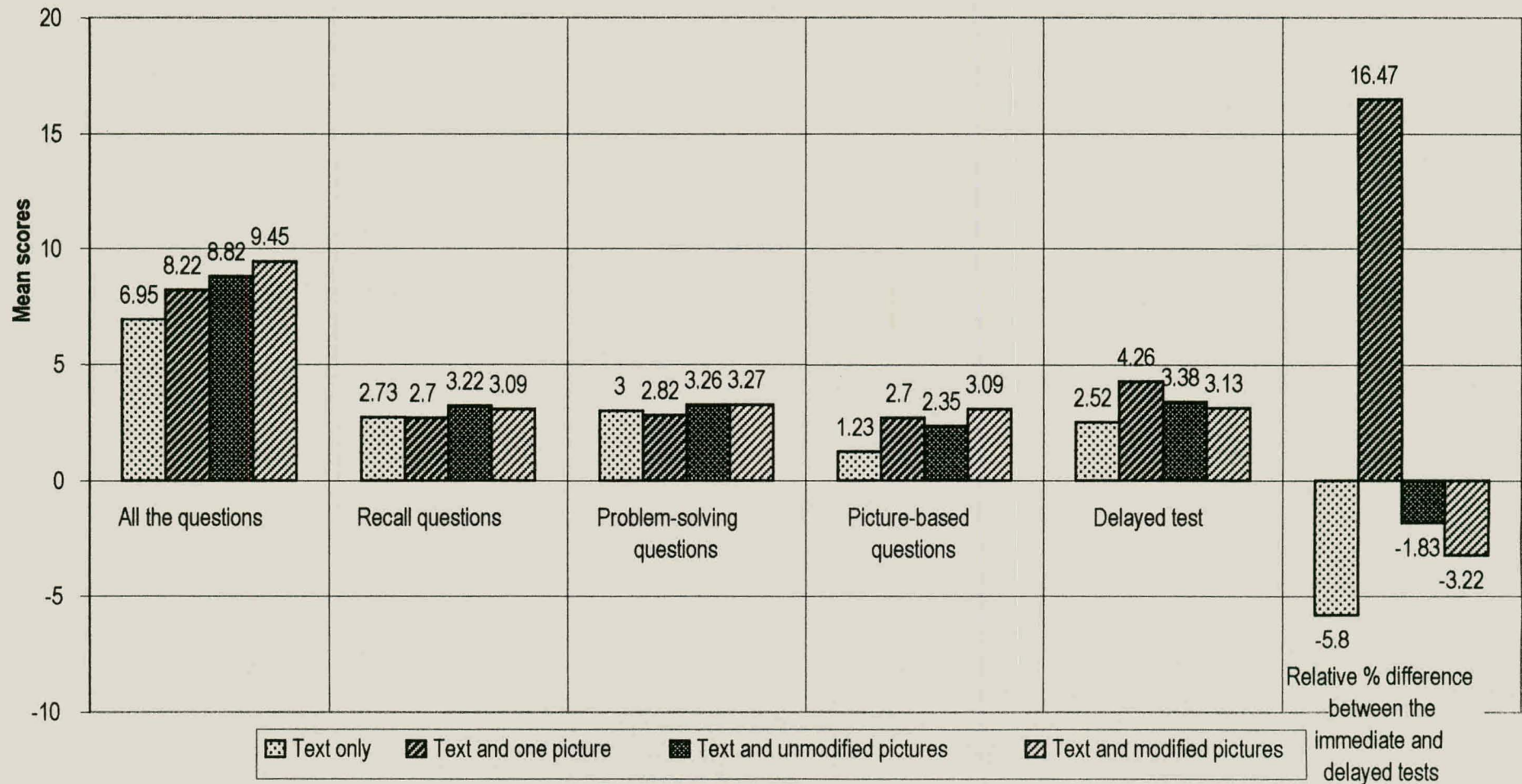
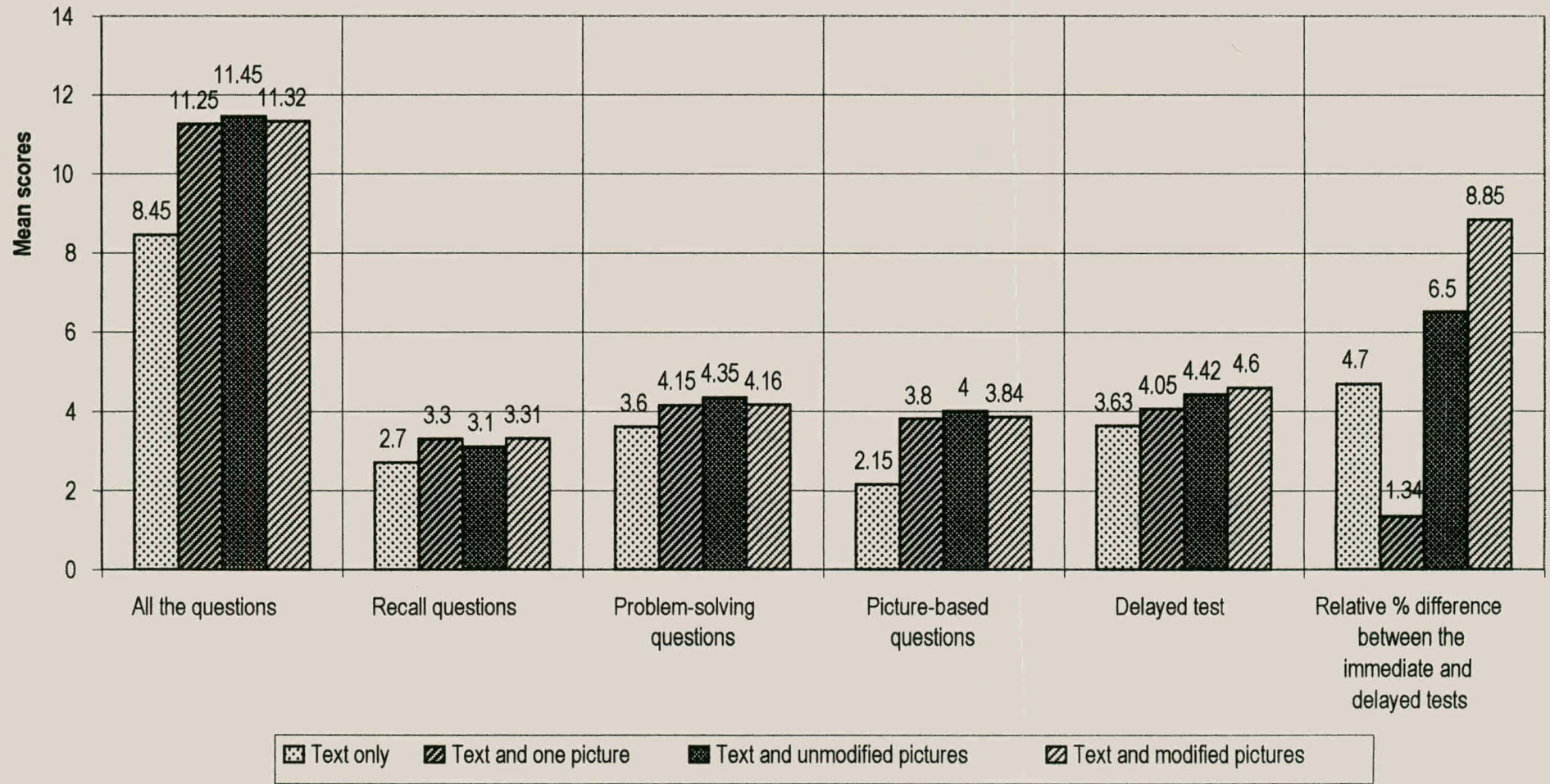


FIGURE 3.8

A graphic representation of the mean scores of the Grade 11 subjects on the immediate and delayed post-tests
(Experiment 6a, peri-urban subjects).







The relative visual literacy of the peri-urban subjects (Table 3.17)

The relative visual literacy of the subjects, that is their understanding of the activity that is depicted in four of the thirteen pictures, is given in Table 3.17. They displayed lower scores for picture two and picture four. Their comprehension of these pictures ranged between 50 percent and 42 percent. The lower scores for picture two is possibly influenced by the girl's arm in the picture which could indicate a lifting action and which could have cause some confusion. These values are relative in that they only provide an indication of the subjects' understanding of four of the thirteen pictures that were used in the learning material.

TABLE 3.17

The subjects' relative visual literacy expressed as a percentage
(Experiment 6a, peri-urban and rural subjects).

					
<i>Picture No.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>Total</i>
Peri-urban subjects	82	50	83	42	64
Rural subjects	75	58	70	43	62
Total	81	52	80	43	64

The preference of the subjects (Table 3.18 and Figure 3.9 (p. 193))

Question 6 in the delayed post-test asked the subjects to choose in which form they would like to receive the material, namely text-only, text and unmodified pictures, or text and modified pictures. Each subject received an example and had to indicate his or her choice on the sheet. Eighty-four subjects indicated their preference for the modified pictures, fifty-nine indicated their preference for the unmodified material and sixteen indicated that they preferred the material without any pictures. Five subjects did not indicate a choice. This larger choice for the modified picture material, when compared to the unmodified material, was statistically significant: $Z_{test} = 1,91 > \text{when } Z_{0.05} = 1,645$.

An analysis of the subjects' answers to Question 7 and Question 8 enabled an allocation of the subject's preference to either the modified picture or the unmodified picture, or an equal preference. The data in Table 3.18 show that there was a near equal preference for modified and unmodified pictures, while a large proportion of subjects indicated an equal preference.

TABLE 3.18

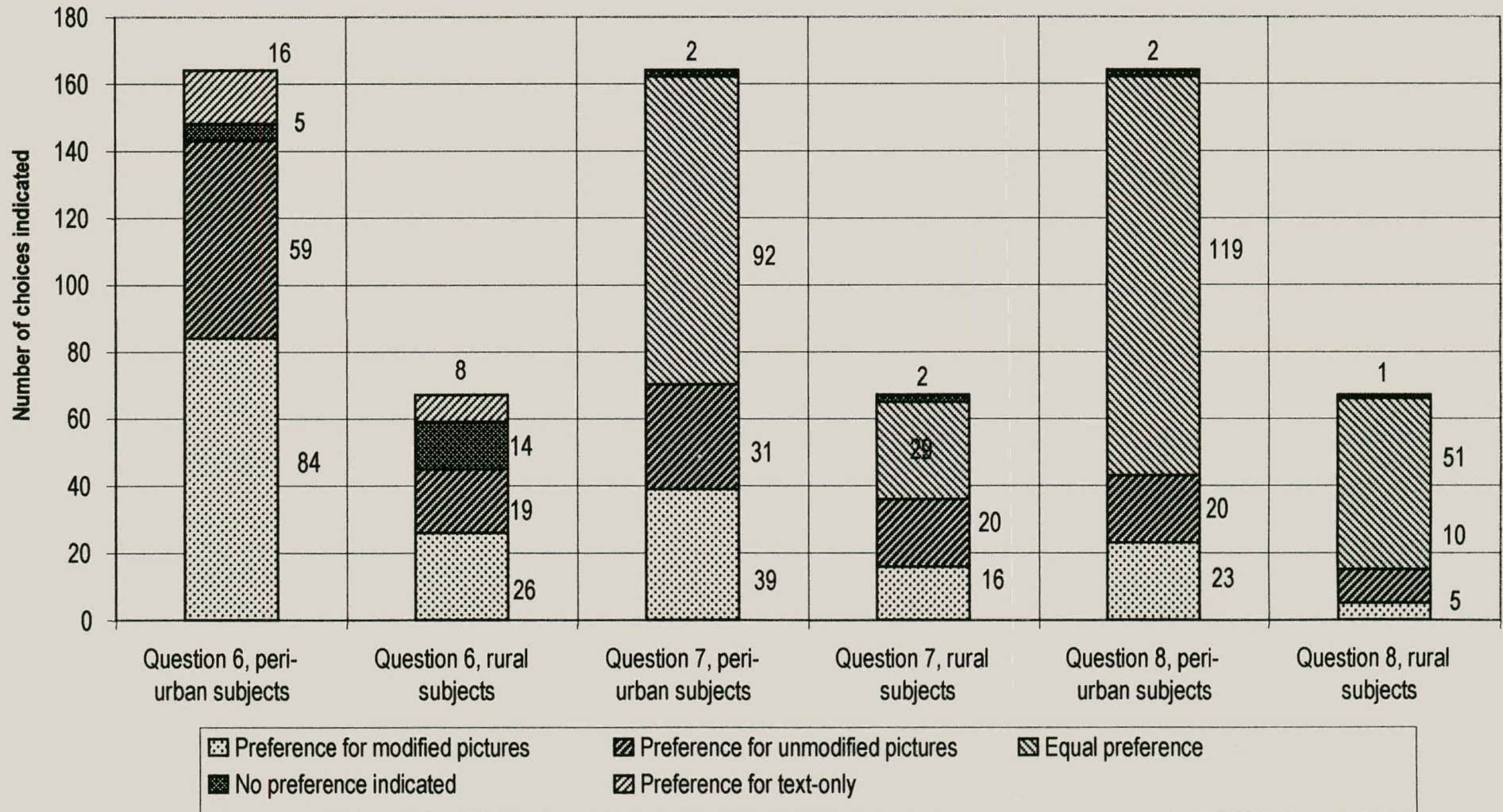
The number of choices indicated for a modified or an unmodified picture
(Experiment 6a, peri-urban and rural subjects).

Question	Preference for modified pictures	Preference for unmodified pictures	Equal preference	No preference indicated (no choice made)	Preference for text-only version
Question 6					
Peri-urban subjects	84*	59	Not asked	5	16
Rural subjects	26	19		14	8
Question 7					
Peri-urban subjects	39	31	92	2	Not asked
Rural subjects	16	20	29	2	
Question 8					
Peri-urban subjects	23	20	119	2	Not asked
Rural subjects	5	10	51	1	
Total	163	159	291	26	24

* Significant preference for modified pictures when compared to the unmodified pictures

FIGURE 3.9

The number of choices indicated for a specific picture (Experiment 6a, peri-urban and rural subjects).



3.6.5.(b) A discussion of the results of the immediate and the delayed post-tests of the peri-urban subjects

The immediate post-test

The non-significant results between the four groups when the mean scores of the questions that tested recall and problem-solving skills were compared with each other, were not expected. It appears that the pictures did not significantly facilitate recall or problem-solving skills amongst these subjects. The low mean scores of all the questions of the groups, when expressed as a percentage, ranged between 52 percent for one experimental group and 31 percent for a control group. These low scores could be an indication that other variables interfered with the subjects' learning and scoring abilities, and that these variables, or a single variable, overshadowed the possible facilitating effect of the pictures. A discussion with a remedial teacher, other teachers and the principal at the school, as well as a former principal, hinted at the possibility that the medium of English could have created an obstacle. It was not possible to verify this from the results of this experiment. The next experiment was therefore designed to overcome this possible negative variable.

The difference between the mean scores of the questions where there were pictures included with the questions (Questions 16 – 18) was highly significant and was expected. Two of these questions tested for information that was available in the pictures and not in the text, whilst one question tested for information that was available in the text and highlighted by graphic cues in the pictures. It is therefore obvious that the three picture groups would score better than the text-only group, as the text-only group did not have access to most of the information probed for in the question.

These results could indicate that the subjects did pay some attention to the pictures but not sufficiently to benefit from the potential facilitating picture effect with regard to recall and comprehension. What is evident from the results is that the modified picture group did not score significantly higher than the unmodified group. Only part of the data supports a small part of the experimental hypothesis and only in respect of questions that are based on information available in the pictures.

The null hypothesis that the modified picture group would perform better than the unmodified picture group and the one-picture group, and that both picture groups would score better than the text-only group, is rejected in favour of the alternative hypothesis.

The delayed post-test

The subjects who received one picture with their text scored significantly better than the text-only or the control group. The dual coding theory could provide a possible explanation for these results (Paivio, 1971, 1983 and 1986; Clark and Paivio, 1991). People can remember pictures better than words and have a large capacity to recall pictures (Kobayashi, 1985 and 1986; Hedman, 1995). One of the factors identified in Section 2.6.2 (*Vide.* p. 69) was that when text is difficult to remember, or text is of interest but not familiar to a learner, it will benefit from the inclusion of pictures (Beck, 1983; Mayer, 1993; Peeck, 1993). It appears as if the subjects who received one picture with their text were able to recall this picture, as the same picture was used in the delayed post-test and that the other picture groups could not do this with the eleven pictures in their material that contained the same information.

The modified picture group, however, did not perform better than the other picture groups or even the control group.

The subjects were not specifically instructed to make use of the pictures or to look at the pictures. Specific verbal instructions to use the pictures in text-picture learning material can activate the potential picture facilitating effect of pictures in learning material (Peeck, 1994).

The differences between the immediate and delayed post-tests

The Grade 9 subjects who received the text with one picture forgot relatively less (or were able to retain relatively more information over a period of seven days) than the control group and the other picture groups. The picture that they received in their learning material was also used in the delayed post-test. The subjects were tested through visual means, which enabled them to recall the picture that they received in their learning material. The *stimulus generalisation theory* states that learning is improved when the test situation is similar to the learning situation (Hartman, 1961; Wu and Dwyer, 1990; Beck, 1990).

The preference of the subjects

The subjects showed a significant preference for only one of the modified pictures in the three sets of pictures. It appears, if given the choice, that most of the subjects would indicate an equal preference and that these subjects do not have a strong overall preference for modified pictures.

3.6.5.(c) *The results of the immediate and the delayed post-tests of the rural subjects*
(Table 3.19 (p. 197), Table 3.20 (p. 198) and Figure 3.10 (p. 199)).

The immediate post-test

There was no significant difference between the two picture groups and the control group when the means of all the questions, the questions that tested for recall the questions that tested for problem-solving skills, and the picture based questions were compared with each other. The modified picture groups from rural schools did not perform better than the unmodified picture groups in the immediate post-test.

The delayed post-test

There was no difference between the mean scores of the rural subjects in the delayed test. There was also no difference when the mean scores between the immediate and delayed tests were compared with each other. The modified picture group from the rural schools did not perform better than the unmodified picture group in the delayed post-test.

The subjects' relative visual literacy (Presented previously in Table 3.17 (p. 191))

The subjects from the rural schools also displayed lower scores for picture two and picture four. Their comprehension of these pictures ranged between 58 percent and 43 percent. The lower score for picture 2 is possibly influenced by the girl's arm in the picture, which could indicate a lifting action and could have caused some confusion. These values are relative in that they only provide an indication of the subjects' understanding of four of the thirteen pictures that were used in the learning material.

The preference of the subjects (Presented previously in Table 3.18 (p. 191) and Figure 3.9 (p. 192))

The subjects from the rural schools indicated forty-seven choices for modified pictures, and forty-nine choices for unmodified pictures. An analysis of the subjects' answers to Question 7 and Question 8 enabled an allocation of the subject's preference to either the modified picture or the unmodified picture, or an equal preference. As with the peri-urban subjects, there was a large proportion that indicated an equal preference.

TABLE 3.19

Means and standard deviations of the subjects' scores on the immediate and the delayed post-tests by condition and by questions (Experiment 6a, rural subjects).

QUESTIONS	Text only			Text and unmodified pictures			Text and modified pictures		
	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	20	6.33	3.12	22	5.73	4.06	24	6.33	2.94
Questions 1-7 Factual recall	20	2.1	0.91	22	1.73	1.28	24	2.33	1.4
Questions 8-15 Problem-solving	20	2.7	1.63	22	2.45	1.57	24	2.42	1.35
Questions 16-18 Picture-based	20	1.5	1.85	22	1.77	2.22	24	1.58	1.56
Delayed post-test (7 days)	19	2.68	2.21	21	2.53	2.2	19	2.47	1.17
Differences between the immediate and delayed tests	19	-9.93	14.78	21	-6.9	12.83	19	-13.6	12.57

3.6.5.(d) A discussion of the results of the immediate and the delayed post-tests of the rural subjects

It appears that the material, in the form that it was used, was too difficult and that the subjects could have based their answers on guessing. This floor effect is possibly due to a language barrier. A teacher at the school mentioned that, although tuition is supposed to take place in English, teachers tend to explain the work in Sesotho. Another observation that was made at the school is that Sesotho was the preferred communication medium at the school amongst the subjects and some of the teachers,

which could be an indication of the difficulty that the subjects had with the English language. The poorer socio-economic conditions of these subjects could also have contributed to the lower scores when compared to the mean scores of the peri-urban subjects. The mean scores of the rural subjects were also lower than the means of the peri-urban groups. The lower mean scores for the rural subjects were expected due to poorer infrastructures at these school and the poorer socio-economic backgrounds of the subjects when compared to the peri-urban subjects. A subject's level of visual literacy, which can be affected by educational and socio-economic variables, can determine if a picture is accessible and relevant to the learner (Cripwell, 1989; Goldsmith, 1986; Hugo, 1991; Peeck, 1993). It is also possible that the combination of test material, time constraint and test conditions were unfavourable towards the rural subjects, resulting in lower scores and no indication of picture facilitation.

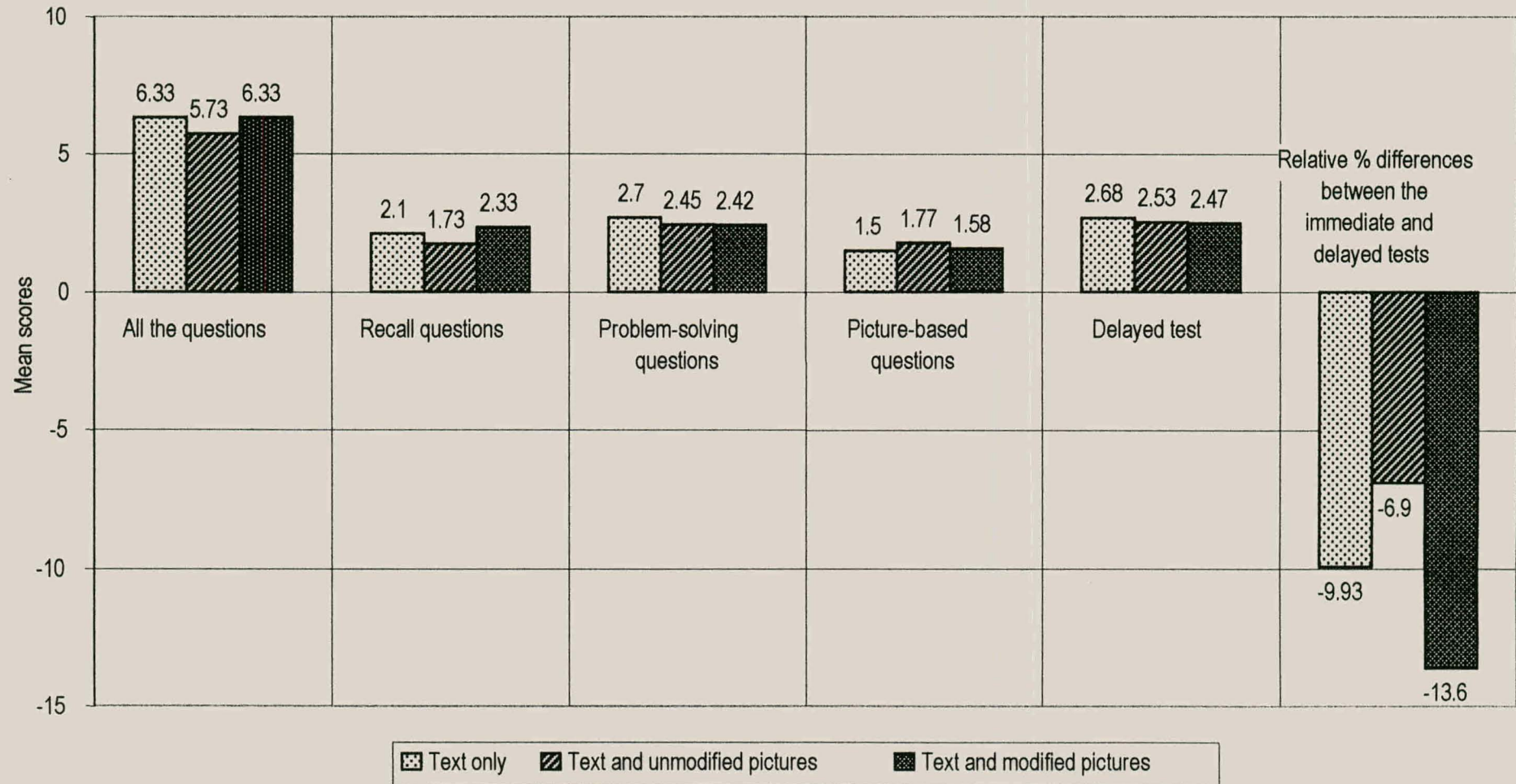
TABLE 3.20

Effect size (ES) of the immediate and the delayed post-tests by condition and by questions (Experiment 6a, rural subjects).

	CONDITION			
	Pictures and text		Modified pictures and text	
QUESTIONS	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	22	-0.19	24	0
Questions 1-7 Factual recall	22	-0.41	24	0.25
Questions 8-15 Problem-solving transfer	22	-0.15	24	-0.17
Questions 16-18 Picture-based questions	22	0.14	24	0.04
Delayed post-test (7 days)	19	-0.67	19	-0.09
Differences between the immediate and delayed tests	19	-0.02	19	0.25

FIGURE 3.10

A graphic representation of the mean scores of the subjects on the immediate and delayed post-tests
(Experiment 6a, rural subjects).



3.6.5.(e) The subjects' comments on the pictures

Question 7 of the post-test provided a space for the subject to write a reason why he or she preferred a modified or unmodified picture or had an equal preference for both pictures. Question 8 of the post-test provided space for the subject to write comments on what he or she liked or did not like in the picture. Only comparative comments between the modified and unmodified pictures, and remarks by the children that reflect their observation as perceiving a difference between the modified and unmodified pictures, are given. Comments from a subject, for example on what the person in the picture is doing or what the picture means, are ignored, as these do not provide information on their liking or preference of the two different pictures.

Comments from the peri-urban subjects

Twenty-one subjects commented on the clothes that the Chinese girl was wearing. They interpreted her clothing and hat as “a worker’s” clothes or as protective clothing, and appeared to prefer these picture due to the protective value of the clothing. Five subjects did not like the Chinese clothing, eight subjects liked the township background, and two subjects stated their liking for the clothing of the African girl. Two subjects expressed a preference for the African girl and her clothing as she looked like them. There were eight comments that related to the buildings and the proximity of the fire to the buildings. Only one person did not like the Chinese girl because she looked too old, and one person did not like the Chinese clothing.

Comments from the rural subjects

There was only one comment that could be considered a negative comparative comment. One subject did not like the hat that the Chinese girl in the picture was wearing. Five subjects commented on the difference in distance between the girl using the fire extinguisher and the buildings in the background. There were three comments that could be interpreted as a misinterpretation of the buildings in the background, and seven subjects appeared to have mistaken the Chinese girl’s clothing and hat for protective clothing.

What is clear from the subjects’ comments is that the subjects did not object to the Chinese girl or the Chinese background in the picture. Only twenty-eight subjects misinterpreted the Chinese girl’s clothing and only three subjects expressed their dislike for the Chinese girl in the picture. Only ten subjects specifically expressed their liking for the township environment and the African girl that were depicted in the picture.

3.6.6 Conclusion of Experiment 6a

There are several conclusions that can be drawn from this experiment. A brief summary of the results is given at the end of this section in Table 3.21 (p. 203) in order to provide a perspective of the results in their entirety. The concluding remarks are ordered in point form.

- 1) Modified pictures appear to be no better than unmodified pictures when an assessment test probes for recall of information and problem-solving skills.
- 2) One picture can be better than a series of pictures as long as the same picture is used in the post-test question and the question is designed to test recall of the information presented in the one picture.
- 3) One appropriate picture can bring about a relatively lower loss of factual information over a period of seven days than a series of pictures embedded with the same information, as long as the same picture is used in the assessment test.
- 4) Subjects appear to pay insufficient attention to pictures if they experience the learning material as difficult.
- 5) Subjects tend not to show a significant preference for modified over unmodified pictures if they are allowed to indicate that they do not have a specific preference for one or the other picture.

The research hypothesis stated that the picture groups would perform better than the text-only group, that the modified picture group would perform better than the other picture groups, and that the majority of the subjects would show a preference for the modified pictures. This hypothesis is partly rejected in favour of the alternative hypothesis.

3.6.7 Summary of Experiment 6a (Table 3.21 (p. 203))

One hundred and sixty-nine subjects from a peri-urban school (Grade 9 and Grade 11) and sixty-seven subjects from two rural schools (Grade 7 – Grade 10) participated in a

control group research design. The mean age of the peri-urban subjects was 16.4 years and the mean age of the rural subjects was 17.4 years.

One group received a text-only version, one group received the text and one explanative picture (only the peri-urban subjects), one group received the text and thirteen unmodified pictures with representational and explanative functions, and the last group received the text and thirteen modified pictures with representational and explanative functions. The text explained the parts and working mechanism of a fire extinguisher and was four hundred and fifteen words long. The subjects were not specifically instructed to look at the pictures. The subjects studied the material for fifteen minutes and used fifteen to twenty minutes to complete an immediate post-test. They used fifteen minutes to complete a delayed post-test seven days later.

It was hypothesised that the picture groups would perform better than the text-only group, that the modified picture-text group would perform better than the other two picture groups, that the subjects would show a significant preference for modified pictures, and that the picture groups would forget less in a delayed test than the text-only group. It was only when the mean scores of the questions where information was only available in pictures were compared and when the questions are based on the pictures that only one Grade 9 and one Grade 11 peri-urban picture groups scored significantly better than their respective control groups. The picture groups (of the peri-urban and rural schools) did not score better than the text-only group with questions that were designed to test factual recall and problem-solving skills. The Grade 9 peri-urban subjects who received one picture performed significantly better than the text-only group in the delayed post-test and also forgot relatively less than the text-only group.

The peri-urban subjects preferred the modified pictures to the unmodified pictures, but only with one set of pictures. The majority of subjects, in both the rural and peri-urban groups, indicated an equal preference. The modified pictures do not seem to facilitate learning more than unmodified pictures in terms of recall and problem-solving skills. It must be noted that the subjects were not specifically instructed to make use of the pictures.

It appears that the subjects did not make sufficient use of the pictures during the learning process. The research hypothesis is partly rejected in favour of the alternative hypothesis.

Table 3.21 (the summary) is presented on the next page.

TABLE 3.21

A summary of the results of Experiment 6a in tabular form.

p = the probability value, SD = Significant Difference, * = results that indicated that there is no difference between the control and experimental groups or no significant preference for modified pictures.

	Peri-urban subjects	Rural subjects
All the questions Immediate post-test	A difference for Grade 11 $p = 0.057$ (ANOVA)	*
Questions 1-7 Immediate post-test	*	*
Questions 8-15 Immediate post-test	*	*
Questions 16-18 Immediate post-test	A SD for the Grade 9 modified picture group, $p = 0.011$ (Tukey's). A SD for the Grade 11 unmodified picture group, $p = 0.011$ (Tukey's).	*
Question 1 Delayed post-test	A SD for the Grade 9 one-picture group, $p = 0.039$, (Tukey's). A SD for the Grade 9 one-picture group $p = 0.026$, (Tukey's) when the differences between the immediate and delayed tests are compared.	
Subjects' preference	A significant preference was shown for a modified picture when p was set at 0.05, but only when a choice had to be made between text-only, unmodified and modified picture-text learning material.	*
Subjects' relative visual literacy	Ranged between 82% - 42% with a mean of 64%.	Ranged between 75% - 43% with a mean of 62%

3.7 EXPERIMENT 6b: The fire extinguisher, a variation of Experiment 6a

3.7.1 Introductory comments

The previous experiment reported on fifty-four comparisons between the scores of the different control and experimental groups. Forty-nine of these comparisons found no difference between the scores of the text-only and the picture-text groups. The Grade 9 peri-urban subjects from the modified picture group and the Grade 11 peri-urban subjects from the unmodified picture group performed significantly better than their respective control groups. The text-and-one-picture group performed significantly better than the control group and forgot significantly less over a period of seven days than the control group. The peri-urban subjects also showed a significant statistical preference for modified pictures, but only in one of the three questions that probed for this preference. It was suspected that the subjects did not pay sufficient attention to the pictures and that the English language could have been a barrier in the experiment.

This experiment was similar to the previous experiment except for changes that were made to the material and procedures. These changes are discussed under the appropriate headings. The hypothesis for this experiment is the same as it was for the previous experiment.

3.7.2 The subjects for Experiment 6b

One hundred and thirty-nine Grade 9 subjects from a peri-urban school in Bloemfontein, with a mean age of 16 years, participated in this experiment. One hundred and twenty-eight subjects listed their home language as Sesotho, while the remaining eleven subjects spoke Setswana, Zulu and Xhosa. Ninety-six subjects were female and forty-three subjects were male. The school was, as in the previous experiment, regarded as one of the better schools in the peri-urban area.

3.7.3 The materials for Experiment 6b (the text, the questions and the pictures)

The material for this experiment was the same as that which was used in the previous experiment except for changes to the language, changes to the modified picture-text

material, and a shorter post-test. These changes are given in Addenda 3.27 – 3.33 (p. 302-320) at the end of this chapter.

3.7.3. (a) *The text*

The text material for this experiment was the same text about a fire extinguisher that had been used in the previous experiment. The language of the text was changed from English to Sesotho to avoid a possible language barrier that was suspected to exist in the previous experiment. The text changed from four hundred and fifteen words to four hundred and six words due to the use of the Sesotho language. Technical names for parts of the extinguisher, for example “strike knob”, were given in English in brackets just after the Sesotho description of the item.

3.7.3. (b) *The pictures*

The pictures in Experiment 6b were the same as those used in the previous experiment, except for small additions to five of the thirteen pictures that were given to an additional experimental group. Six labels were added to five of the thirteen pictures. These labels contained a descriptive sentence in Sesotho inside a callout box with an arrow pointing to a specific part of the fire extinguisher, which was discussed in the text. The English name of the part was given in brackets after the Sesotho text. An example of these changes is given in Plate 3.7 (p. 206). Cueing by means of arrows, colour and labels is an effective way to increase a picture’s value in educational material (Pettersson, 1993; Levie and Lentz, 1982; Peeck, 1993 and 1994). The material for this extra or fifth group thus has the theoretical base to facilitate learning to a greater degree than with any of the other experimental groups.

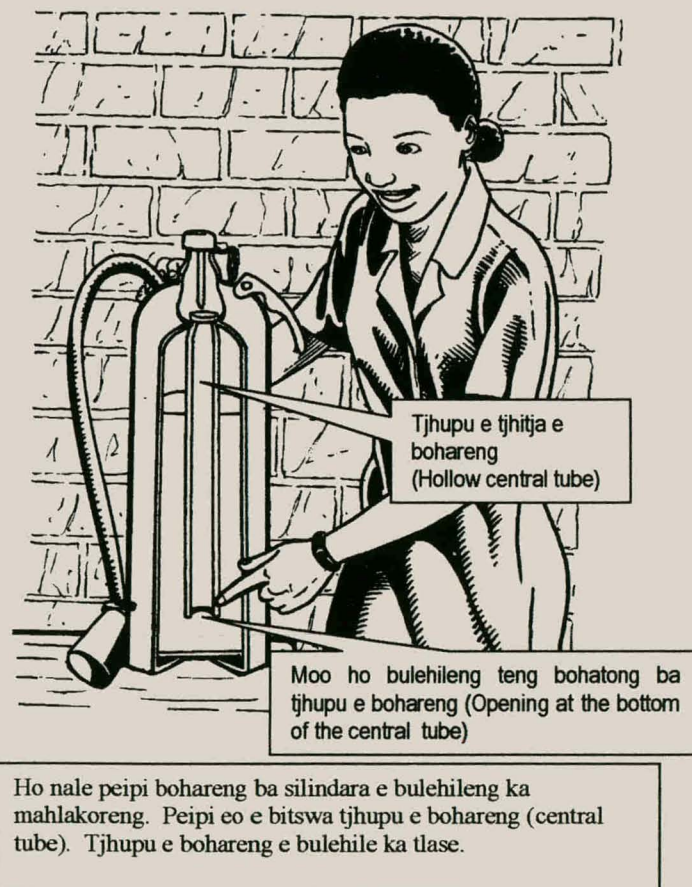
3.7.3. (c) *The questions*

The questions were the same as those used in the previous experiment, except for changes to the language and the length of the two post-tests. Two questions, deemed to be too time consuming, were removed from the immediate post-test, as less time was available at the schools to complete the last two experiments. More time was used to settle the subjects in the classroom, to introduce the project, and to commence and conclude the experiment than what was anticipated. Removing Question 15 and Question 18 reduced the overall time that was spent in a classroom.

Sesotho also replaced English as the language used for the two delayed post-tests. The last three questions in the delayed post-test, which tested the subjects' preference, was changed to effect a shorter testing time, and the test took a different approach towards testing their preferences. The subjects in the new delayed post-test were not asked to write down any comments or reasons, but just had to indicate by means of a mark which of the two pictures they preferred. Subjects were not given the option to make an equal-preference choice and were forced to indicate a preference for either the modified or the unmodified picture. The same pictures that were used in the first delayed post-test were also used in this adapted delayed post-test.

PLATE 3.7

An example of one of the pictures in the reading material of Experiment 6b where labels were added as additional graphic cues.



3.7.4 The experimental design and procedure of Experiment 6b

This experiment used the same experimental design that was used in the previous experiment, with the addition of the fifth experimental group. One group received text-only material, one group received the text and one picture, one group received the text with unmodified pictures, one group received the text with modified pictures, and one group received the text with modified pictures and labels. Students were allocated to the different groups through random numbers. The five groups were also randomly allocated as the control group or one of the experimental groups through the use of random numbers.

The experiment took place at the end of a school day in the classrooms where the subjects received their normal lessons. The researcher explained the research project to the subjects and warned them that they would be writing a test directly after having studied the material. The subjects who received pictures with their material were also specifically instructed to look at the pictures and to make sure that they understood the pictures. The subjects received twelve minutes to study the material and approximately fifteen to twenty minutes to complete the first post-test. The subjects participated willingly in the experiment. They were informed that their results would not be used for or against them. The subjects were also informed that they would be writing a second test seven days later on the same material. Changed circumstances at the school caused the delayed test to take place ten days later. The subjects wrote their delayed test ten days later in the same room and received thirteen minutes to complete the questions. The subjects were thanked for their participation and received a sweet after each post-test.

3.7.5 The results of Experiment 6b and a discussion of the results

The results of Experiment 6b are tabulated in Tables 3.22 to Table 3.25 (p. 210-216) and portrayed in Figure 3.11 (p. 211) and Figure 3.12 (p. 217).

Comparisons were made between the mean scores of the different experimental groups and the control group, and the subjects' preferences for modified or unmodified pictures. The data were analysed using a single factor Analysis of Variance (ANOVA) and the Z- test for proportions. Post-hoc analyses were conducted using Tukey's Least

Significant Difference tests where significant differences between the mean scores were indicated by the ANOVA test.

The results of the immediate post-test are given as a mean for all the questions combined (Questions 1-16), for the questions that tested factual recall (Questions 1-7), for the questions that tested problem-solving skills (Questions 8-14), and for questions where the information was only available in a picture (Questions 15-16).

The results of the delayed post-test are given as a mean for the first question. The subjects' relative visual literacy is expressed as a percentage. Their preferences for modified or unmodified pictures are given as the number of choices that they have made.

The large number of separate results are discussed, as in the previous experiment, under subheadings, and are summarised in a table at the end of this section to provide a logical and sequential presentation of the results.

The differences between the immediate and delayed post-tests are given as a percentage. They are relative values and do not express an actual increase or decrease in recall or comprehension over a period of time, as the questions and maximum score obtainable in each post-test are not the same. The values only indicate the comparative values obtained by each group.

3.7.5. (a) The results of the immediate and the delayed post-tests

(Table 3.22 (p. 210), Table 3.23 (p. 212) and Figure 3.11 (p. 211))

The three picture groups obtained means from 7.43 to 8.04, whilst the text-only and the one-picture group scored 5.54 and 5.6 respectively in the immediate post-test. This difference between the groups was significant $F(4, 134; 0.05) = 8.39 > 2.44$, $p = 0.000005$. Tukey's test showed that all three groups performed significantly better than the text-only and the text-and-one-picture group (unmodified group $p = 0.004$; modified group $p = 0.009$; modified group with labels $p = 0.00016$). A closer inspection of the data in Table 3.22 shows that it was only when the mean scores of the last two questions were compared with each other that the differences became significant.

The three picture groups scored between 1.61 and 2, whilst the text-only group scored 0.75 and the text-and-one-picture group scored 0.85. This difference was significant $F(4, 134; 0.05) = 9.58 > 2.44$, $p = 0.000001$. Tukey's test showed that the unmodified picture group scored significantly better than the text-only group ($p = 0.17$), and that the modified picture group scored significantly better than the text-only group ($p = 0.00008$) and significantly better than the one-picture group ($p = 0.00045$). The group that received modified pictures with labels likewise scored likewise better than the text-only group ($p = 0.00045$) and better than the one-picture group ($p = 0.00045$). There was, however, no difference between the mean scores of the two modified picture groups and the unmodified picture group. The group that received modified pictures with labels, contrary to expectations, did not perform any better than the other two groups that received pictures without labels. There were no significant differences between the groups when the questions that tested recall and problem-solving skills were compared with each other.

The delayed post-test showed a significant difference when the means were compared with each other $F(4, 124; 0.05) = 5.91 > 2.44$, $p = 0.00022$. The one-picture group obtained a mean of 5.53 whilst the other four groups' means ranged from 2.87 to 3.48. The means of the one-picture group differed significantly from the text-only group ($p = 0.00025$), the unmodified picture group ($p = 0.0013$), the modified picture group ($p = 0.025$) and the group that received modified pictures with labels ($p = 0.0049$).

The differences between the relative mean scores of the immediate and the delayed tests were also significant $F(4, 124; 0.05) = 9.69 > 2.44$, $p = 0.000011$. The scores for these values are expressed as a percentage, as the tests used different questions and did not use the same questions in the manner that they were used in Experiment 4. There was a +35 percent difference between the immediate and delayed post-test scores of the group that received only one picture with their text, whilst the difference of the other groups ranged between +1.6 percent and -0.4 percent. These scores are only relative to the other groups and the two post-tests that were completed. The scores of the one-picture group differed significantly from all the other groups (unmodified group $p = 0.0002$; modified group $p = 0.0029$; modified group with labels $p = 0.00022$).

TABLE 3.22

Means and standard deviations of the subjects' mean scores of the immediate and the delayed post-tests by condition and by questions (Experiment 6b).

QUESTIONS	CONDITION														
	Text only			Text and one picture			Text and unmodified pictures			Text and modified pictures			Text and modified pictures with labels		
	<i>N</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	28	5.54	1.82	27	5.6	2.12	28	7.75*	2.43	28	7.43*	2.24	28	8.04*	2.3
Questions 1-7 Factual recall	28	3	1.09	27	2.93	1.36	28	3.39	1.34	28	3.54	1.50	28	3.54	1.23
Questions 8-14 Problem-solving	28	1.79	1.1	27	1.78	1.25	28	2.57	1.45	28	2.21	1.23	28	2.5	1.67
Questions 15-16 Picture-based	28	0.75	1.04	27	0.85	1.13	28	1.61*	1.07	28	2**	1.05	28	2**	0.86
Delayed post-test (10 days)	23	2.87	1.98	26	5.54***	1.98	26	3.27	2.13	27	3.78	2.51	27	3.48	2.03
Differences between the immediate and delayed tests	23	1.6	27.1	26	35.9****	28	26	-2	30	27	7.04	34.8	27	-0.41	21.6

* Significant difference when compared to the text-only group.

** Significant difference when compared to the text-only and the text-and-one-picture group.

*** Significant difference when compared to all the other groups.

FIGURE 3.11

A graphic representation of the mean scores of the subjects on the immediate and delayed post-tests
(Experiment 6b).

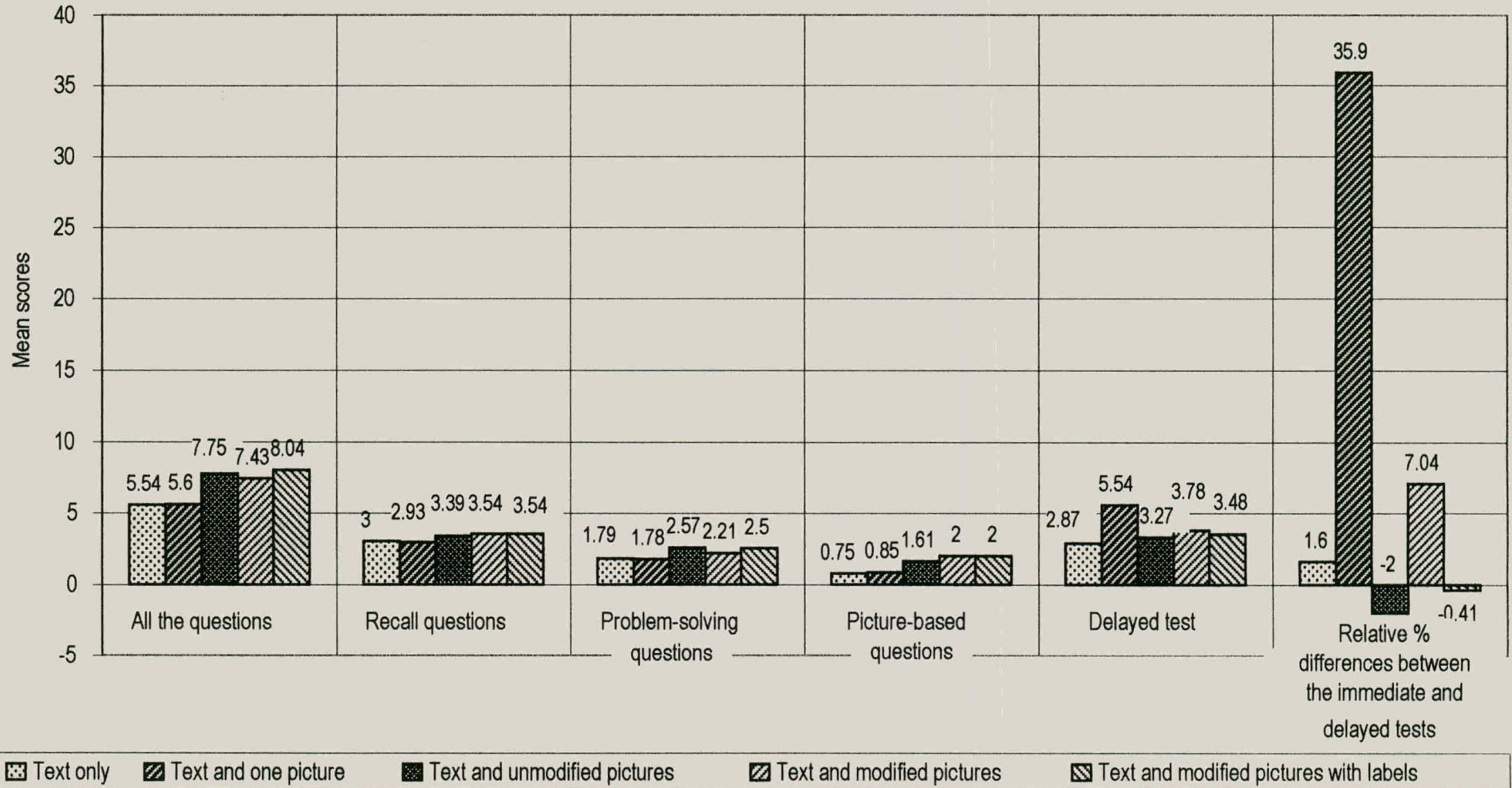


TABLE 3.23

Effect size (ES) of the immediate and the delayed post-tests by condition and by questions (Experiment 6b).

QUESTIONS	CONDITION							
	Text and one picture		Text and unmodified pictures		Text and modified pictures		Text and modified pictures with labels	
	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>	<i>n</i>	<i>ES</i>
All the questions	28	0.03	28	1.21	28	1.04	28	1.37
Questions 1-7 Factual recall	28	-0.06	28	0.36	28	0.5	28	0.5
Questions 8-14 Problem-solving	28	-0.009	28	0.71	28	0.38	28	0.65
Questions 15-16 Picture-based	28	0.1	28	0.83	28	1.2	28	1.2
Delayed post-test (10 days)	26	1.35	26	0.2	27	0.46	27	0.31
Differences between the immediate and delayed tests	26	1.27	26	0.07	27	0.2	27	0.07

3.7.5. (b) *A discussion of the results of the immediate and the delayed post-tests*

The non-significant results between the five groups when the mean scores of the questions that tested factual recall and problem-solving skills were compared with each other, was not expected. It was hoped that the change from English to Sesotho in the text would remove a possible language barrier and that the instruction to make use of the pictures would benefit the subjects who received pictures with their text. What must be noted is that the groups who received modified and unmodified pictures with their text did obtain higher scores than the text-only group, but this small increase was not statistically significant at 0.05. Even the group that received labels with the modified pictures did not perform significantly better with factual recall and problem-solving

questions when compared to all the other groups. Labels are a cue that can activate the facilitating effect of pictures when they are combined with text (Peeck, 1993 and 1994). The low mean scores of all the questions of the groups when expressed as a percentage ranged between 43 percent for one experimental group to 34 percent for the control group. These low scores could be an indication that other variables interfered with the subjects' learning and scoring abilities, and that these variables, or single variable, overshadowed the possible facilitating effect of the pictures. A change to English and a verbal instruction to make use of the pictures do not appear to have positively influenced the picture groups.

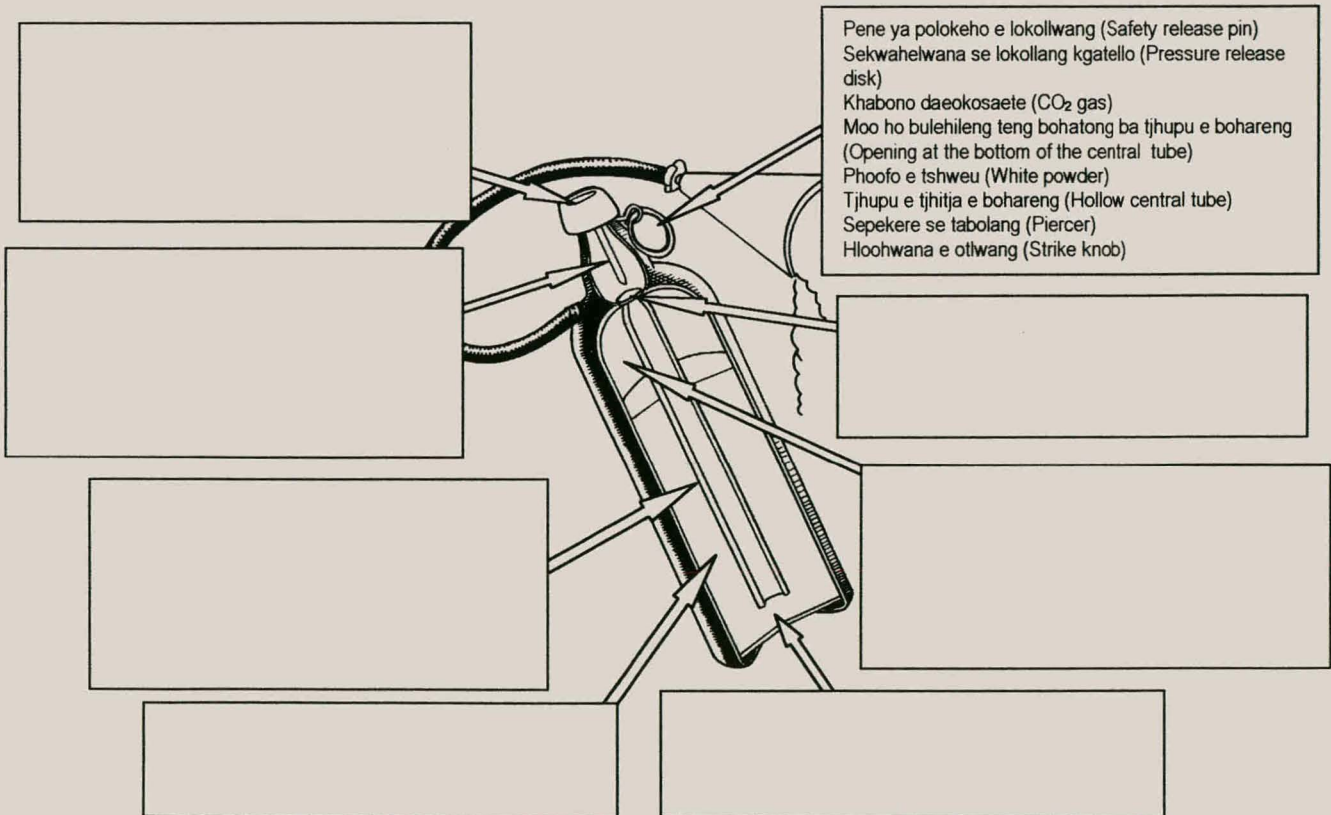
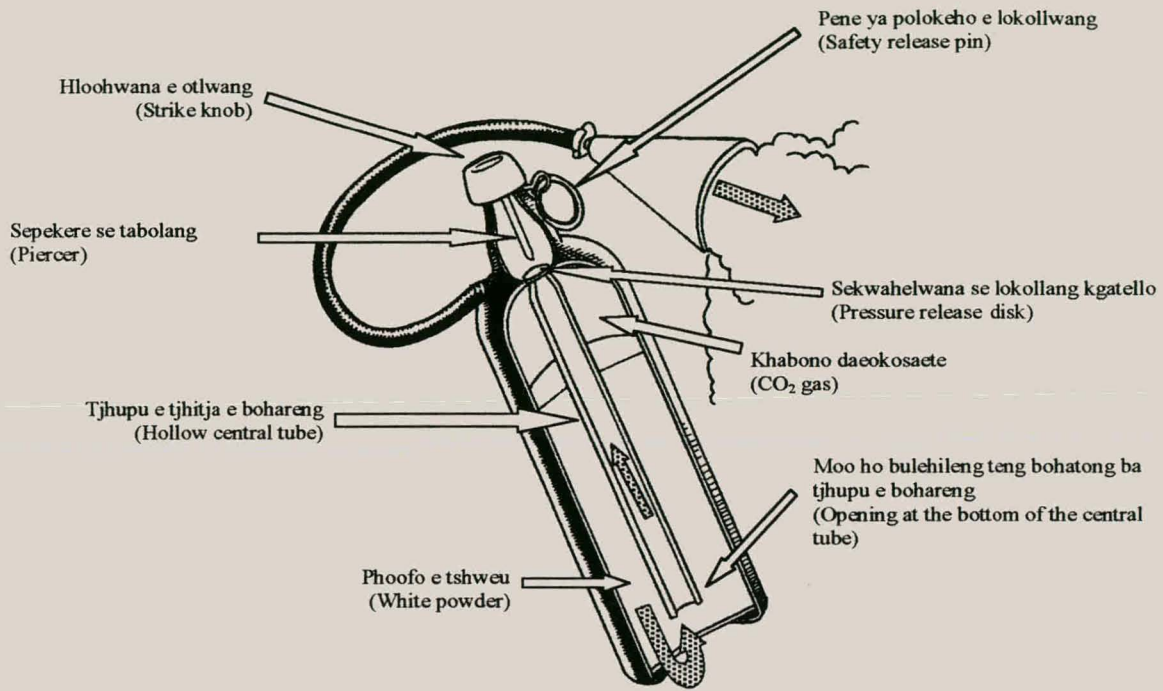
There was a significant difference between the mean scores of the questions where pictures were included with the questions. This was expected, as the three picture groups did have access to the information in the pictures.

The comparison of the mean differences of the delayed post-test showed that the one-picture group performed significantly better than all the other groups. The group that received only one picture forgot relatively less than all the other picture groups and the control group over a period of ten days. This group received the same picture in their reading material that they had received in the delayed post-test, and this picture appeared to have acted as a priming agent to recall the parts of the extinguisher. This is then also an obvious and logical reason why this group performed better. What is possibly unique about this is that one picture produced better results than a series of pictures that contained the same information. It appears that when subjects experience learning material and questions as being difficult, a visual testing method, based on the same visuals that were used in the learning material, can benefit subjects. It is also possible that a visual testing method is a more accurate testing method in the circumstances and for the type of student described for this experiment. The picture that the one-picture group used and the picture that was used in the delayed post-test are given on the next page in Plate 3.8 (p. 214). These pictures are reduced to fit onto this page, resulting in insufficient space for all the text to fit into all the callout boxes of the bottom picture. The original material is in Addendum 3.26 (p. 298-301).

The group that received modified pictures with labels and instructions to make use of the pictures did not score significantly better than the unmodified picture group or even the control group. Only part of the data support a small part of the experimental hypothesis and only with respect to the delayed post-test.

PLATE 3.8

An example of the picture that the one-picture group received and the picture that was used in the delayed post-test. The upper picture was used in the learning material. The bottom picture was used in the delayed post-test.







3.7.5.(c) *The subjects' relative visual literacy (Table 3.24)*

The results for this experiment are similar to the trend that was shown in the previous experiment. The subjects obtained lower scores for picture two and picture four as was the case in the previous experiment. Their comprehension of these pictures ranged between 54 percent and 30 percent. These values are relative in that they only provide an indication of the subjects' understanding of four of the fourteen pictures that were used in the learning material. Before receiving their learning material, the subjects were instructed to attend to the pictures and to make sure that they understood the pictures. This does not seem to have worked, as the low scores for pictures two and four persisted.

TABLE 3.24

The subjects' relative visual literacy expressed as a percentage (Experiment 6b).

					
Picture No.	1	2	3	4	Total
Grade 9 peri-urban subjects	87	54	76	30	62

3.7.5.(d) *The subjects' preference (Table 3.25 (p. 216) and Figure 3.12 (p. 217)).*

Question 6 in the delayed post-test provided the subjects with three sets of two pictures each. Each set contained a modified and an unmodified picture. The subjects were asked to indicate which picture they liked or preferred the most. Two hundred and seventy-two choices were made for the modified pictures, whilst one hundred and twenty-two

choices went to the unmodified pictures. Three choices indicated an equal preference (although this option was not available to the subjects), whilst four choices did not indicate a preference or were left out. This larger choice for the modified picture material, when compared to the unmodified material, was statistically significant: $Z_{\text{test}} = 7.56 >$ when $Z_{0.05} = 1.645$.

It appears that subjects tend to prefer pictures that are modified to their culture if they must make a choice between what is familiar to them and what is culturally unfamiliar.

TABLE 3.25

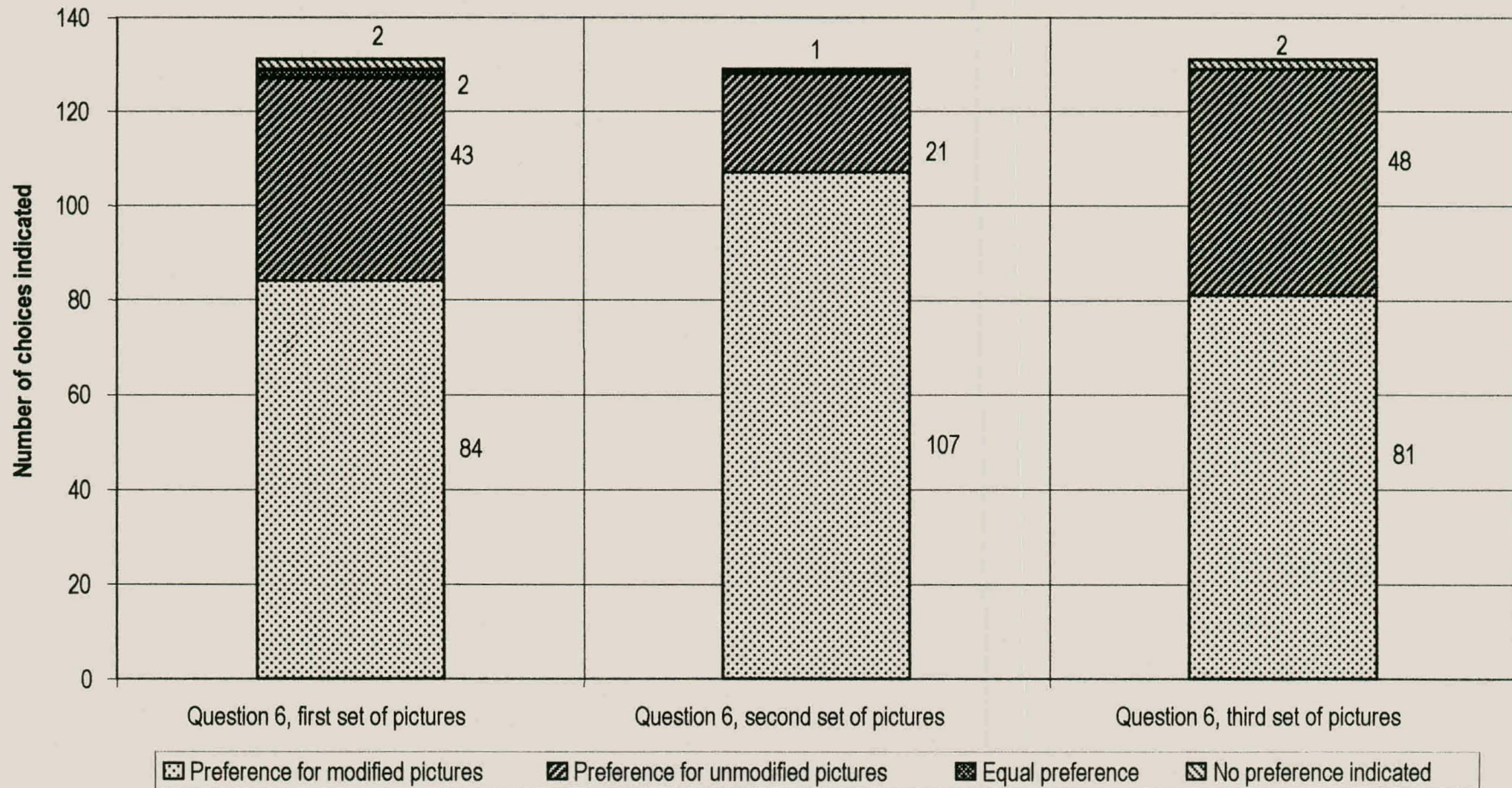
The number of choices indicated for a modified or an unmodified picture
(Experiment 6b).

Question	Preference for modified pictures	Preference for unmodified pictures	Equal preference	No preference indicated (no choice made)
Question 6 First set of pictures	84	43	2	2
Question 6 Second set of pictures	107	21	1	0
Question 6 Third set of pictures	81	48	0	2
Total	272*	112	3	4

* Significant preference for modified pictures when compared to the unmodified pictures.

FIGURE 3.12

The number of choices indicated for a specific picture (Experiment 6b).



3.7.6 Conclusion of Experiment 6b

There are several conclusions that can be drawn from this experiment. A brief summary of the results is given in Table 3.26 (p. 220) to provide a perspective of the results in their entirety. The concluding remarks are given in point form and are similar to those that were made with regard to the previous experiment. These conclusion must be viewed in the context of the experiment and cannot necessarily be generalised to other picture-text communication material.

- 1) Modified pictures appear to be no better than unmodified pictures or even just one appropriate explanative picture in an immediate post-test in terms of recall and problem-solving skills.
- 2) All the experimental groups scored significantly better than the text-only group when the mean scores of all the questions were compared with each other, but this improvement was due to questions that probed for information that was only available in the pictures.
- 3) An instruction to the students to make use of the pictures and the addition of labels did not help the modified pictures to facilitate learning more than unmodified pictures or even just one explanative picture in terms of recall and problem-solving skills.
- 4) Introducing Sesotho as the language in the learning material did not appear to benefit the subjects in this experiment.
- 5) The subjects preferred the modified pictures to the unmodified pictures for three sets of pictures from which they had to choose.
- 6) Subjects can benefit more from one picture than a series of pictures in learning material if the testing method uses the same picture that what was used in the learning material and if the questions test the subjects on the recall of the same information displayed in the original picture. Pictures are more likely to benefit a reader when the text is difficult to comprehend, for example an unfamiliar object or situation. The picture can help the reader to visualise the object or situation (Peeck, 1993).
- 7) Verbal instructions to subjects to make use of pictures will not necessarily effect a better understanding of the pictures or of the material accompanying the pictures.

The research hypothesis stated that the picture groups would perform better than the text-only group, that the modified picture group would perform better than the other picture groups and that the majority of the subjects would show a preference for the modified pictures. This hypothesis is partly rejected in favour of the alternative hypothesis.

3.7.7 Summary of Experiment 6b

One hundred and thirty-nine Grade 9 subjects from a peri-urban school participated in a control group research design. The mean age of the peri-urban subjects was 16 years.

One group received a text-only version, one group received the text and one explanative picture, one group received the text and thirteen unmodified pictures with representational and explanative functions, one group received the text and thirteen modified pictures with representational and explanative functions, and the last group also received the same text with the modified pictures except that there were six labels added to five of the pictures. The text explained the parts and working mechanism of a fire extinguisher, was set in Sesotho, and was four hundred and six words long. The subjects were specifically instructed to look at the pictures and to make sure that they understood the pictures. The subjects studied the material for twelve minutes and used fifteen to twenty minutes to complete an immediate post-test. They used fifteen minutes to complete a delayed post-test ten days later. It was hypothesised that the picture groups would perform better than the text-only group, that the two modified picture-text groups would perform better than the other picture groups, that the subjects would show a significant preference for modified pictures, and that the picture groups would forget less in a delayed test than the text-only group. The two modified and the unmodified picture-groups scored significantly better than the text-only group when the mean scores of all the questions were compared with each other. This improvement was, however, caused by the scores that they obtained with the questions where information was only available in pictures and was not specifically mentioned in the text, and where the questions were picture based. The picture groups did not score better than the text-only group with questions that were designed to test factual recall and problem-solving skills. The modified and unmodified picture groups also did not perform significantly better than the text-only group in the delayed post-test. The group that received the one picture with their text, however, performed significantly better than all the other groups in the post-test. This group also forgot relatively less than all the other groups when the differences between the immediate and delayed tests were compared with each other.

The primary conclusion of this experiment is that one appropriate picture with labels can be more effective than a series of pictures that contain the same information, as long as the same picture is used in an assessment test and as long as the questions probe for the same information that was presented by labels in the picture.

The majority of subjects preferred modified pictures. Modified pictures do not seem to facilitate learning more than unmodified pictures or even just one explanative picture in terms of recall and problem-solving skills. Only part of the hypothesis is not rejected. The research hypothesis is partly rejected in favour of the alternative hypothesis.

TABLE 3.26

A summary of the results of Experiment 6b in tabular form.

p = the probability value, SD = Significant Difference, * = results that indicated that there is no difference between the control and experimental groups

All the questions Immediate post-test	A SD, $p = 0.000005$ (ANOVA)
Questions 1-7 Immediate post-test	*
Questions 8-15 Immediate post-test	*
Questions 16-18 Immediate post-test	A SD for the unmodified picture group (compared to the text-only group), $p = 0.17$ (Tukey's). A SD for the modified picture group (compared to the text-only group), $p = 0.00008$ (Tukey's). A SD for the modified picture group (compared to the one-picture group), $p = 0.00045$ (Tukey's). A SD for the modified picture group with labels (compared to the text-only group), $p = 0.00045$ (Tukey's). A SD for the modified picture group with labels (compared to the one-picture group), $p = 0.00045$ (Tukey's).
Question 1 Delayed post-test	A SD for the one-picture group (compared to all the other groups), $p = 0.00022$, (ANOVA). A SD for the one-picture group when the differences between the immediate and delayed tests are compared (compared to all the other groups), $p = 0.000011$, (ANOVA)
Subjects' preference	A significant preference was shown for a modified picture when p was set at 0.05.
Subjects' relative visual literacy	Ranged between 87% - 30% with a mean of 62%.

3.8 EXPERIMENT 6c: The fire extinguisher, a variation of Experiment 6b

3.8.1 Introductory comments

Experiment 6b reported on thirty-three comparisons between the scores of the different control and experimental groups. Eight of these comparisons found a significant difference between the scores of the different groups. The most important result from the previous experiment was that the group that received the one picture with their text performed significantly better than all the other groups in the delayed test and also forgot relatively less than all the other groups.

This experiment was similar to the previous experiment except for changes to the experimental groups. These changes are discussed under the appropriate headings. The hypothesis for this experiment is the same as the one used in the previous experiment.

The report on this experiment will be limited to the changes that took place in the design of the experiment, the results, a discussion of the results and the conclusion.

3.8.2 The subjects for Experiment 6c

Seventy-two Grade 9 subjects and sixty-three Grade 11 subjects from a peri-urban school in Bloemfontein participated in this experiment. The mean ages of the Grade 9 and Grade 11 subjects were 16.8 and 19.8 years respectively. One hundred and thirty-three subjects listed their home language as Sesotho, while the remaining eleven subjects spoke Setswana, Zulu, and Xhosa. Eighty-one subjects were female and forty-four subjects were male.

3.8.3 The materials for Experiment 6c

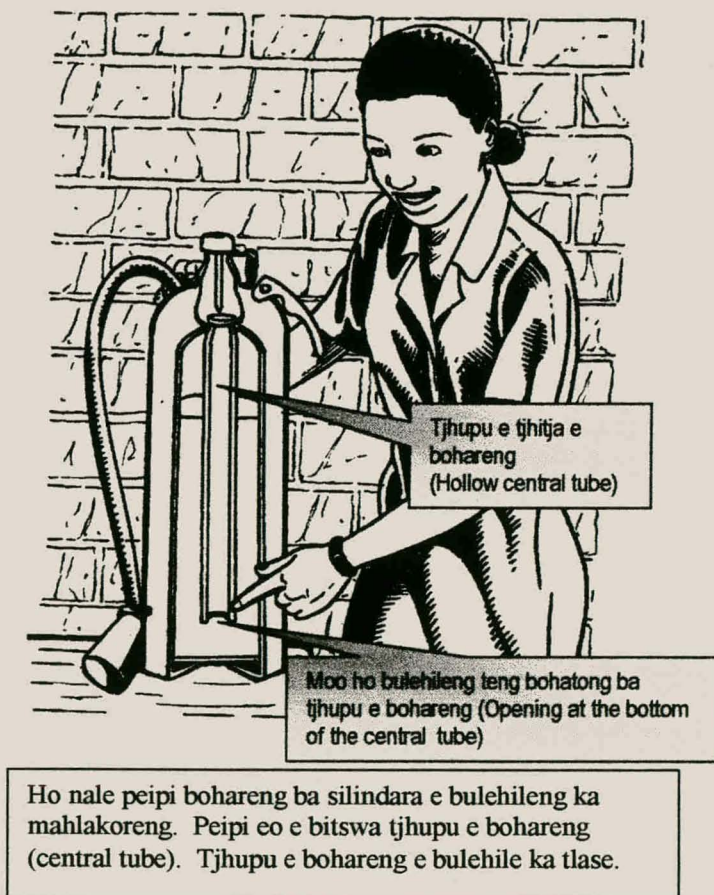
The experimental material for this experiment was the same as that used in the previous experiment, except for changes to the modified picture-text material. This is therefore the only item described. The material for this experiment is given in Addendum 3.20, (p. 283-284) and Addenda 3.27 – 3.33 (p. 302-318) at the end of chapter 3.

3.8.3.(a) The pictures

The six labels and the items described by the labels in the modified picture-text material were given localised colour to increase the attention-getting value of the graphic cues. An example of these changes is given in Plate 3.9. The use of colour and labels is an effective way to increase a picture's value in educational material (Levie and Lentz, 1982; Pettersson, 1993; Peeck, 1993 and 1994). Combining cues can increase facilitation over non-cued material, whilst cueing only in pictures or only in text will not automatically facilitate comprehension or recall (Beck, 1984). It was hoped that this combination of attention and repetition factors would assist learning.

PLATE 3.9

An example of one of the pictures in the reading material of Experiment 6c where colour was added to the labels as an additional graphic cue.



3.8.4 The experimental design and procedure of Experiment 6c

This experiment used the same experimental design as that which was used in the previous experiment, except that there was only one modified picture group whose pictures contained localised colour and coloured labels. The experimental design had therefore one control group (text-only), one modified picture group with colour and labels, one unmodified picture group, and one group that received the text with only one picture. The Grade 9 and Grade 11 subjects were treated separately as with Experiment 6a. The one-picture group was not included with the Grade 11 subjects due to the low number of students in this group.

The procedure was the same as in the previous experiment. The subjects received instructions to look at the pictures and to make use of the pictures.

3.8.5 The results of Experiment 6c and a discussion of the results

The results of Experiment 6c are tabulated in Table 3.27 to Table 3.31 (p. 225-234) and portrayed in Figure 3.13 to Figure 3.15 (p. 227-230).

There was a significant difference between the groups of the Grade 11 subjects when all the questions were compared with each other $F(2, 60; 0.05) = 6.37 > 3.15$, $p = 0.003$. The scores obtained with the questions that were picture based caused this difference. Further analysis (Tukey's test) showed that both the modified group ($p = 0.00012$) and the unmodified group ($p = 0.0005$) performed better than the text-only group, but only in Questions 15-16, which are the picture-based questions.

Likewise the Grade 9 subjects from the modified group scored significantly better in the picture-based questions than the text-only group ($p = 0.018$).

The group that received modified pictures with labels and colour, contrary to expectations, did not perform any better than the other group that received pictures without labels. There were no significant differences between the groups when the questions that tested recall and problem-solving skills were compared with each other.

There was no significant statistical difference between the groups in the delayed post-test and also no significant difference when the differences between the immediate and delayed post-tests were compared with each other.

3.8.5(a) A discussion of the results of the immediate and the delayed post-tests

The non-significant results between the five groups when the mean scores of the questions that tested factual recall and problem-solving skills were compared with each other, was not expected. It was hoped that the addition of colour to the labels would assist the modified group.

The groups that received modified and unmodified pictures with their text did obtain higher scores than the text-only group in most of the questions and in the delayed post-test, but these small increases were not statistically significant at 0.05. Even the group that received labels and colour with the modified pictures did not perform significantly better with factual recall and problem-solving questions when compared to all the other groups.

Subjects in Experiment 6a, who received the text and one-picture material, performed better than the text-only group and forgot relatively less than the text-only group. The subjects from Experiment 6b showed the same tendency. Subjects in Experiment 6b, who received the text and one-picture material, not only performed better than the text-only group and forgot relatively less than the text-only group, but also performed better than all the other groups. It was therefore surprising that this tendency was not found with the subjects from this last experiment.

What is noticeable, is that the scores of the subjects in Experiment 6a and in Experiment 6b are comparatively higher than those in Experiment 6c. The means for all the questions, for example for the Grade 9 subjects, ranged between 39 percent for the modified group and 29 percent for the control group. The means in the previous experiment, for the same questions and for Grade 9 subjects, ranged from 43 percent to 34 percent. A comparison between the different schools, for example by using all the means scores (Grade 9) of the delayed test, found that there was a significant statistical difference $F(2, 280; 0.05) = 8.41 > 3.028$, $p = 0.00028$. The scores were 3.8, 3.32 and 2.4 respectively. It appears as if the lower overall performance of the subjects in the last experiment could have played a major part in obscuring or nullifying the potential facilitating effect of the pictures and the graphic cues.

The results have shown that the group that received modified pictures with labels, colour, and instructions to make use of the pictures did not score significantly better than the unmodified picture group or even the control group. Only part of the data supports a small part of the experimental hypothesis and only with respect to the delayed post-test.

TABLE 3.27

Means and standard deviations of the subjects' scores in the immediate and the delayed post-tests by condition and by questions (Experiment 6c).

*The first row in each cell represents the scores of the Grade 9 subjects
The second row in each cell represents the scores of the Grade 11 subjects*

QUESTIONS	CONDITION											
	Text only			Text and one picture			Text and unmodified pictures			Text and modified pictures with labels and colour		
	<i>n</i>	\bar{X}	<i>SD</i>	<i>n</i>	\bar{X}	<i>SD</i>	<i>n</i>	\bar{X}	<i>SD</i>	<i>n</i>	\bar{x}	<i>SD</i>
All the questions	18	5	1.33	19	5.74	1.97	17	6.71	1.96	18	6.5	2.71
	20	5.6	2.21	n.o.	n.o.	n.o.	21	7.95*	2.25	22	7.45*	2.2
Questions 1-7 Factual recall	18	2.56	0.92	19	3.21	1.23	17	3.12	1.32	18	3	1.64
	20	3	1.41	n.o.	n.o.	n.o.	21	4	1.45	22	3.01	1.09
Questions 8-14 Problem-solving questions	18	2	1.14	19	1.63	1.16	17	2.18	1.19	18	1.94	1.21
	20	2.25	1.71	n.o.	n.o.	n.o.	21	2.29	0.96	22	2.18	1.01
Questions 15-16 Picture-based questions	18	0.44	0.86	19	0.89	1.05	17	1.41	1.33	18	1.55*	1.15
	20	0.35	0.59	n.o.	n.o.	n.o.	21	1.67*	1.31	22	2.22*	1.02
Delayed post-test (7 days)	14	1.93	2.09	18	2.94	2.01	16	2.31	2.57	17	2.29	2.14
	18	3.33	2.89	n.o.	n.o.	n.o.	21	4.19	2.91	21	2.76	2.41
Differences between the immediate and delayed tests	14	-9.63	24.5	18	2.31	22.6	16	-9.93	31.6	17	-7.03	21.3
	18	1.21	36	n.o.	n.o.	n.o.	21	7.37	32.6	21	-2.5	28.9

Significant difference when compared to the text-only group

n.o. = not obtained

TABLE 3.28

Effect size (ES) of the immediate post-test of the one picture and text, picture-text, modified picture-text, and modified picture-text with labels conditions (Experiment 6c).

*The first row in each cell represents the scores of the Grade 9 subjects
The second row in each cell represents the scores of the Grade 11 subjects*

CONDITION						
	One picture and text		Text and unmodified pictures		Text and modified pictures with labels and colour	
QUESTIONS	<i>N</i>	<i>ES</i>	<i>n</i>	<i>ES</i>	<i>N</i>	<i>ES</i>
All the questions	19	0.56	17 21	1.29 1.06	18 22	1.13 0.84
Questions 1-7 Factual recall	19	0.7	17 21	0.6 0.71	18 22	0.47 0.007
Questions 8-14 Problem-solving questions	19	-0.32	17 21	0.15 0.02	18 22	-0.05 -0.04
Questions 15-16 Picture-based questions	19	0.52	17 21	1.13 2.24	18 22	1.29 3.17
Delayed post-test (10 days)	18	0.48	16 21	0.18 0.29	17 21	0.17 -0.19
Differences between the immediate and delayed tests	18	0.49	16 21	-0.01 0.17	17 21	-0.11 0.1

FIGURE 3.13

A graphic representation of the mean scores of the Grade 9 subjects in the immediate and delayed post-tests (Experiment 6c).

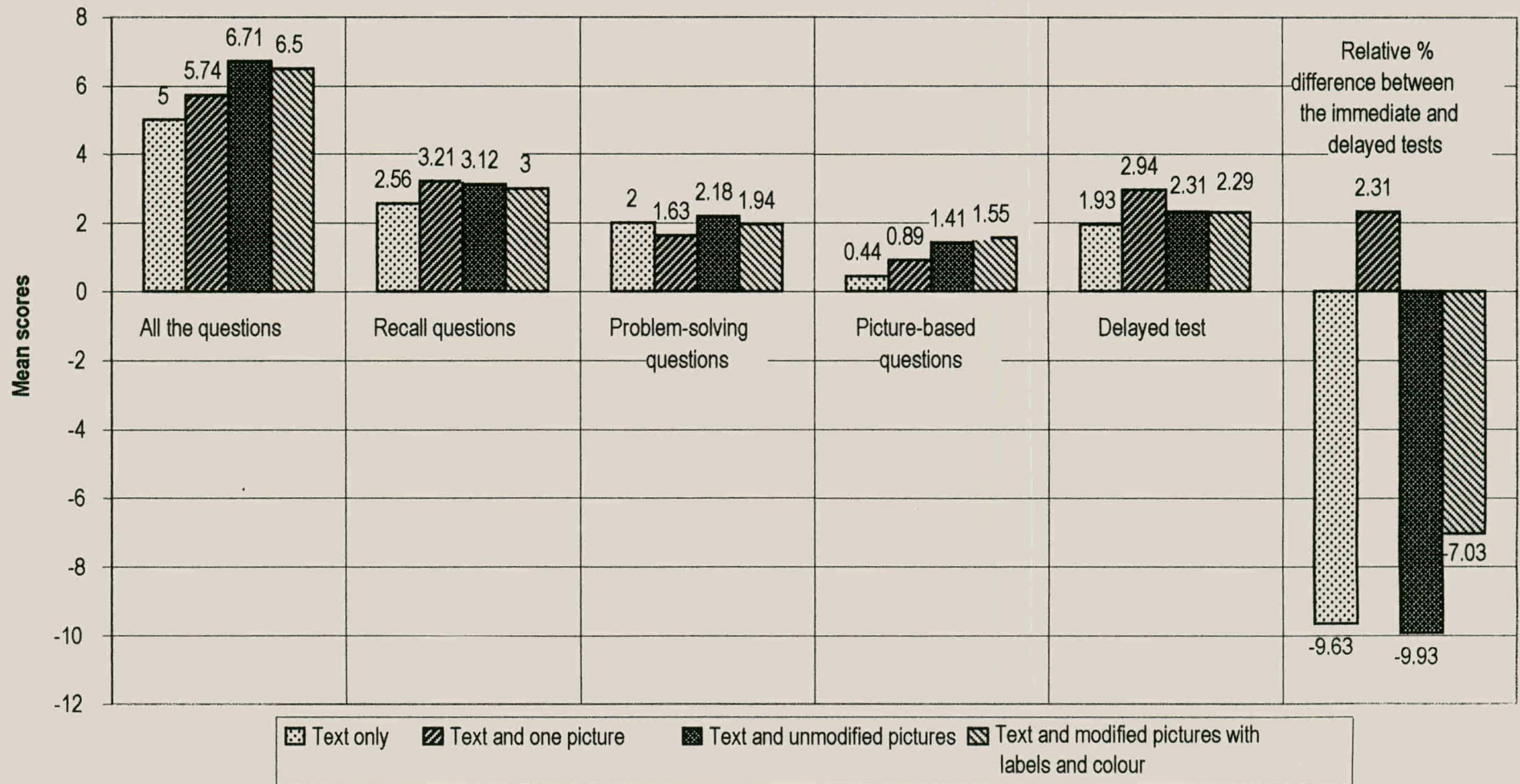
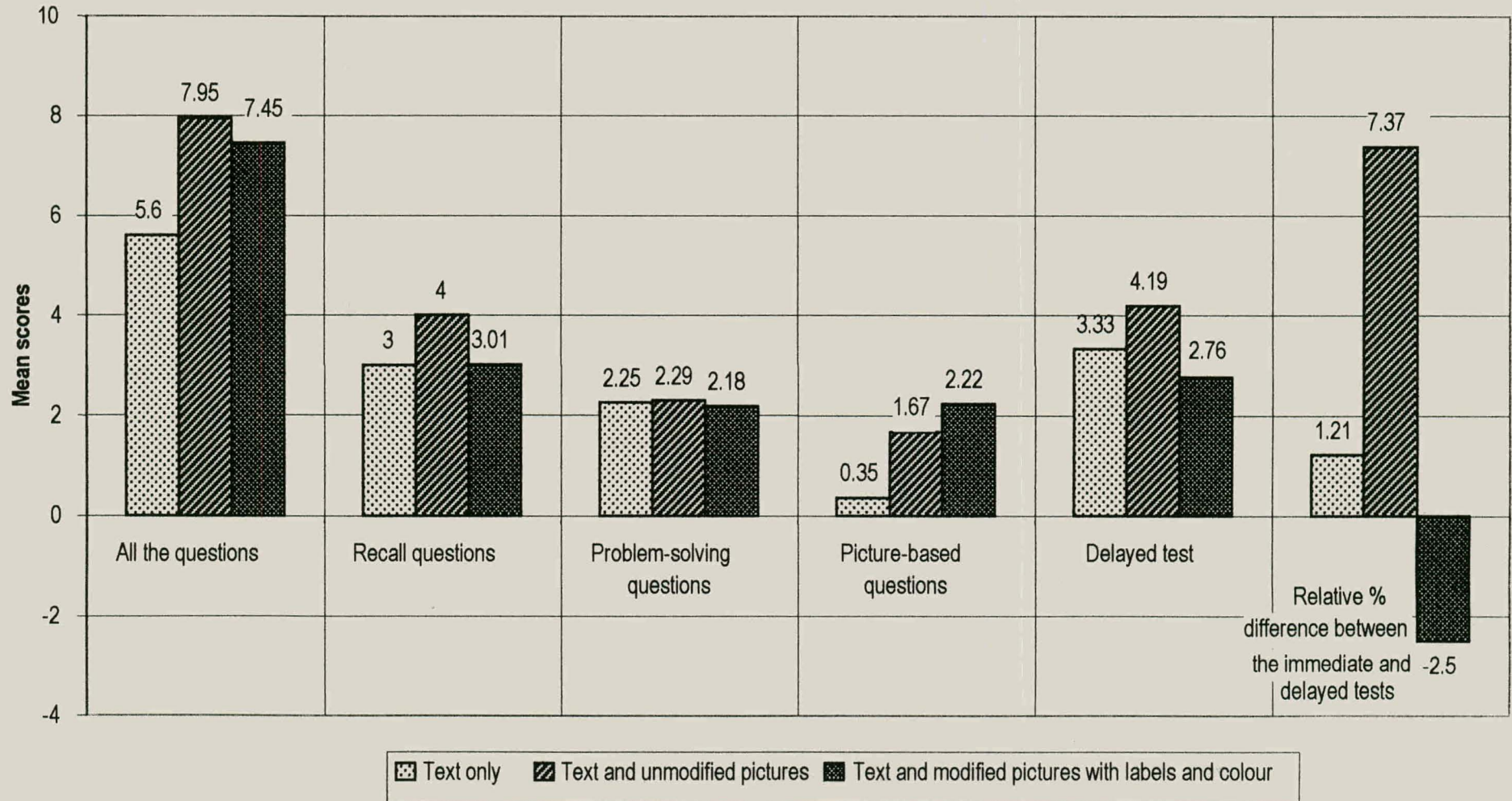


FIGURE 3.14

A graphic representation of the mean scores of the Grade 11 subjects in the immediate and delayed post-tests (Experiment 6c).



3.8.5(b) The subjects' relative visual literacy (Table 3.29)

The results for this experiment are similar to the trend that was shown in the previous two experiments. The subjects again obtained lower scores for picture two and picture four. Their comprehension of these pictures ranged between 54 percent and 31 percent. The overall mean comprehension dropped from 64 percent in Experiment 6a to 58 percent in this experiment.

TABLE 3.29

The subjects' relative visual literacy expressed as a percentage (Experiment 6c).

Picture No.	1	2	3	4	Total
Grade 9 and Grade 11 peri-urban subjects	83	54	66	31	58.5

3.8.5.(c) The subjects' preference (Figure 3.15 (p. 230) and Table 3.30 (p. 231))

One hundred and eighteen choices were made for modified pictures and fifty-one choices were made for unmodified pictures. Seven choices indicated an equal preference (although this option was not available to the subjects) whilst nineteen choices did not indicate a preference or were omitted. This greater choice for the modified picture material, when compared to the unmodified material, was statistically significant: $Z_{\text{test}} = 5.15 > \text{when } Z_{0.05} = 1.645$.

The trend that subjects prefer pictures that are modified to their culture continued to be manifested with this experiment.

FIGURE 3.15
The number of choices indicated for a specific picture (Experiment 6c).

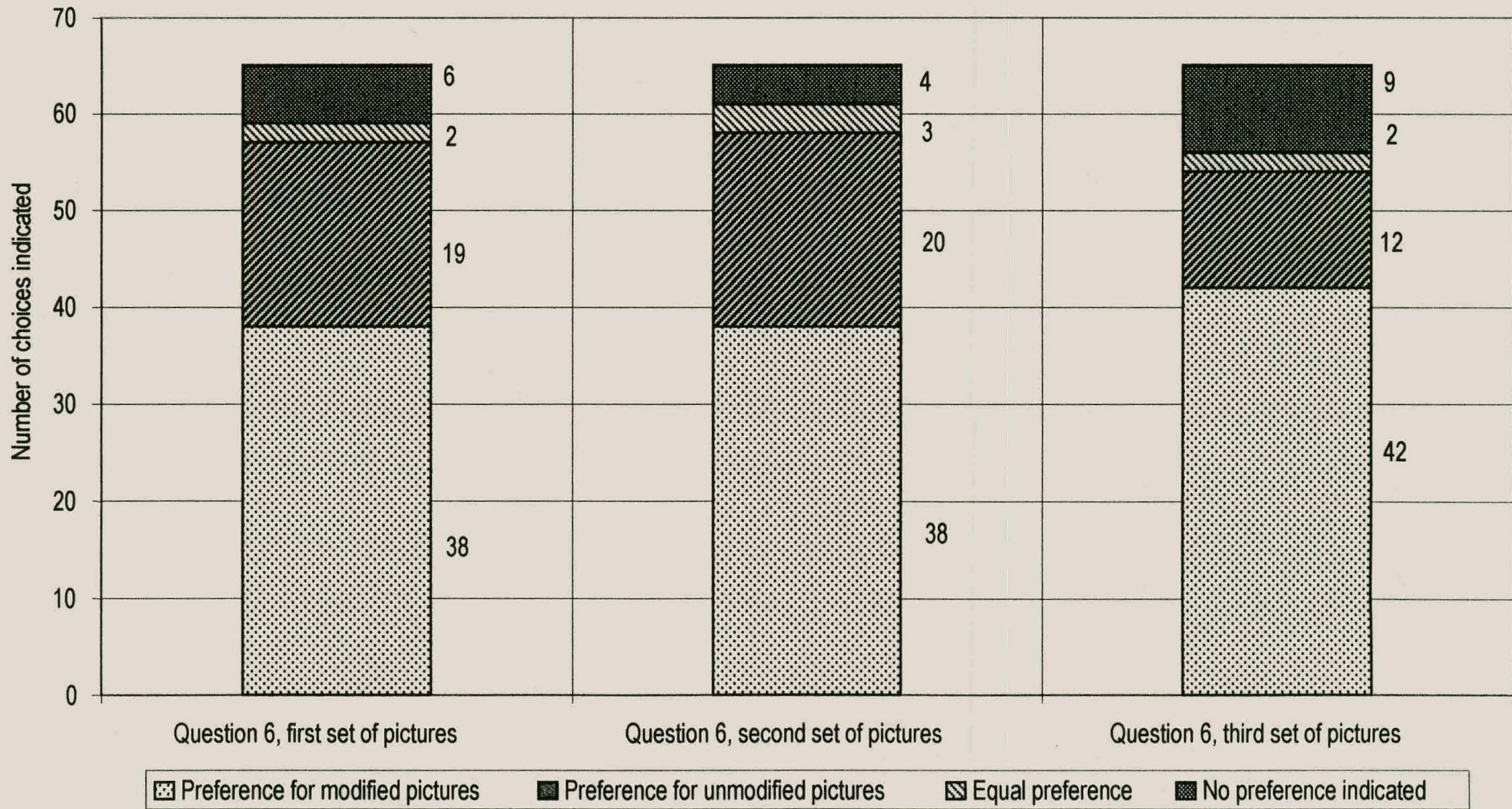


TABLE 3.30

The number of choices indicated for a modified or an unmodified picture
(Experiment 6c).

Question	Preference for modified pictures	Preference for unmodified pictures	Equal preference	No preference indicated (no choice made)
Question 6 First set of pictures	38	19	2	6
Question 6 Second set of pictures	38	20	3	4
Question Third set of pictures	42	12	2	9
Total	118*	51	7	19

* Significant preference at 0.05 for modified pictures when compared to unmodified pictures.

3.8.6 Conclusion of Experiment 6c

Parts of the conclusions of this experiment are similar to the conclusions of the previous two experiments. Conclusion number two is different in that it is a conclusion drawn when these results are evaluated against the results of the previous two experiments. The concluding remarks are given in point form.

- 1) Modified pictures appear to be no better than unmodified pictures when an assessment test probes for recall and problem-solving skills.
- 2) The potential benefit of one appropriate picture in bringing about a relative decrease in the loss of factual information over a period of seven to ten days, as found in the

previous two experiments, might not materialise if the subjects experience the learning material and subsequent tests as being difficult.

- 3) Modified pictures with labels and colour do not seem to facilitate learning more than unmodified pictures or even just text in terms of recall and problem-solving skills, even when the subjects are instructed to make use of the pictures.
- 4) The subjects tend to prefer modified pictures to unmodified pictures if they do not have an option to indicate an equal preference.
- 5) The addition of labels, colour cues and verbal instructions to subjects to make use of pictures will not necessarily effect a better understanding of the pictures or of the material accompanying the pictures when the subjects experience the material and assessment tests as being difficult.

A brief summary of the results is given in Table 3.31 (p. 234) to provide a perspective of the results in their entirety.

The research hypothesis stated that the picture groups would perform better than the text-only group, that the modified picture group would perform better than the other picture groups, and that the majority of the subjects would show a preference for the modified pictures. This hypothesis is partly rejected in favour of the alternative hypothesis.

3.8.7 Summary of Experiment 6c

Seventy-two Grade 9 subjects and sixty-three Grade 11 subjects from a peri-urban school participated in a control group experimental design. The mean ages of the subjects were 16.8 and 19.8 years respectively.

One group received a text-only version, one group received the text and one explanative picture, one group received the text and thirteen unmodified pictures with representational and explanative functions, and the last group also received the same text but with modified pictures and with the addition of six labels added to five of the pictures. There was no one-picture group in the experimental design for the Grade 11 subjects.

The text explaining the parts and working mechanism of a fire extinguisher was set in Sesotho and consisted of four hundred and six words. The subjects were specifically instructed to look at the pictures and to make sure that they understood the pictures. The subjects studied the material for twelve minutes and used fifteen to twenty minutes to complete an immediate post-test. They used fifteen minutes to complete a delayed post-test seven days later. It was hypothesised that the picture groups would perform better than the text-only group, that the two modified picture-text groups would perform better than the other picture groups, that the subjects would show a significant preference for modified pictures, and that the picture groups would forget less in a delayed test than the text-only group.

The modified picture group and the unmodified picture group consisting of just the Grade 11 subjects scored significantly better than the text-only group when the mean scores of all the questions were compared with each other. This improvement was, however, caused by the scores the subjects obtained in the questions where information was only available in pictures and not specifically mentioned in the text, and where the questions were picture based. The Grade 9 modified picture group scored better than the Grade 9 text-only group in the picture-based questions. The Grade 9 and Grade 11 picture groups did not score better than the text-only group in questions that were designed to test factual recall and problem-solving skills.

The modified and unmodified picture groups also did not perform significantly better than the text-only group in the delayed post-test. The one-picture-and-text Grade 9 subjects did not perform significantly better than all the other groups in the post-test as was reported in the previous two experiments.

The primary conclusion is that the potential benefit of one appropriate picture with labels can be lost or obscured if the subjects experience the learning material and assessment tests as being difficult.

The majority of subjects preferred modified pictures. The modified pictures do not seem to facilitate learning more than unmodified pictures. Only part of the hypothesis is not rejected. The research hypothesis is partly rejected in favour of the alternative hypothesis.

TABLE 3.31

A summary of the results of Experiment 6c in tabular form.

p = the probability value, SD = Significant Difference, * = results that indicated that there is no difference between the control and experimental groups

All the questions Immediate post-test	A SD, $p = 0.003$ (ANOVA), but only for the Grade 11 subjects
Questions 1-7 Immediate post-test	*
Questions 8-14 Immediate post-test	*
Questions 15-16 Immediate post-test	A SD for the Grade 11 unmodified picture group (compared to the text-only group), $p = 0.0005$ (Tukey's). A SD for the Grade 11 modified picture group (compared to the text-only group), $p = 0.00012$ (Tukey's). A SD for the Grade 9 modified picture group (compared to the text-only group), $p = 0.018$ (Tukey's).
Question 1 Delayed post-test	*
Subjects' preference	A significant preference was shown for a modified picture when p was set at 0.05.
Subjects' relative visual literacy	Ranged between 83% - 31% with a mean of 58.5%.

--oo0oo--

ADDENDUM 3.1

The first page of the test material that was used for the experimental group in Experiment 1. Adapted from Clacherty and Ludlow (1995:66).

Khoikhoi animals

The Khoikhoi got meat by hunting. They also gathered plants for food. So, as you can see, they were still doing what *hunter-gatherers* do to get food. But they were also *herders*. This meant that they could always get food. If they could not find animals to hunt or plants for food, they always had their cattle.

Look carefully at this page from a book about the Khoikhoi herders. Look at the drawings and read the paragraph.



ADDENDUM 3.2

The second page of the test material that was used for the experimental group in Experiment 1. Adapted from Clacherty and Ludlow (1995:67).



Their riches are cattle, such as oxen and sheep. They have herds of 9 or 10 thousand.

They build no houses, because they always go with their cattle. They never stay longer than six weeks in one place. They stay in one place as long as their animals find grass there and then they move away to another place which is suited to their animals.

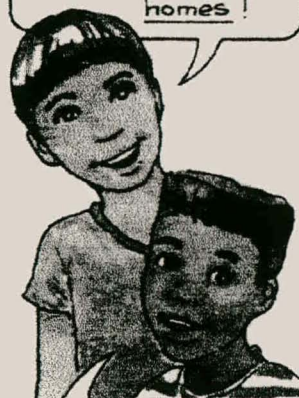
If they kill an animal they choose always the worst and thinnest, saying that it would be a pity to kill a fat animal.

(This was written by a European called Vermeulen in 1668)

The writing on the drawings is notes made by the artist.



You have learned that the Khoikhoi didn't have houses. But they did have homes!



ADDENDUM 3.3

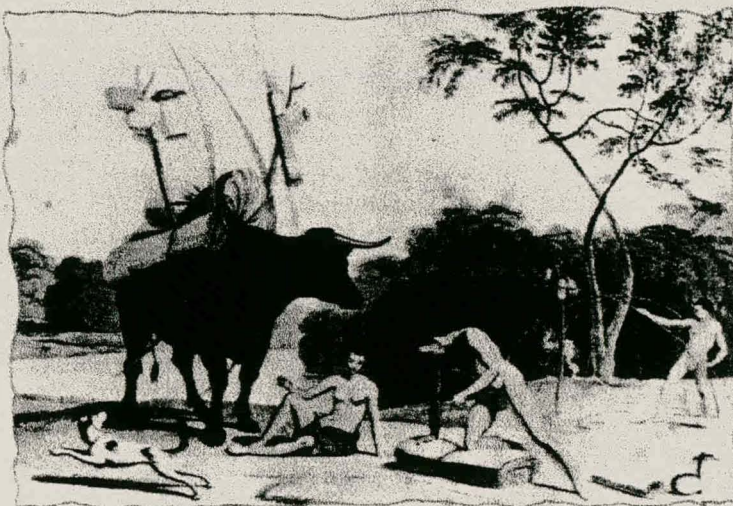
The third page of the test material that was used for the experimental group in Experiment 1. Adapted from Clacherty and Ludlow (1995:68).

You must again look carefully at the drawings and read the paragraph on this page from the book about the Khoikhoi.



They have no houses but live in little huts which they make from bent sticks or hoops. They hang reed mats on the sticks. They usually put these huts 10 or 12 together in a circle. As soon as they see their cattle have no grass, they take down their huts, put the hoops on their pack-oxen and set them up again where they find good grass.

(This was written by a European called Hoffman in 1672)



Addendum 3.4

KHOIKHOI ANIMALS

The Khoikhoi got meat by hunting. They also gathered plants for food. So, as you can see, they were still doing what hunter-gatherers do to get food. If they could not find animals to hunt or plants for food, they always had their cattle.

Their riches are cattle, such as oxen and sheep. They have herds of 9 or 10 thousand.

They build no houses, because they always go with their cattle. They never stay longer than six weeks in one place. They stay in one place as long as their animals find grass there and then they move away to another place which is suited to their animals.

If they kill an animal they choose always the worst and thinnest, saying that it would be a pity to kill a fat animal.

HOW DID THE KHOIKHOI LIVE?

The Khoikhoi lived in groups of 100 to 500 people. They had **chiefs**. Each chief ruled over a number of groups.

The chief and his council probably decided when the groups should move to new pasture.

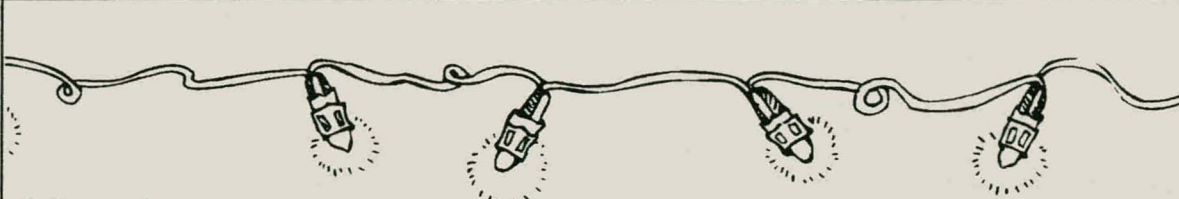
The chief and his council also helped to make peace when groups disagreed with each other.

The chiefs were more powerful and richer than other people. The chiefs usually had more cattle than other people.

They have no houses but live in little huts which they make from bent sticks or hoops. They hang reed mats on the sticks. They usually put these huts 10 or 12 together in a circle. As soon as they see their cattle have no grass, they take down their huts, put the hoops on their pack-oxen and set them up again where they find good grass.



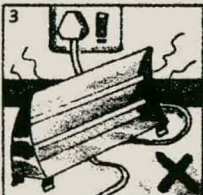
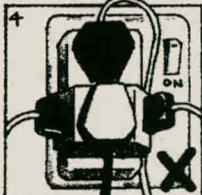


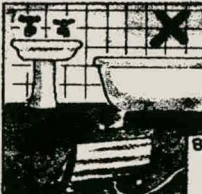
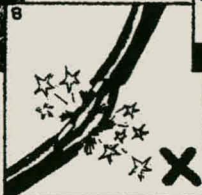



ADDENDUM 3.6

A copy of some of the original material (text and pictures) from which the experimental material for Experiment 2 was developed (Press and Macgregor, 1992:67).



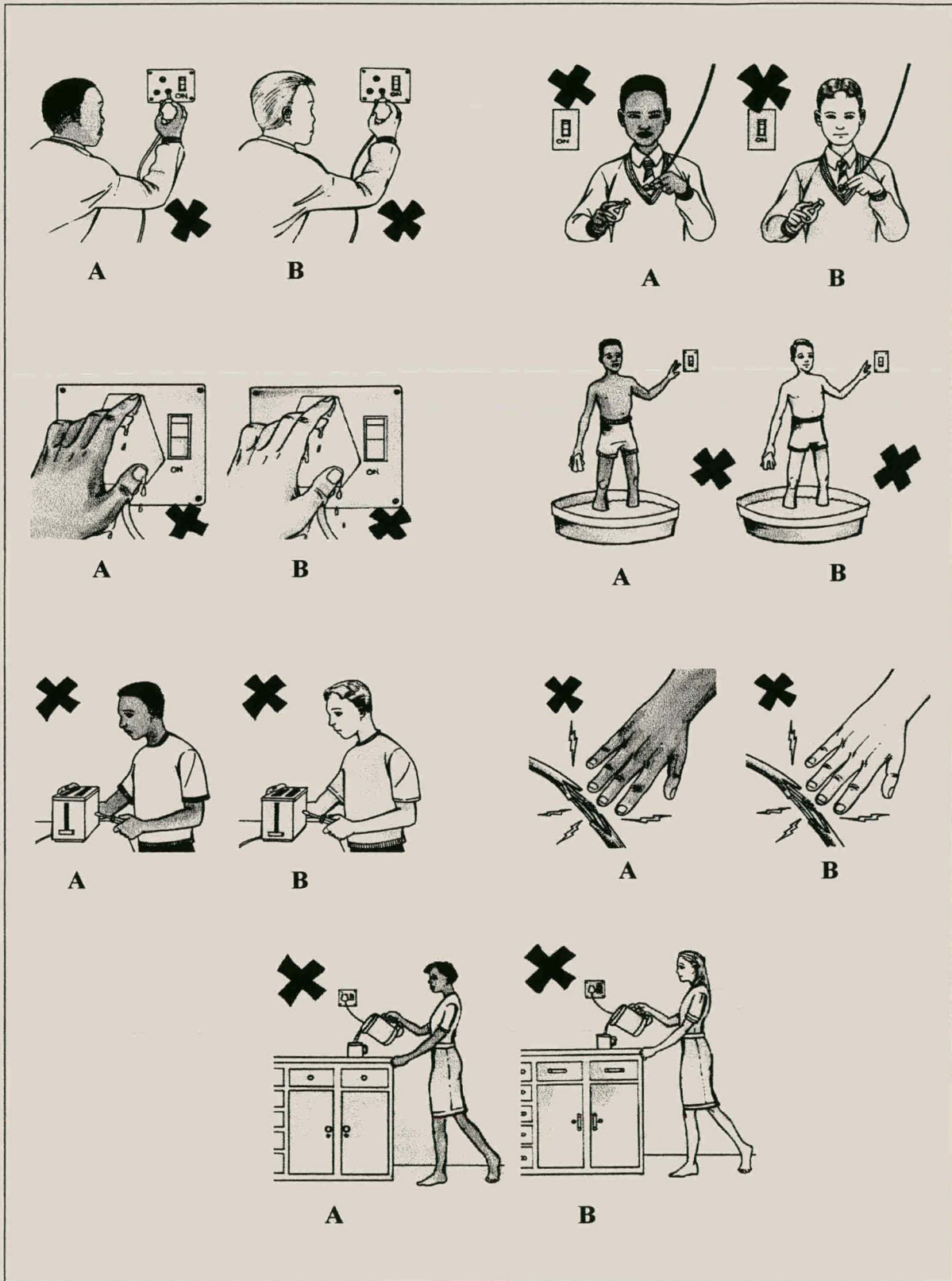
Safety rules

1. **Never** put a plug into a wall socket (plug hole) or take it out unless it is switched off at the wall.
2. **Never** change a light bulb while the wall switch is on.
3. **Never** put a heater near an electric wire or plug.
4. **Never** put lots of plugs into the same wall socket.
5. **Never** touch any electric plug or switch with wet hands.
6. **Never** touch a plug or switch if you are standing or sitting in water.
7. **Never** take an electric machine into the bathroom.
8. **Never** let the wires in an electric cord touch each other. Each wire must have a plastic cover around it.
9. **Never** try to fix a plug or machine, or the wiring in the house, by yourself.
10. **Never** use electrical appliances (machines) if you aren't wearing shoes. Shoes with rubber soles are the safest to wear.
11. **Never** touch bare electric wires or cables that you may find in your house or lying in the street.

ADDENDUM 3.7

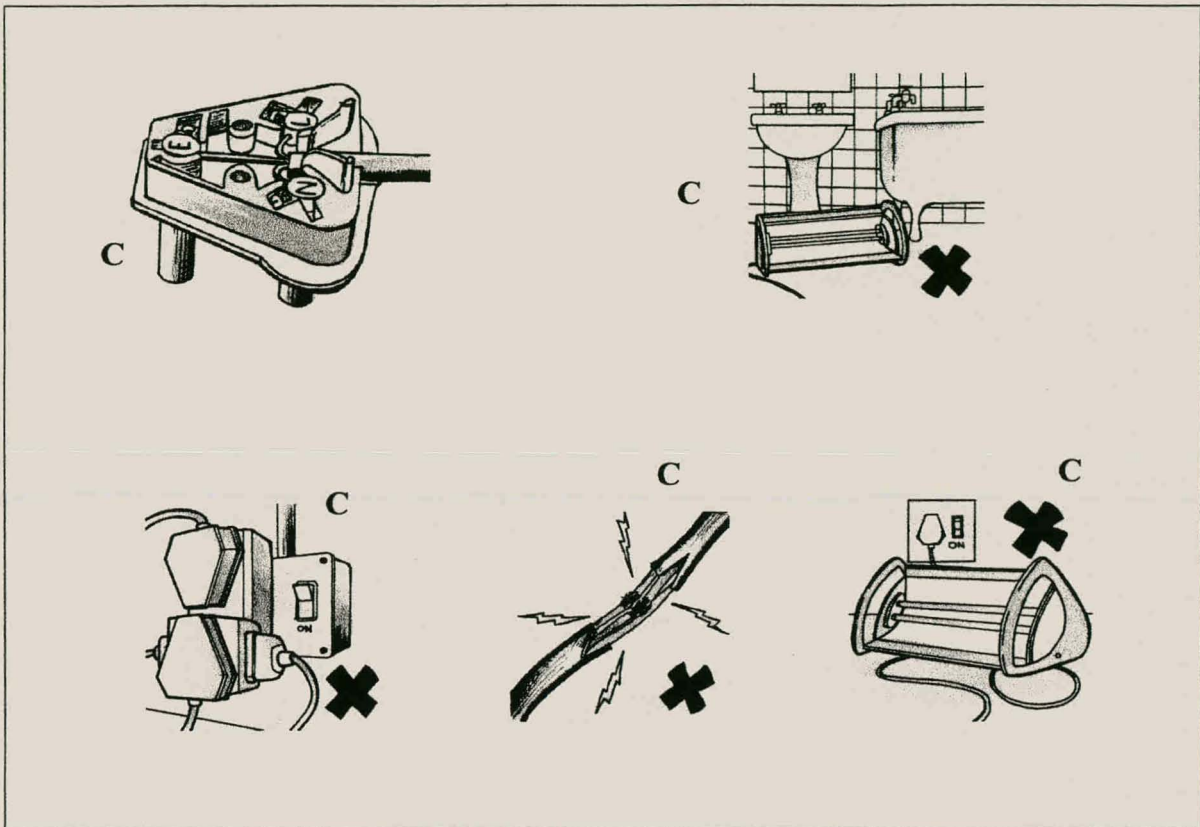
All the pictures that were used in Experiment 2.
A = the modified picture, B = unmodified pictures



ADDENDUM 3.7 (continued)

All the pictures that were used in Experiment 2.

C = the pictures that were the same for both experimental groups.



SAFETY RULES

Electricity is very useful, but it can also be very dangerous.

If the wires on an electric machine touch each other, the electric current can move in a short circuit. This makes the wires very hot, which can start a fire. The fire can spread from the machine to the furniture and curtains, and burn down a whole building. People can get badly burnt, or be suffocated by its smoke.

An electric current can flow easily through your body. It can burn your body and give you a painful shock. The electric current that flows in the wires in a house is strong enough to kill a person.

Electricity is safe to use if we follow the safety rules.

DID YOU KNOW?

There are three wires inside an electric cord. They are wrapped in plastic of different colours. When the wires are connected to a plug, each colour must go in the right place.

The three colours are:

- * brown: the live (L) wire
- * blue: the neutral (N) wire
- * green-yellow: the earth (E) wire

The plug has the same letters on it, to show where each wire goes.

SAFETY RULES

1. **Never** put a plug into a wall socket (plug hole) or take it out unless it is switched off at the wall.
2. **Never** change a light bulb while the wall switch is on.
3. **Never** put a heater near an electric wire or plug.
4. **Never** put lots of plugs into the same wall socket.
5. **Never** touch any electric plug or switch with wet hands.
6. **Never** touch a plug or switch if you are standing or sitting in water.
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10. **Never** use electrical appliances (machines) if you aren't wearing shoes. Shoes with rubber soles are the safest to wear.
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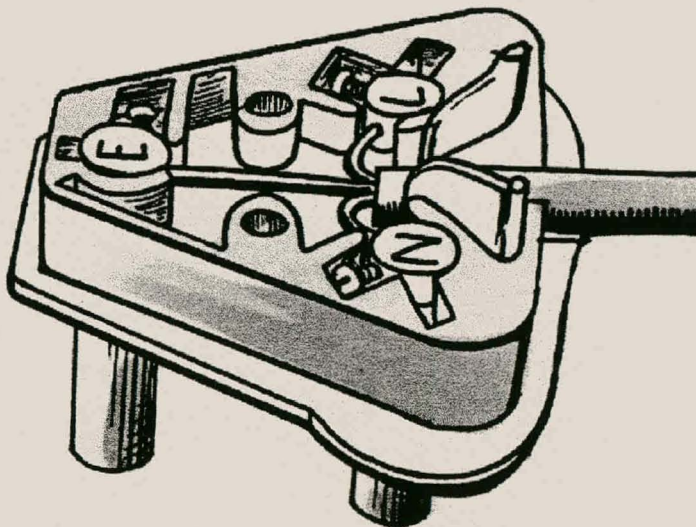
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- * brown: the live (L) wire
- * blue: the neutral (N) wire
- * green-yellow: the earth (E) wire

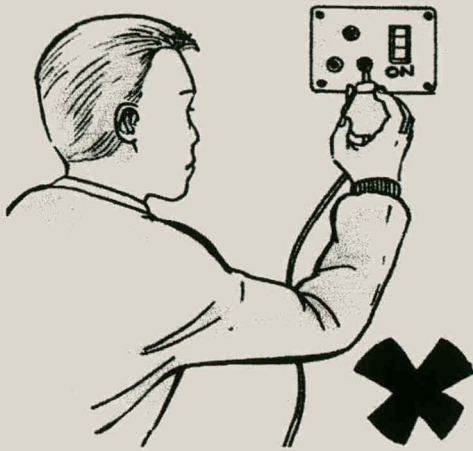
The plug has the same letters on it, to show where each wire goes.



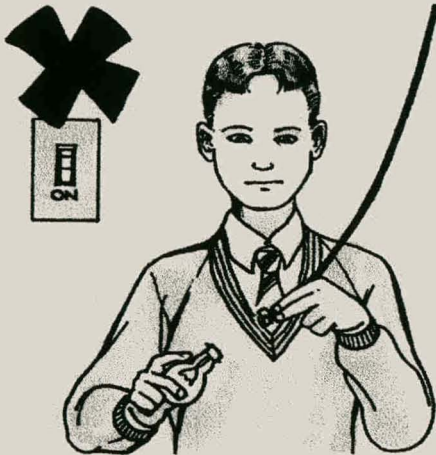
Addendum 3.9 (continued)

SAFETY RULES

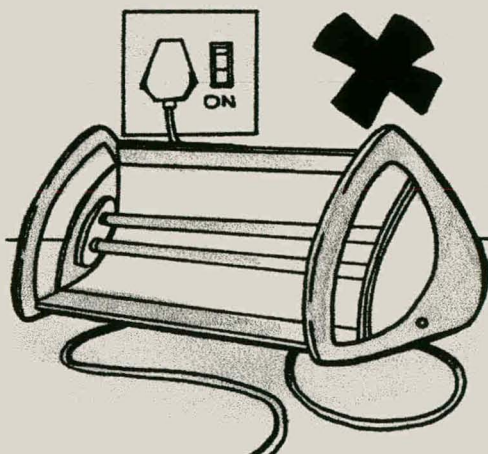
1. **Never** put a plug into a wall socket (plug hole) or take it out unless it is switched off at the wall.



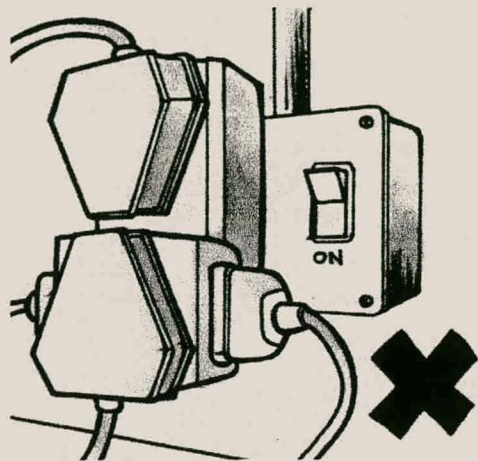
2. **Never** change a light bulb while the wall switch is on.



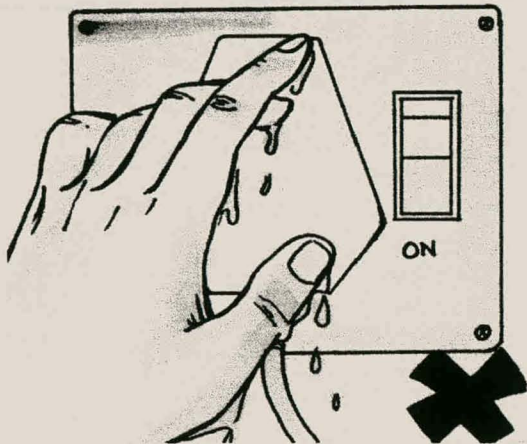
3. **Never** put a heater near an electric wire or plug.



4. Never put lots of plugs into the same wall socket.



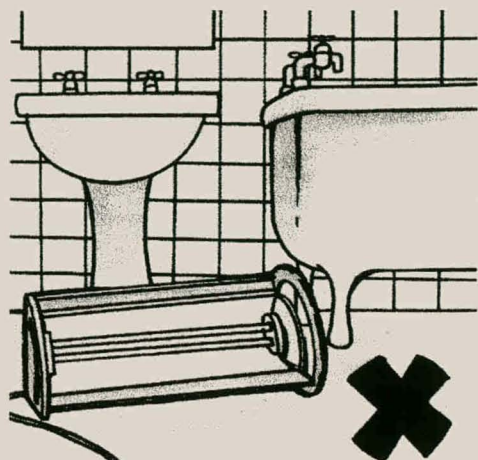
5. Never touch any electric plug or switch with wet hands.



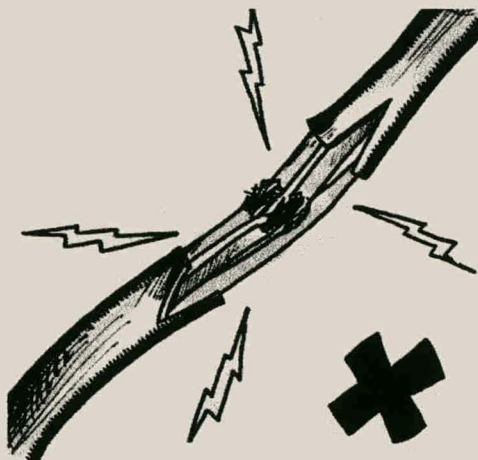
6. Never touch a plug or switch if you are standing or sitting in water.



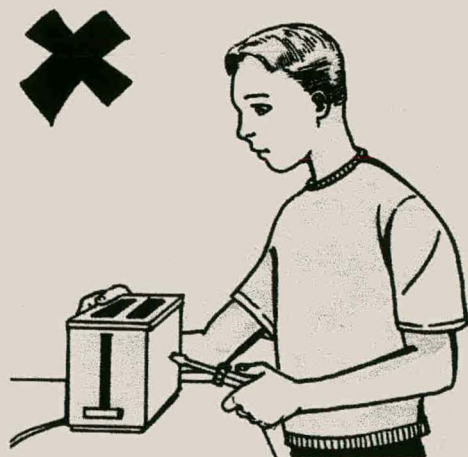
7. **Never** take an electric machine into the bathroom.



8. **Never** let the wires in an electric cord touch each other. Each wire must have a plastic cover around it.



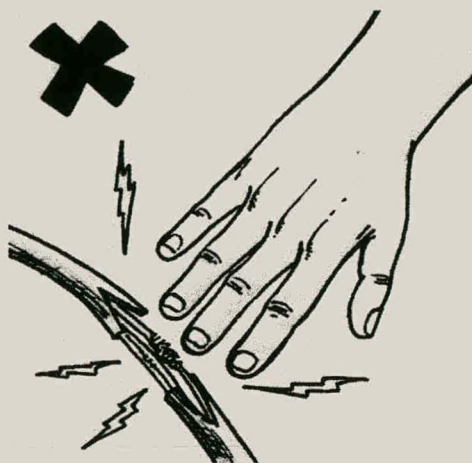
9. **Never** try to fix a plug or machine, or the wiring in the house, by yourself.



10. **Never** use electrical appliances (machines) if you aren't wearing shoes. Shoes with rubber soles are the safest to wear.



11. **Never** touch bare electric wires or cables that you may find in your house or lying in the street.



SAFETY RULES

Electricity is very useful, but it can also very dangerous.

If the wires on an electric machine touch each other, the electric current can move in a short circuit. This makes the wires very hot, which can start a fire. The fire can spread from the machine to the furniture and curtains, and burn down a whole building. People can get badly burnt, or be suffocated by its smoke.

An electric current can flow easily through your body. It can burn your body and give you a painful shock. The electric current that flows in the wires in a house is strong enough to kill a person.

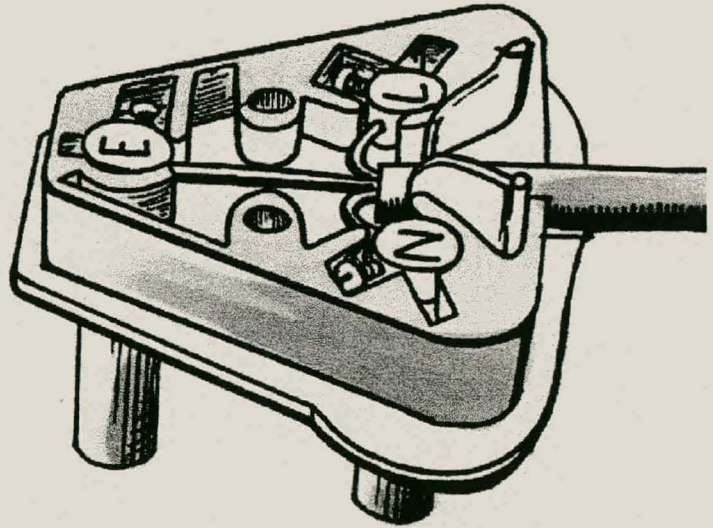
Electricity is safe to use if we follow the safety rules.

DID YOU KNOW?

There are three wires inside an electric cord. They are wrapped in plastic of different colours. When the wires are connected to a plug, each colour must go in the right place.

The three colours are:

- * brown: the live (L) wire
- * blue: the neutral (N) wire
- * green-yellow: the earth (E) wire

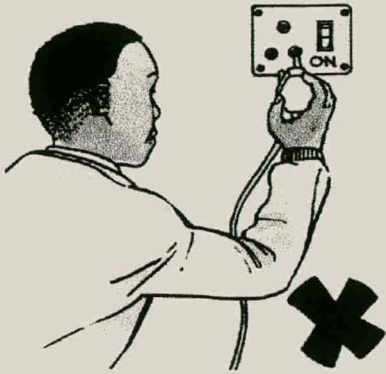


The plug has the same letters on it, to show where each wire goes.

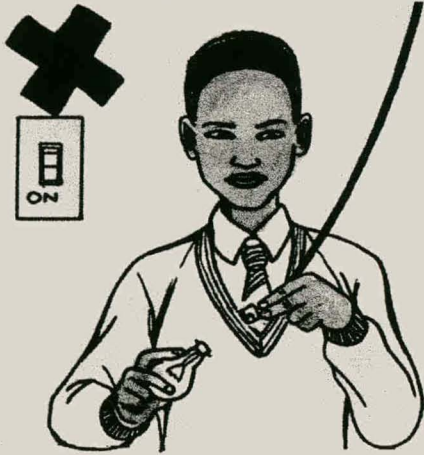
Addendum 3.10 (continued)

SAFETY RULES

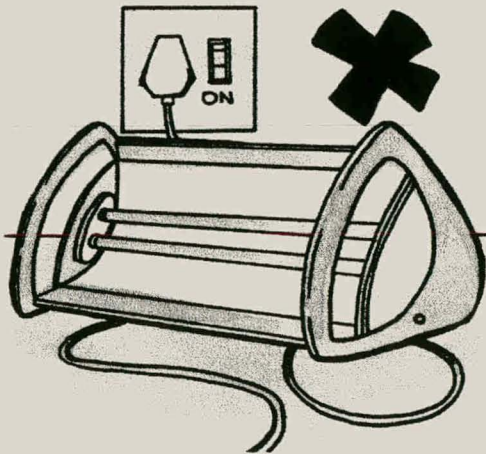
1. **Never** put a plug into a wall socket (plug hole) or take it out unless it is switched off at the wall.



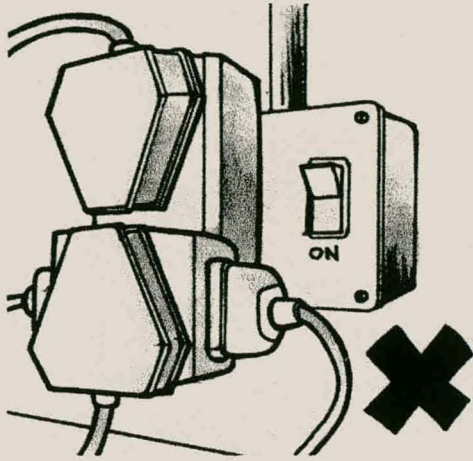
2. **Never** change a light bulb while the wall switch is on.



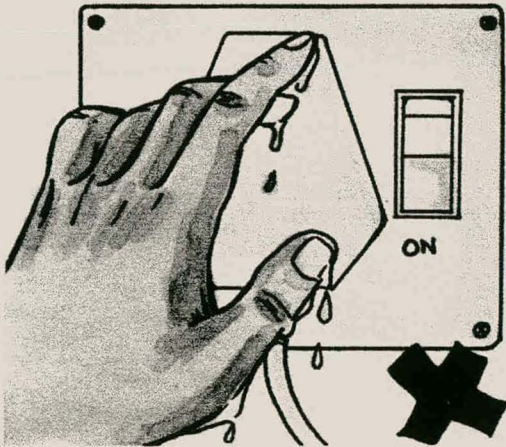
3. **Never** put a heater near an electric wire or plug.



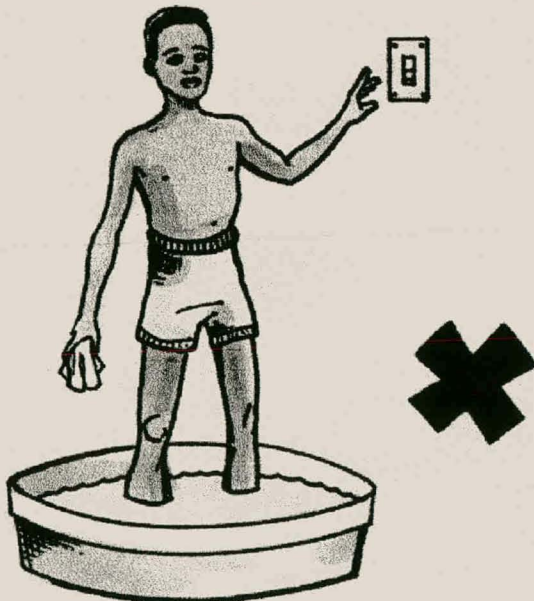
4. Never put lots of plugs into the same wall socket.



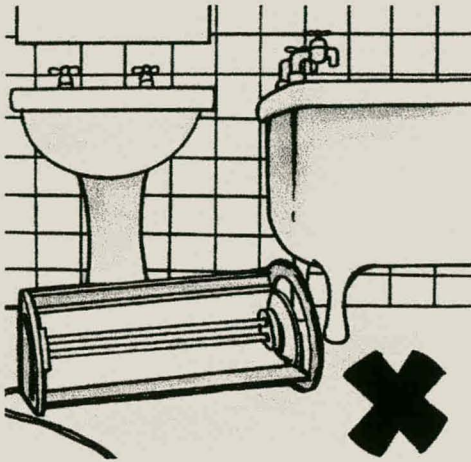
5. Never touch any electric plug or switch with wet hands.



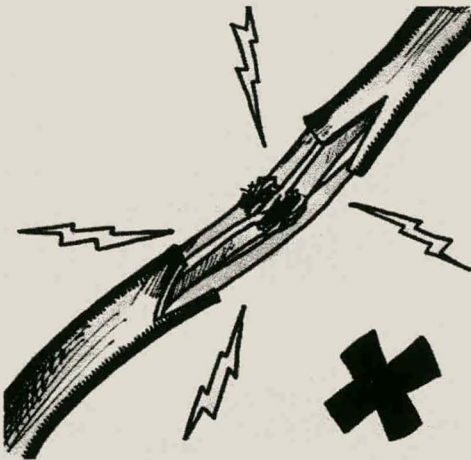
6. Never touch a plug or switch if you are standing or sitting in water.



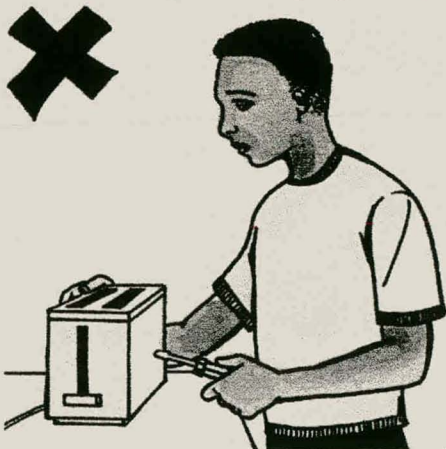
7. **Never** take an electric machine into the bathroom.



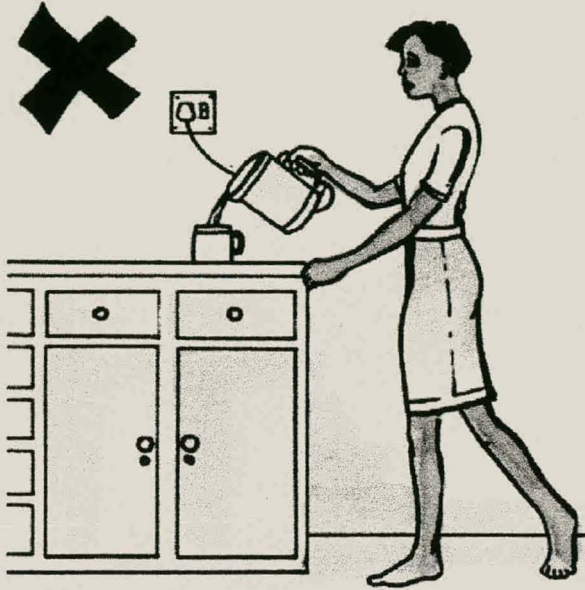
8. **Never** let the wires in an electric cord touch each other. Each wire must have a plastic cover around it.



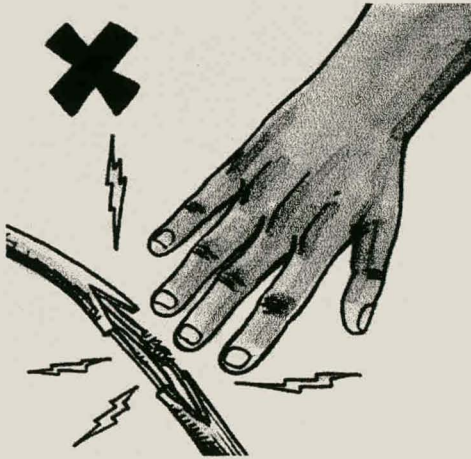
9. **Never** try to fix a plug or machine, or the wiring in the house, by yourself.



10. **Never** use electrical appliances (machines) if you aren't wearing shoes. Shoes with rubber soles are the safest to wear.



11. **Never** touch bare electric wires or cables that you may find in your house or lying in the street.



ADDENDUM 3.12

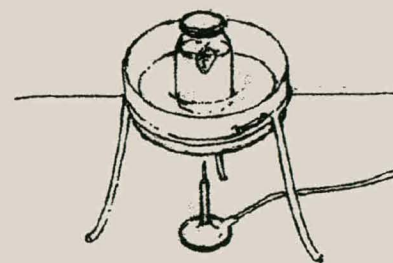
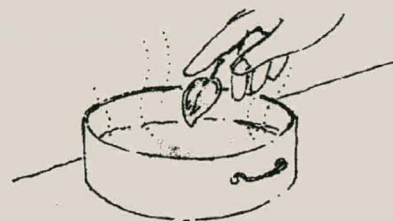
A copy of some of the original material (text and pictures) in a reduced format from which the experimental material for Experiments 3 was developed
(Press & Macgregor, 1992:81).



Let's do this experiment to find out if there is starch in a leaf.

28**EXPERIMENT**

1. Boil some water in a pot.
2. Put a leaf in the boiling water to soften it.
3. Now put the leaf in a smaller jar (it should be made of strong glass that can be heated without breaking) that is full of methylated spirits. Place this jar in a pot of hot water (the level of the water should be lower than the jar) and bring the water to the boil. Boiling the leaf in the methylated spirits will take the green chlorophyll out of the leaf.
4. Wash the leaf in hot water.
5. Put some iodine solution on the leaf.
What happens?



The leaf turns black. This shows that there is starch in the leaf. You can test any plant to see if it is storing starch by putting iodine on it.



ADDENDUM 3.13

All the pictures that were used in Experiment 3.

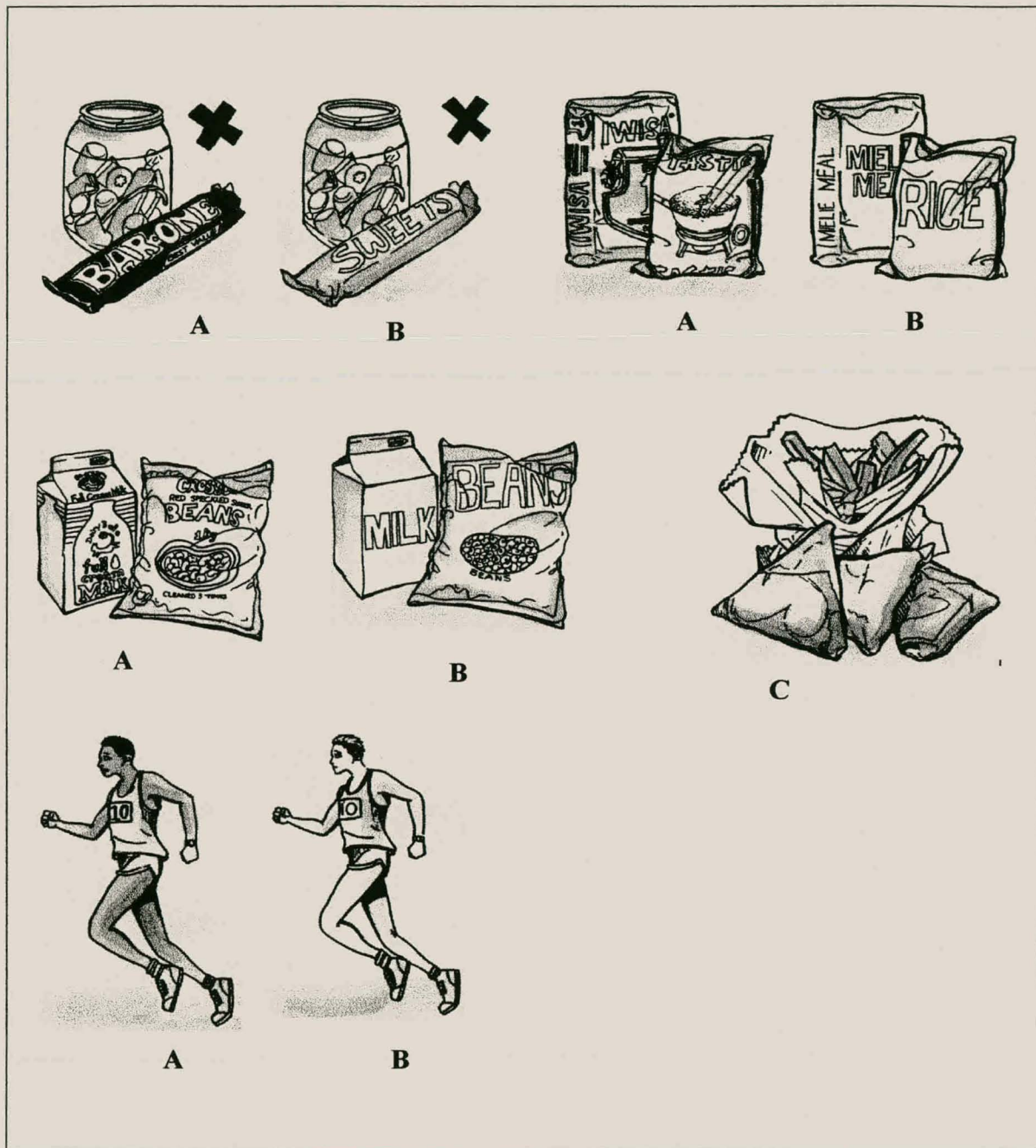
A = the modified picture, B = unmodified pictures, C = the pictures that were the same for both experimental groups.



ADDENDUM 3.13 (continued)

All the pictures that were used in Experiment 3.

A = the modified picture, B = unmodified pictures C = the picture that was the same for both experimental groups.



Addendum 3.14

STORING FOOD

Living things can store food all over their bodies.

People store food in a layer of fat that covers their bodies. Pinch the skin on your arm. Can you feel the layer of fat under the skin?

How do plants store food?

Plants can also store food. When they make food it is in the form of sugar. Plants use some of the sugar, but they store the rest of it in the form of starch, fats and proteins.

Where do plants store food?

Plants can make special storage places, by making certain parts swell up. A potato is a swollen stem of a plant, a carrot is a swollen root, an onion is a bunch of swollen leaves. Each of these plants has made a special storage organ (the stem, the root or the leaves) for storing food. Plants also store food in seeds. Seeds have a hard outer covering to protect the baby plant (called the embryo) and its supply of food. When the embryo begins to grow, it has a store of food right next to it.

Question

How do you know that plants store food in the form of starch?

Answer

There is a test for starch. If you put iodine solution on something that has starch in it, it turns black.

EXPERIMENT

Let's do this experiment to find out if there is starch in a leaf.

1. Boil some water in a pot.
2. Put a leaf in the boiling water to soften it.
3. Now put the leaf in a smaller jar (it should be made of strong glass that can be heated without breaking) that is full of methylated spirits.
4. Place this jar in a pot of hot water (the level of the water should be lower than the jar) and bring the water to the boil. Boiling the leaf in the methylated spirits will take the green chlorophyll out of the leaf.
5. Wash the leaf in hot water.
6. Put some iodine solution on the leaf. What happens?
7. The leaf turns black. This shows that there is starch in the leaf. You can test any plant to see if it is storing starch by putting iodine on it.

PLANTS ARE GOOD FOR YOU

We know that plants store sugar, starch, fats and proteins. We call these things nutrients. A nutrient is a substance that you need in your body to stay alive and be healthy. If you don't eat enough of the right nutrients, you can become very sick. Animals need nutrients too.

What do nutrients do?

Sugar give you energy. You can get sugar from many kinds of fruits and vegetables. You can also get sugar from sweets, but it is the wrong kind of sugar, and if you eat too much of it your teeth will rot.

Starch also gives you energy, but it lasts for a longer time. You can get starch from potatoes, mealie meal rice and bread. Sugar and starch are part of a group of energy giving foods called carbohydrates.

Carbohydrates are very important nutrients. If you don't eat enough of them you will be tired and unable to concentrate in class. But if you eat too many of them your body can't use them up fast enough, and it will store them in a layer of fat on your body.

Fats also give you energy. We only need to eat a small amount of fat. You find fat in butter and cooking oils. Fried foods, like chips and samoosas have a lot of fat in them. You should try not to eat too many fried foods. Too much fat is bad for you.

Proteins are foods that you need you grow. They build your body by making your muscles and bones grow. It is very important for young people to eat enough protein. You find protein in eggs, milk, meat, beans and nuts.

A balanced diet

Your body needs a mixture of nutrients to keep working properly. This means that you should make sure that you eat foods containing carbohydrates, fats and proteins.

Did you know?

Long distance runners eat a lot of carbohydrates before a race. This gives them the energy they need to run for many kilometres.

STORING FOOD

Living things can store food all over their bodies. People store food in a layer of fat that covers their bodies. Pinch the skin on your arm. Can you feel the layer of fat under the skin?

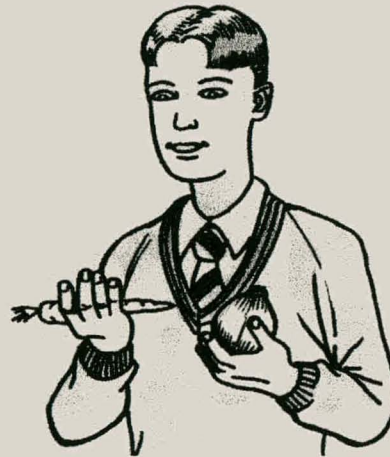


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Question

How do you know that plants store food in the form of starch?

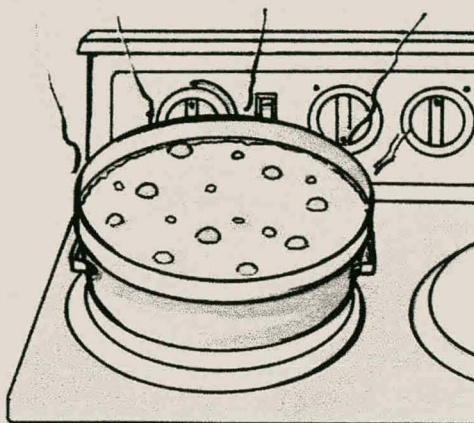
Answer

There is a test for starch. If you put iodine solution on something that has starch in it, it turns black.

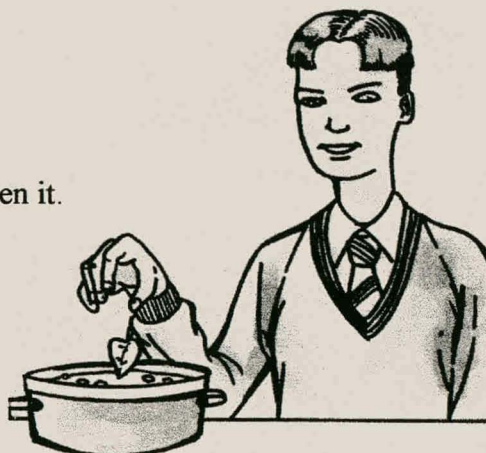
EXPERIMENT

Let's do this experiment to find out if there is starch in a leaf.

1. Boil some water in a pot.



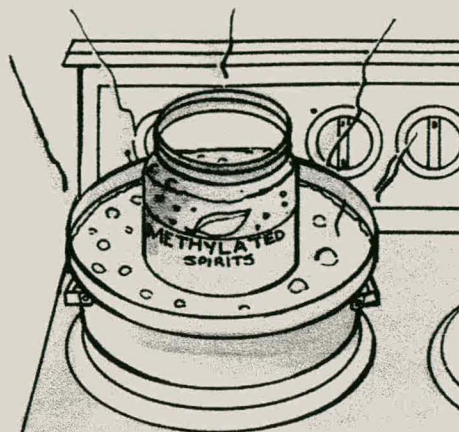
2. Put a leaf in the boiling water to soften it.



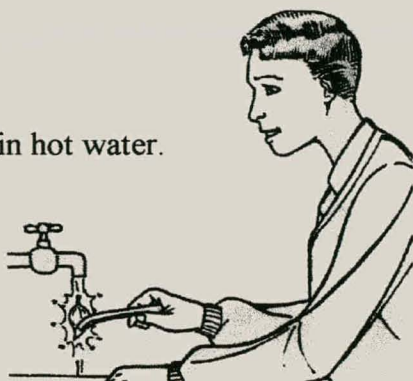
3. Now put the leaf in a smaller jar (it should be made of strong glass that can be heated without breaking) that is full of methylated spirits.



4. Place this jar in a pot of hot water (the level of the water should be lower than the jar) and bring the water to the boil. Boiling the leaf in the methylated spirits will take the green chlorophyll out of the leaf.



5. Wash the leaf in hot water.



6. Put some iodine solution on the leaf. What happens?



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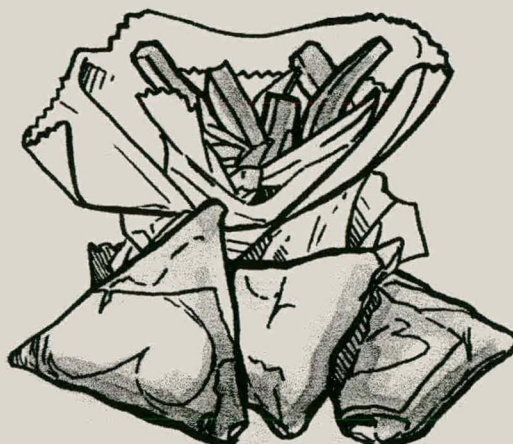


Starch also gives you energy, but it lasts for a longer time. You can get starch from potatoes, mealie meal rice and bread. Sugar and starch are part of a group of energy giving foods called carbohydrates.



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Question

How do you know that plants store food in the form of starch?

Answer

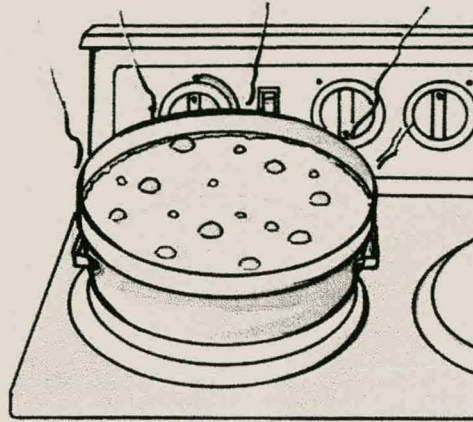
There is a test for starch. If you put iodine solution on something that has starch in it, it turns black.



EXPERIMENT

Let's do this experiment to find out if there is starch in a leaf.

1. Boil some water in a pot.



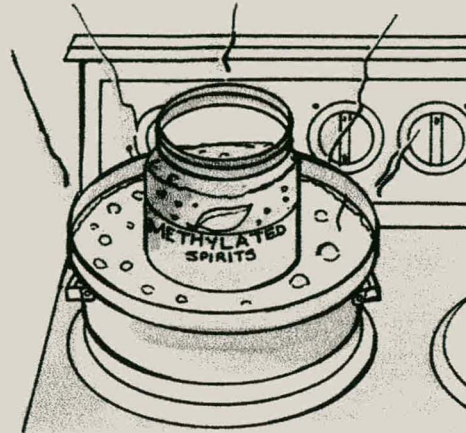
2. Put a leaf in the boiling water to soften it.



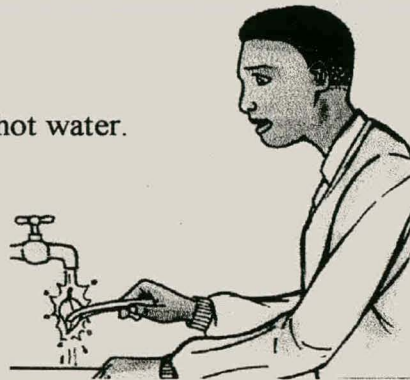
3. Now put the leaf in a smaller jar (it should be made of strong glass that can be heated without breaking) that is full of methylated spirits.



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- Wash the leaf in hot water.



- Put some iodine solution on the leaf. What happens?



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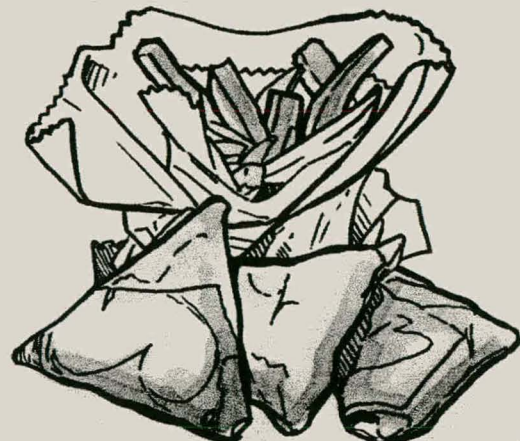


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Did you know?

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4) Which food contains too much sugar that can cause your teeth to rot?

.....

5) You can get starch from potatoes, bread

and

6) Too much fat is bad for you. Name two types of fried food that have a lot of fat in them.

.....

.....

7) You will find protein in eggs, meat, nuts,

and

8) In which sport do the people eat a lot of carbohydrates to give them energy?

.....

ADDENDUM 3.18

All the pictures that were used in Experiment 4 and 5.

A = the modified picture, B = unmodified pictures, C = the pictures that were the same for both experimental groups.



ADDENDUM 3.18 (continued)

All the pictures that were used in Experiment 4 and 5.

A = the modified picture, B = unmodified pictures C = the picture that was the same for both experimental groups.



A



B



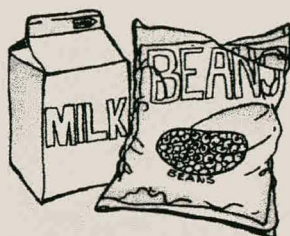
A



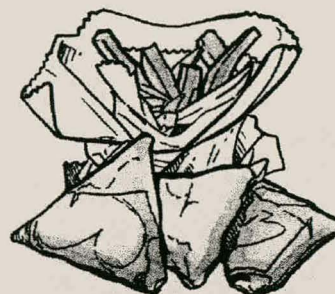
B



A



B



C



A



B

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Question

How do you know that plants store food in the form of starch?

Answer

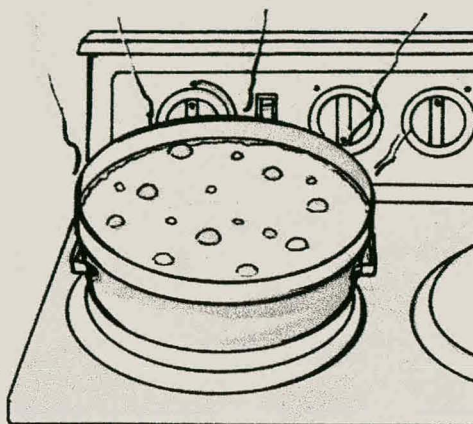
There is a test for starch. If you put iodine solution on something that has starch in it, it turns black.



EXPERIMENT

Let's do this experiment to find out if there is starch in a leaf.

1. Boil some water in a pot.



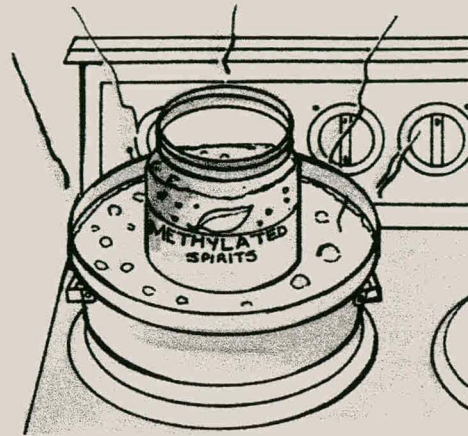
2. Put a leaf in the boiling water to soften it.



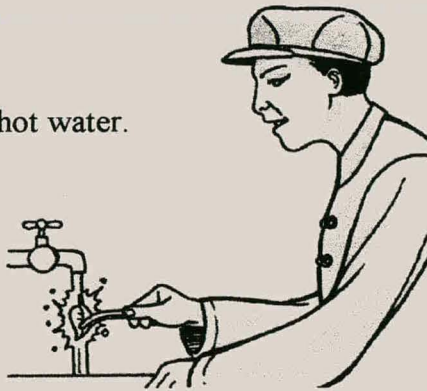
3. Now put the leaf in a smaller jar (it should be made of strong glass that can be heated without breaking) that is full of methylated spirits.



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Sugar give you energy. You can get sugar from many kinds of fruits and vegetables. You can also get sugar from sweets, but it is the wrong kind of sugar, and if you eat too much of it your teeth will rot.

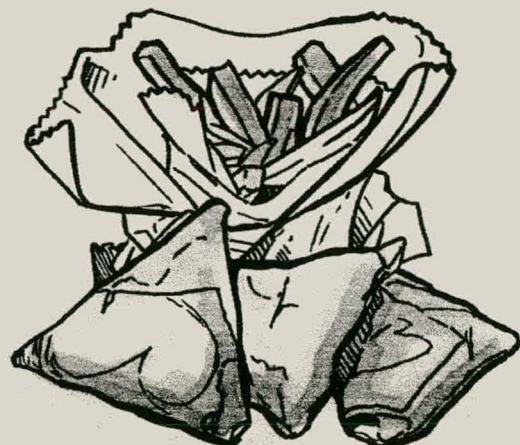


Starch also gives you energy, but it lasts for a longer time. You can get starch from potatoes, mealie meal rice and bread. Sugar and starch are part of a group of energy giving foods called carbohydrates.

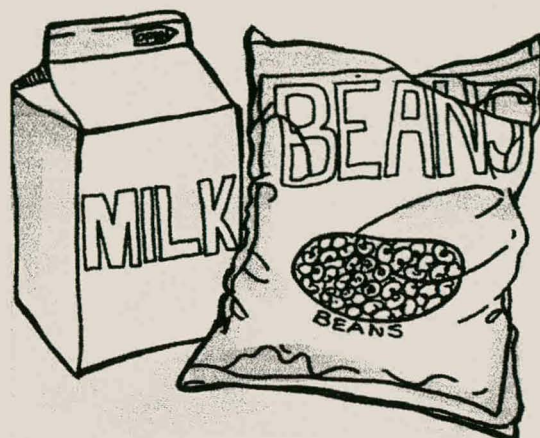


Carbohydrates are very important nutrients. If you don't eat enough of them you will be tired and unable to concentrate in class. But if you eat too many of them your body can't use them up fast enough, and it will store them in a layer of fat on your body.

Fats also give you energy. We only need to eat a small amount of fat. You find fat in butter and cooking oils. Fried foods, like chips and samoosas have a lot of fat in them. You should try not to eat too many fried foods. Too much fat is bad for you.



Proteins are foods that you need to grow. They build your body by making your muscles and bones grow. It is very important for young people to eat enough protein. You find protein in eggs, milk, meat, beans and nuts.



A balanced diet

Your body needs a mixture of nutrients to keep working properly. This means that you should make sure that you eat foods containing carbohydrates, fats and proteins.

Did you know?

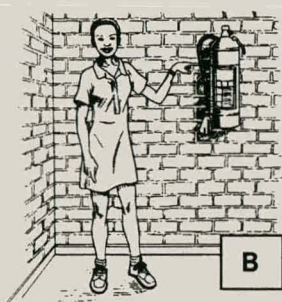
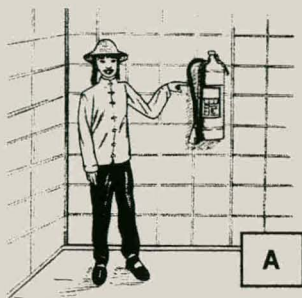
Long distance runners eat a lot of carbohydrates before a race. This gives them the energy they need to run for many kilometres.



ADDENDUM 3.20

The pictures and their corresponding modified pictures that were used in Experiments 6a – 6c.

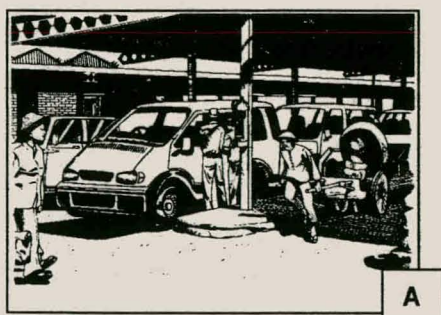
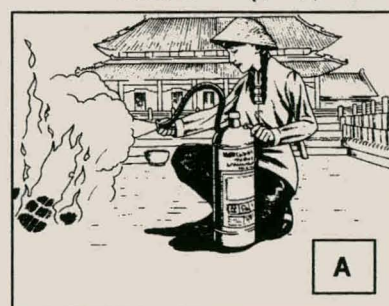
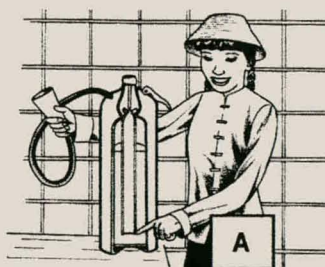
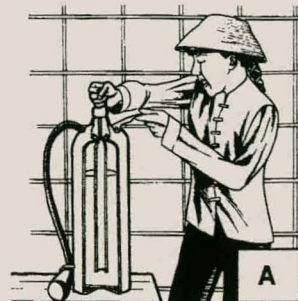
The pictures are in a reduced format and are not in the proportions as they were used in the experimental material. A = unmodified pictures, B = modified pictures.



ADDENDUM 3.20 (continued)

The pictures and their corresponding modified pictures that were used in Experiments 6a – 6c.

The pictures are in a reduced format and are not in the proportions as they were used in the experimental material. A = unmodified pictures, B = modified pictures.



THE FIRE EXTINGUISHER

Fire extinguishers are easy to recognise. You will find them hanging on the walls of buildings and in some schools. Most fire extinguishers are carbon dioxide (CO₂)-type fire extinguisher and are filled with a white powder and pressurised with a gas called carbon dioxide. The extinguishers come in different sizes. There are small and large extinguishers.

The main part of a fire extinguisher consists of a strong, round metal cylinder. The cylinder is flat at the bottom and rounded at the top. There is a hollow pipe inside the middle of the metal cylinder. This pipe is called the central tube. The central tube is attached to the top of the inside of the cylinder. The central tube is open at the bottom. The central tube is closed at the top with a pressure release disk. The knob on top of the extinguisher is the strike knob. There is a sharp, strong spike at the bottom of the strike knob. This spike is called the piercer. This piercer points towards the release disk that is on top of the central tube. There is also a safety release pin on the side of the strike knob. You cannot use the extinguisher if you do not remove the pin. This safety release pin stops the piercer from making a hole in the pressure release disk if you hit the strike knob by accident.

A rubber pipe emerges from the cylinder next to the strike knob. There is a plastic nozzle at the end of the rubber pipe.

If you want to use an extinguisher then you must first remove the safety pin. Hit the strike knob with your hand. The strike knob will push the spike into the release disk. The release disk will now have a hole. The pressurised gas in the cylinder will push the powder down to the bottom of the cylinder. The pressurised gas and powder will go through the opening of the central tube at the bottom and then through the hole in the release disk. The powder and gas will now go into the rubber pipe that is at the top of the cylinder and will come out of the nozzle. Direct the nozzle towards the fire. The gas is heavier than air and will settle on the fire like a blanket. This will keep the oxygen away from the fire. The fire will go out. There are also other places where you might find fire extinguishers.

Addendum 3.22

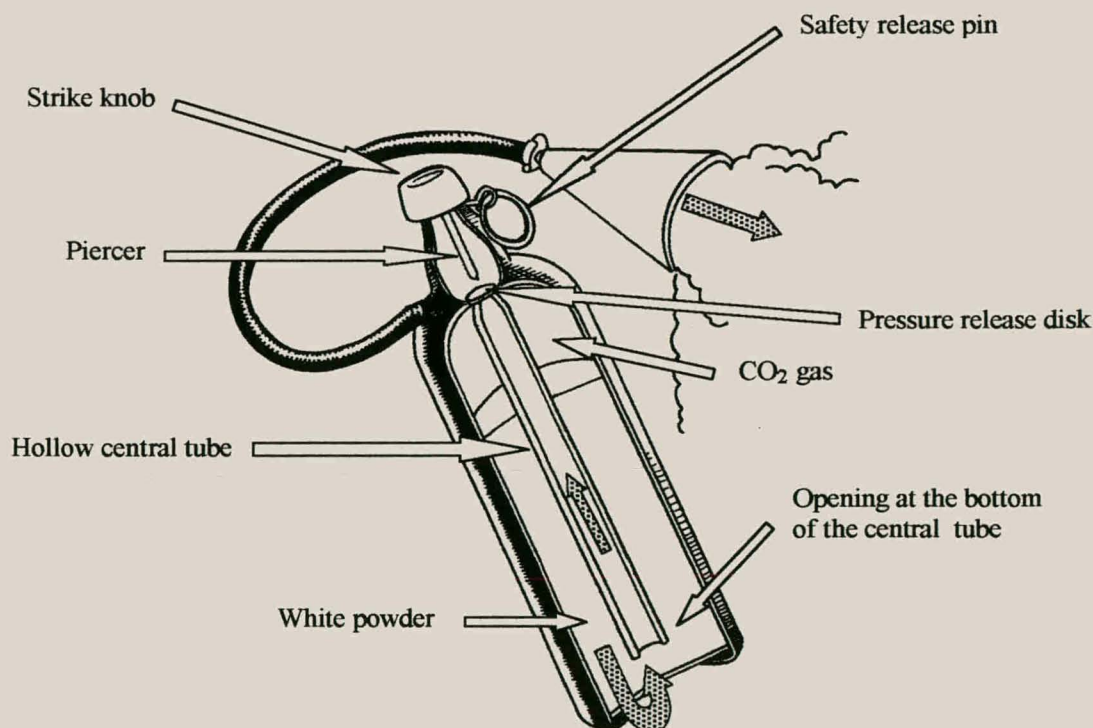
THE FIRE EXTINGUISHER

Fire extinguishers are easy to recognise. You will find them hanging on the walls of buildings and in some schools. Most fire extinguishers are carbon dioxide (CO_2)-type fire extinguisher and are filled with a white powder and pressurised with a gas called carbon dioxide. The extinguishers come in different sizes. There are small and large extinguishers.

The main part of a fire extinguisher consists of a strong, round metal cylinder. The cylinder is flat at the bottom and rounded at the top. There is a hollow pipe inside the middle of the metal cylinder. This pipe is called the central tube. The central tube is open at the bottom. The central tube is closed at the top with a pressure release disk. The knob on top of the extinguisher is the strike knob. There is a sharp, strong spike at the bottom of the strike knob. This spike is called the piercer. This piercer points towards the release disk that is on top of the central tube. There is also a safety release pin on the side of the strike knob. You cannot use the extinguisher if you do not remove the pin. This safety release pin stops the piercer from making a hole in the pressure release disk if you hit the strike knob by accident.

A rubber pipe emerges from the cylinder next to the strike knob. There is a plastic nozzle at the end of the rubber pipe.

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THE FIRE EXTINGUISHER



Fire extinguishers are easy to recognise. You will find them hanging on the walls of buildings and in some schools.



Most fire extinguishers are carbon dioxide (CO₂)-type fire extinguisher and are filled with a white powder and pressurised with a gas called carbon dioxide.



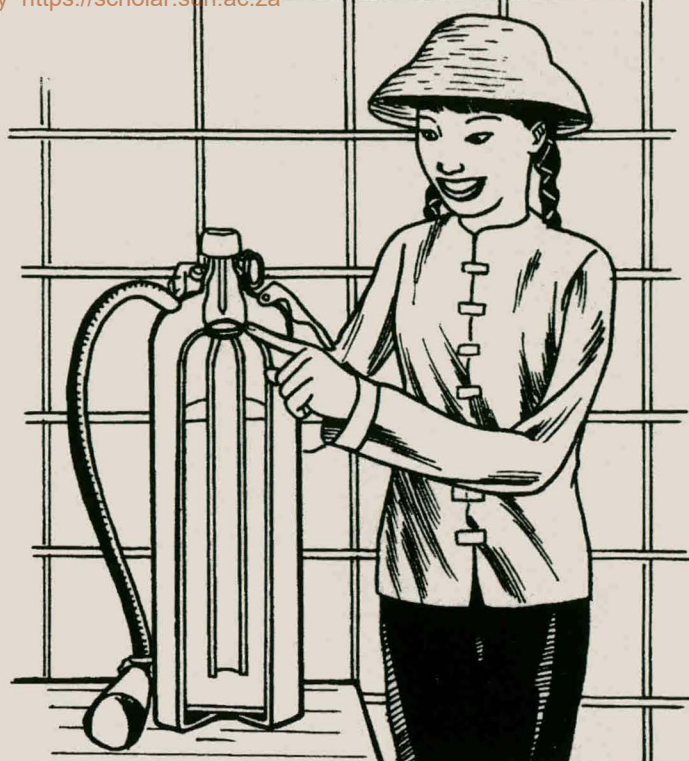
The main part of a fire extinguisher consists of a long and round metal cylinder. The cylinder is flat at the bottom and rounded at the top.



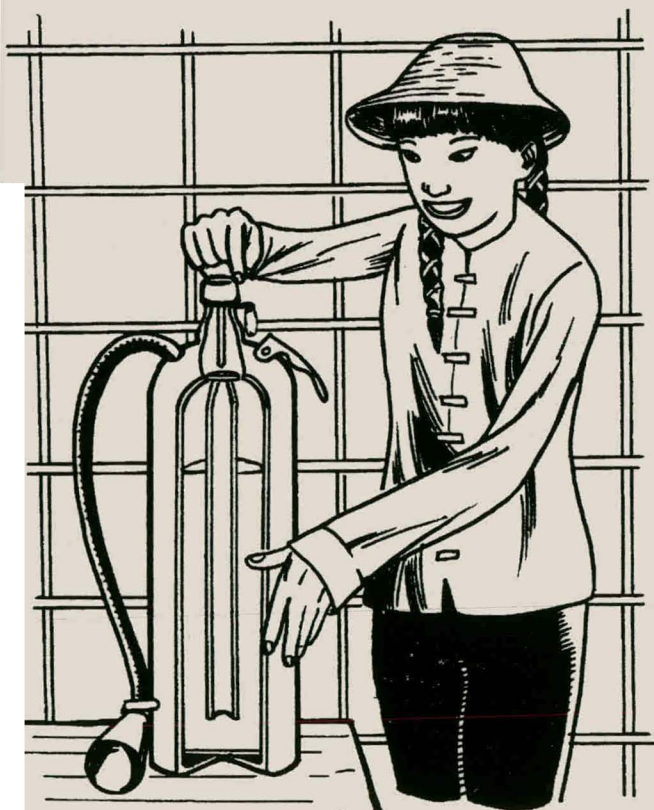
The extinguishers come in different sizes. There are small and large extinguishers.



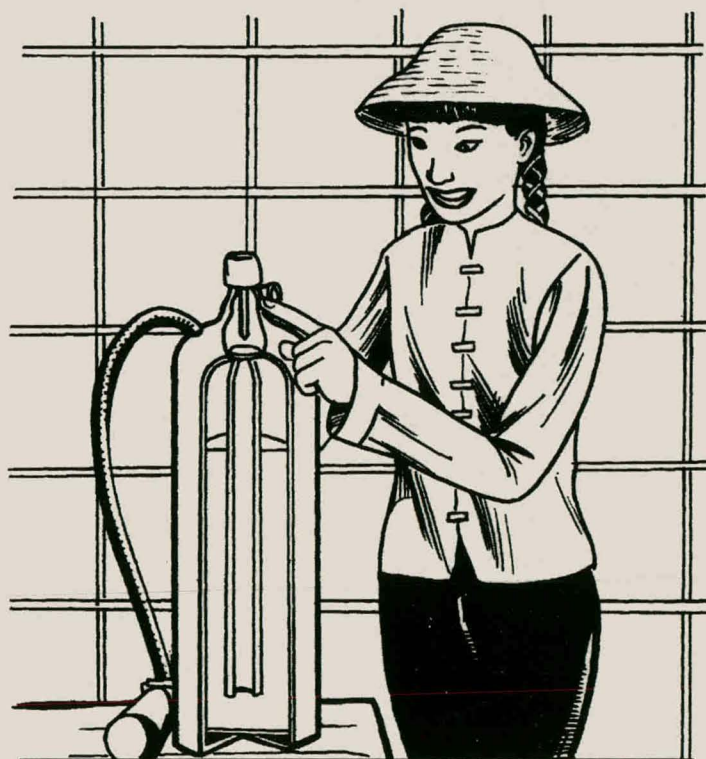
There is a hollow pipe inside the middle of the metal cylinder. This pipe is called the central tube. The central tube is open at the bottom.



The central tube is closed at the top with a pressure release disk.



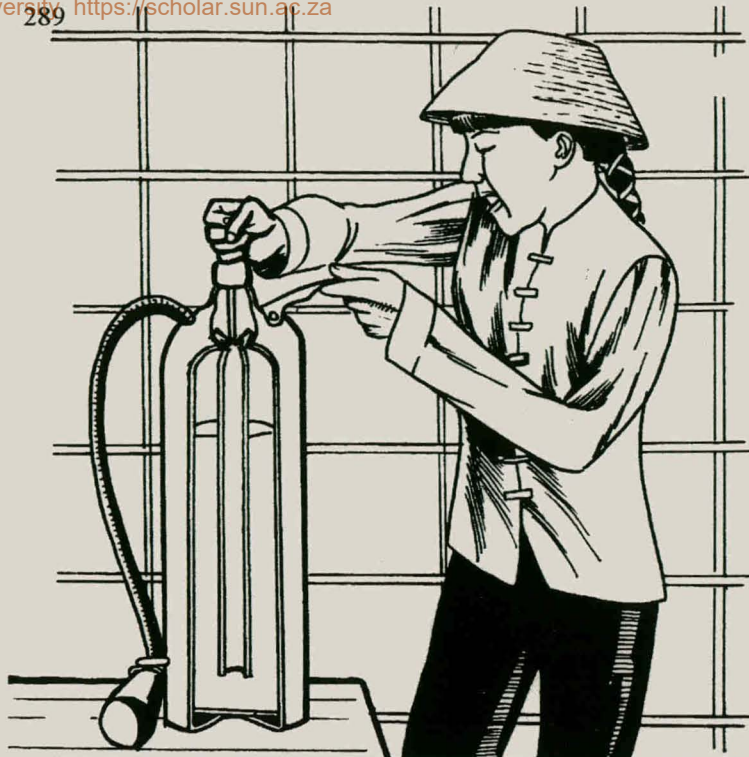
The knob on top of the extinguisher is the strike knob.



There is a sharp, strong spike at the bottom of the strike knob. This spike is called the piercer. This piercer points towards the release disk that is on top of the central tube.



There is also a safety release pin on the side of the strike knob. You cannot use the extinguisher if you do not remove the pin. This safety release pin stops the piercer from making a hole in the pressure release disk if you hit the strike knob by accident. A rubber pipe emerges from the cylinder next to the strike knob. There is a plastic nozzle at the end of the rubber pipe



If you want to use an extinguisher then you must first remove the safety pin. Hit the strike knob with your hand. The strike knob will push the spike into the release disk. The release disk will now have a hole.



The pressurised gas in the cylinder will push the powder down to the bottom of the cylinder. The pressurised gas and powder will go through the opening of the central tube at the bottom and then through the hole in the release disk. The powder and gas will now go into the rubber pipe that is at the top of the cylinder and will come out of the nozzle.



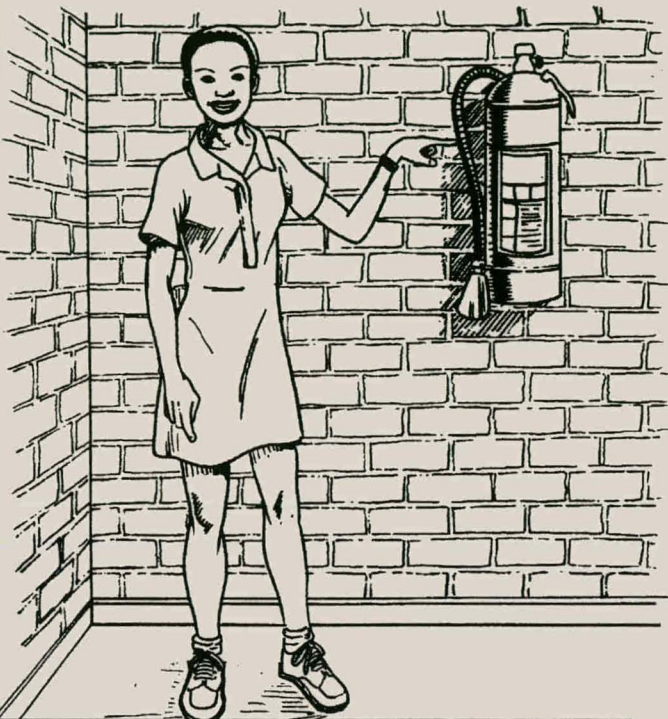
Direct the nozzle towards the fire. The gas is heavier than air and will settle on the fire like a blanket. This will keep the oxygen away from the fire. The fire will go out.



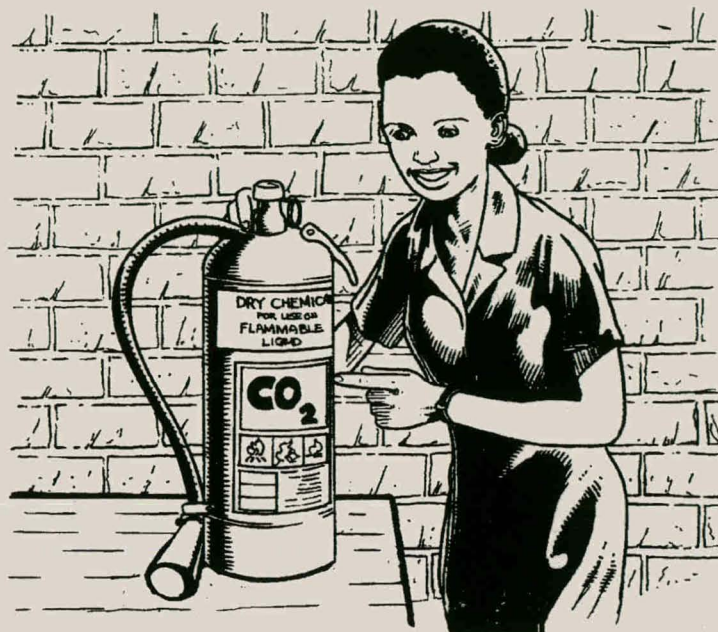
There are also other places where you will find fire extinguishers

Addendum 3.24

THE FIRE EXTINGUISHER



Fire extinguishers are easy to recognise. You will find them hanging on the walls of buildings and in some schools.



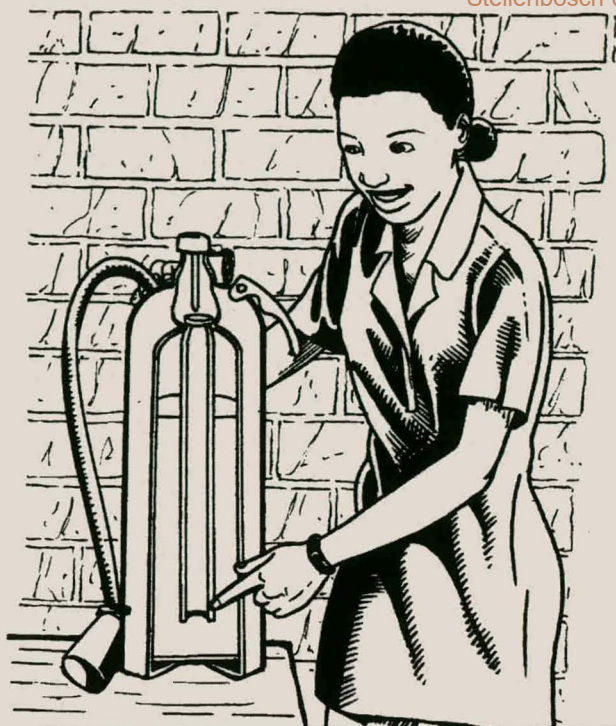
Most fire extinguishers are carbon dioxide (CO₂)-type fire extinguisher and are filled with a white powder and pressurised with a gas called carbon dioxide.



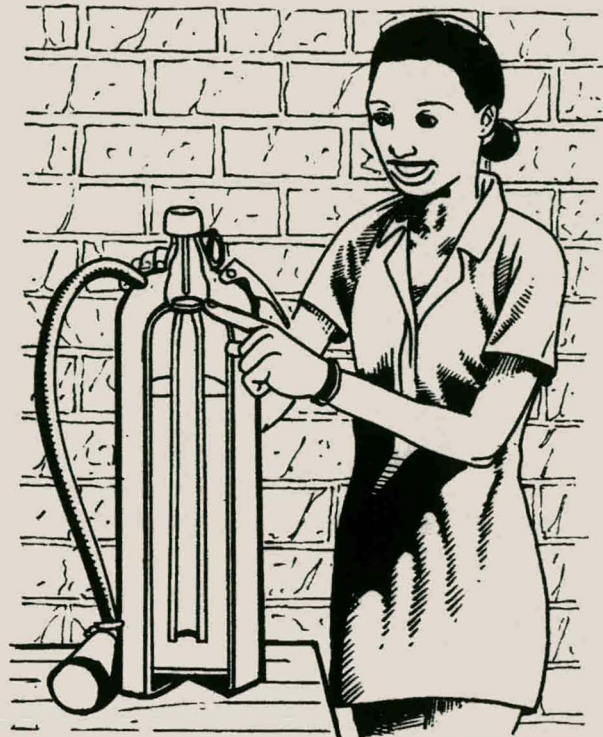
The main part of a fire extinguisher consists of a strong and round metal cylinder. The cylinder is flat at the bottom and rounded at the top.



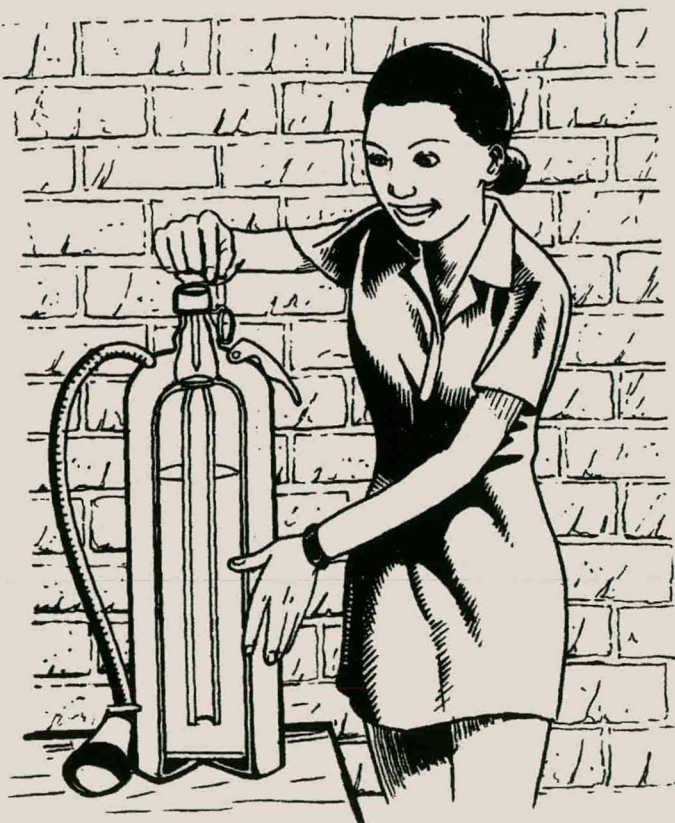
The extinguishers come in different sizes. There are small and large extinguishers.



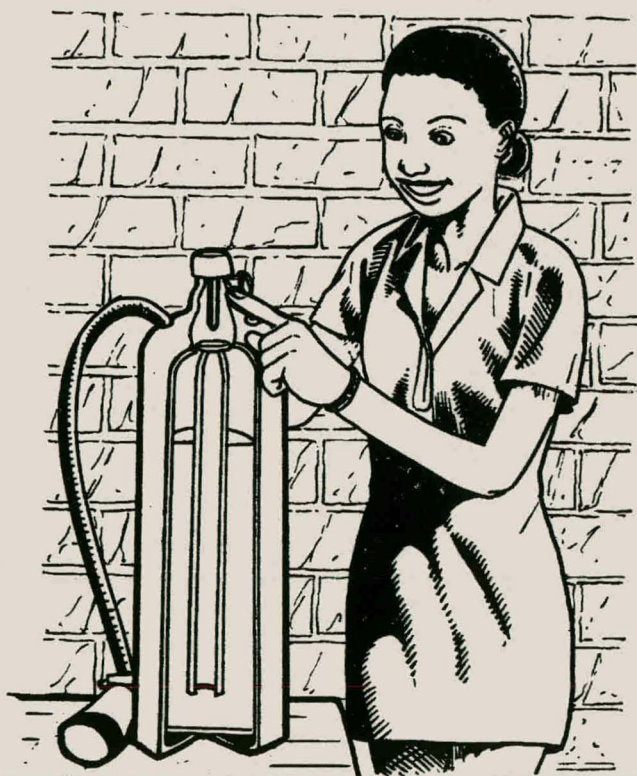
There is a hollow pipe inside the middle of the metal cylinder. This pipe is called the central tube. The central tube is open at the bottom.



The central tube is closed at the top with a pressure release disk.



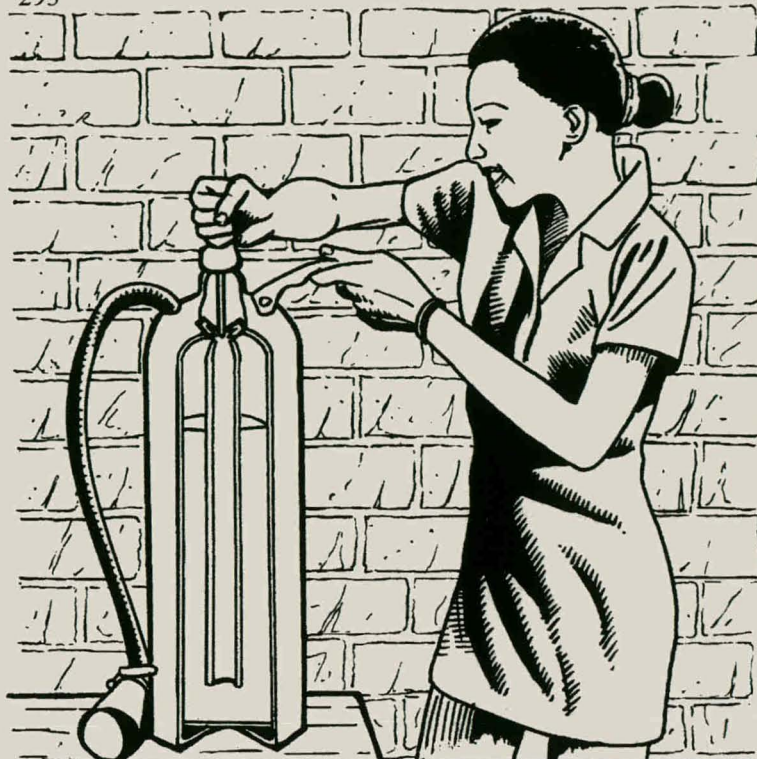
The knob on top of the extinguisher is the strike knob.



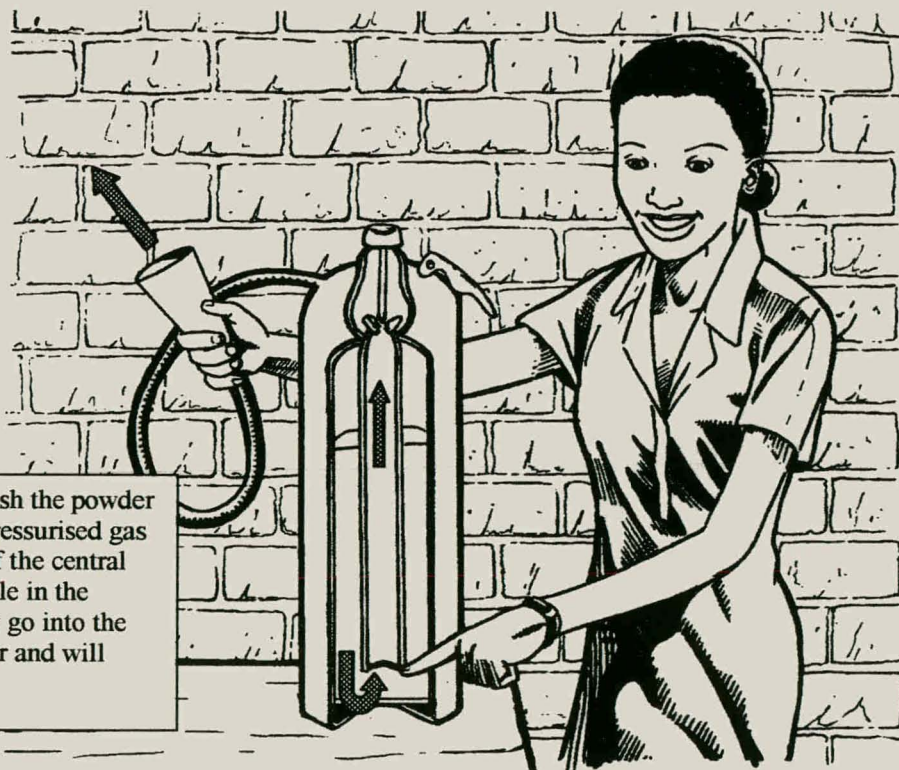
There is a sharp, strong spike at the bottom of the strike knob. This spike is called the piercer. This piercer points towards the release disk that is on top of the central tube.



There is also a safety release pin on the side of the strike knob. You cannot use the extinguisher if you do not remove the pin. This safety release pin stops the piercer from making a hole in the pressure release disk if you hit the strike knob by accident. A rubber pipe emerges from the cylinder next to the strike knob. There is a plastic nozzle at the end of the rubber pipe



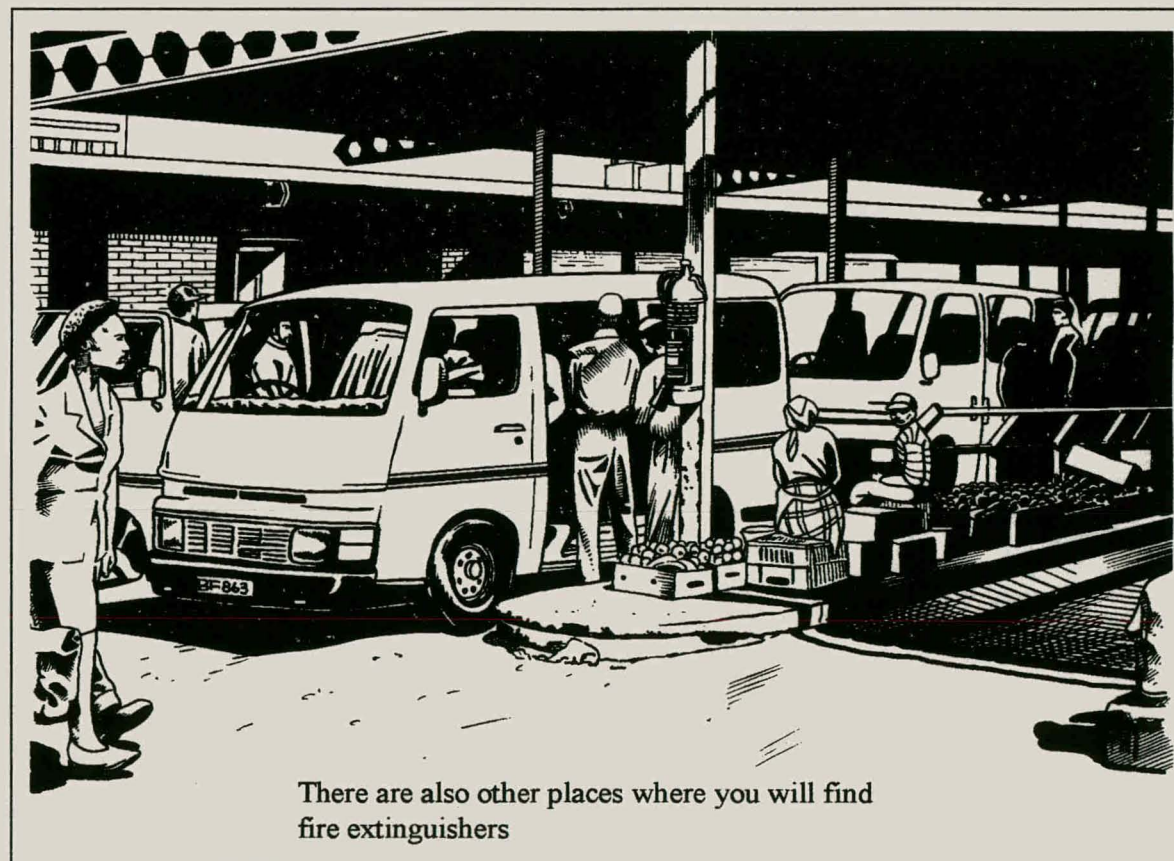
If you want to use an extinguisher then you must first remove the safety pin. Hit the strike knob with your hand. The strike knob will push the spike into the release disk. The release disk will now have a hole.



The pressurised gas in the cylinder will push the powder down to the bottom of the cylinder. The pressurised gas and powder will go through the opening of the central tube at the bottom and then through the hole in the release disk. The powder and gas will now go into the rubber pipe that is at the top of the cylinder and will come out of the nozzle.



Direct the nozzle towards the fire. The gas is heavier than air and will settle on the fire like a blanket. This will keep the oxygen away from the fire. The fire will go out.



There are also other places where you will find fire extinguishers

NAME..... AGE HOME LANGUAGE BOY / GIRL

THE FIRE EXTINGUISHER

Addendum 3.25

Underline the correct answer.

- 1) Fire extinguishers are easy to recognise. You can find extinguishers:**
 - a) Hanging on walls outside buildings.
 - b) Hanging in the principal's office.
 - c) Hanging on the walls inside buildings.
 - d) Hanging on the walls of fire engines.
 - e) All the above answers are wrong.

- 2) Most fire extinguishers are filled with**
 - a) CO^2
 - b) C_oO
 - c) CO_2
 - d) C2_0
 - e) All the above answers are wrong.

- 3) Small fire extinguishers are about the same size as:**
 - a) A large bottle of Coca-Cola.
 - b) A large tin of Coca-Cola.
 - c) A small bottle of Coca-Cola.
 - d) A small child.
 - e) All the above answers are wrong.

- 4) Large fire extinguishers are about as tall as:**
 - a) A large bottle of Coca-Cola.
 - b) A small child.
 - c) A television set.
 - d) A short man.
 - e) All the above answers are wrong.

- 5) The main part of a fire extinguisher consists of:**
 - a) A flat metal cylinder
 - b) A flat, round and strong cylinder
 - c) A strong and flat cylinder
 - d) A strong and round cylinder.
 - e) All the above answers are wrong.

- 6) The central tube of a fire extinguisher is:**
 - a) Hollow and closed at the bottom with a release disk.
 - b) Hollow and closed at the bottom with a pierce disk.
 - c) Hollow and closed at the top with a pierce disk.
 - d) Hollow and closed at the top with a release disk.
 - e) All the above answers are wrong.

- 7) The piercer of a fire extinguisher:**
 - a) Is a sharp spike inside the central tube.
 - b) Is a sharp spike inside the cylinder.
 - c) Is a sharp spike at the bottom of the strike knob.
 - d) Is a sharp spike at the bottom of the release disk.
 - e) All the above answers are wrong.

- 8) What will happen if you hit the strike knob without removing the safety pin?**
 - a) The safety pin will break.
 - b) The release disk will break.
 - c) The piercer will break.
 - d) The control tube will break.
 - e) All the above answers are wrong.

- 9) What will happen if the central tube is closed at the bottom and you remove the safety pin and hit the strike knob?
- The extinguisher might explode.
 - The gas and powder will stay inside the cylinder.
 - The extinguisher will lose all its gas.
 - The gas and powder will move into the central tube.
 - All the above answers are wrong.
- 10) What could be wrong if the gas and powder leak out of a fire extinguisher without anyone using it?
- A broken safety pin.
 - A hole in the pressure release disk.
 - A hole in the central tube.
 - A hole in the control tube.
 - All the above answers are wrong.
- 11) What will happen if the pressure release disk gets a hole?
- The central tube will break.
 - The gas will come out and will leave the powder behind.
 - The powder will come out and will leave the gas behind.
 - The powder and gas will come out.
 - All the above answers are wrong.
- 12) Suppose someone removes the piercer from a fire extinguisher. What will happen when you use the extinguisher?
- The central tube will break.
 - The gas will come out and will leave the powder behind.
 - The powder will come out and will leave the gas behind.
 - The powder and gas will come out.
 - All the above answers are wrong.
- 13) What will happen if you remove the safety pin?
- Only gas will come out.
 - Only powder will come out.
 - Gas and powder will come out.
 - No gas or powder will come out.
 - All the above answers are wrong.
- 14) Suppose someone puts milk in place of the carbon dioxide gas and powder in a fire extinguisher. What will happen when you use the extinguisher?
- Milk will come out.
 - No milk will come out.
 - The piercer will not work properly.
 - The central tube will not work properly.
 - All the above answers are wrong.
- 15) Suppose you use a fire extinguisher, but the powder and gas does not come out. What could be wrong? Provide 3 answers.

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sb

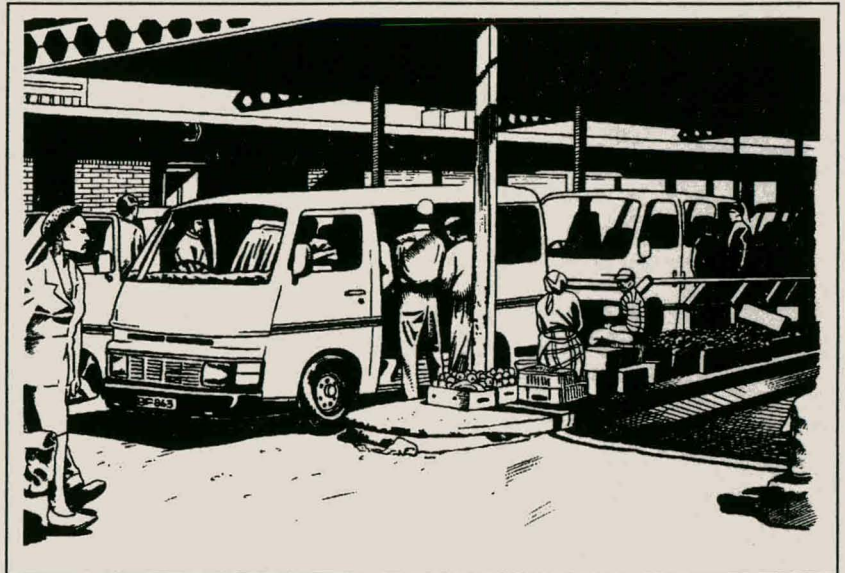
Question 16. Complete the drawing.

Draw the gas and powder that will come out of the fire extinguisher



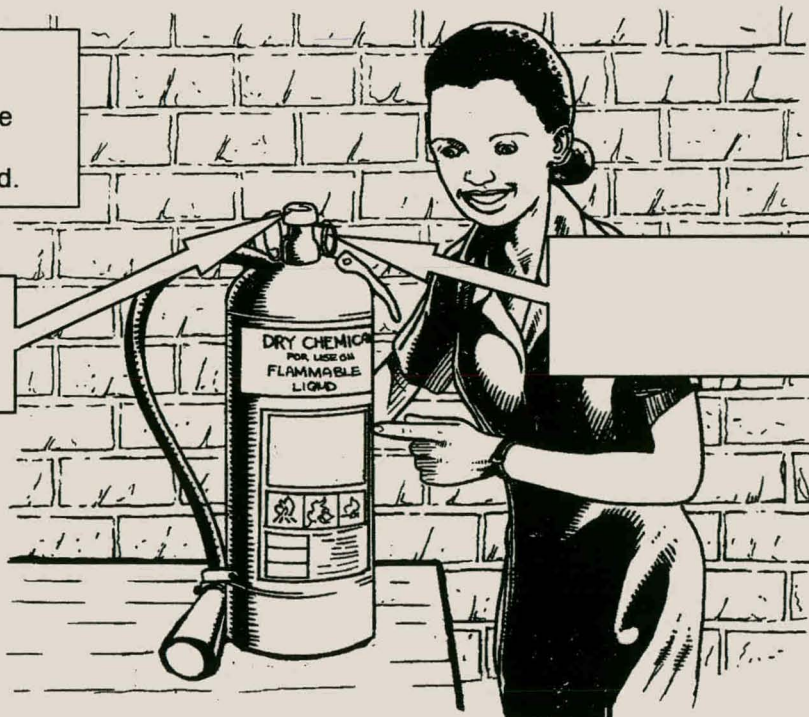
Question 17. Complete the drawing

Make a cross **X** on the picture where you might find a fire extinguisher.



Question 18

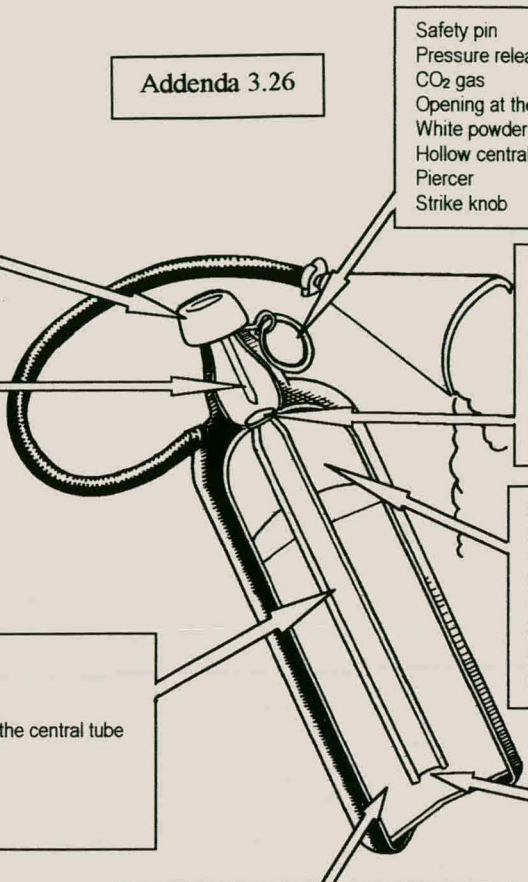
Name the parts that are indicated by the arrows.
Write the answers in the space provided.



Question 1

Underline the correct name for each part

Addenda 3.26



- Safety pin
- Pressure release disk
- CO₂ gas
- Opening at the bottom of the central tube
- White powder
- Hollow central tube
- Piercer
- Strike knob

- Safety pin
- Pressure release disk
- CO₂ gas
- Opening at the bottom of the central tube
- White powder
- Hollow central tube
- Piercer
- Strike knob

- Safety pin
- Pressure release disk
- CO₂ gas
- Opening at the bottom of the central tube
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- Opening at the bottom of the central tube
- White powder
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- Piercer
- Strike knob

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- CO₂ gas
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- Safety pin
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- CO₂ gas
- Opening at the bottom of the central tube
- White powder
- Hollow central tube
- Piercer
- Strike knob

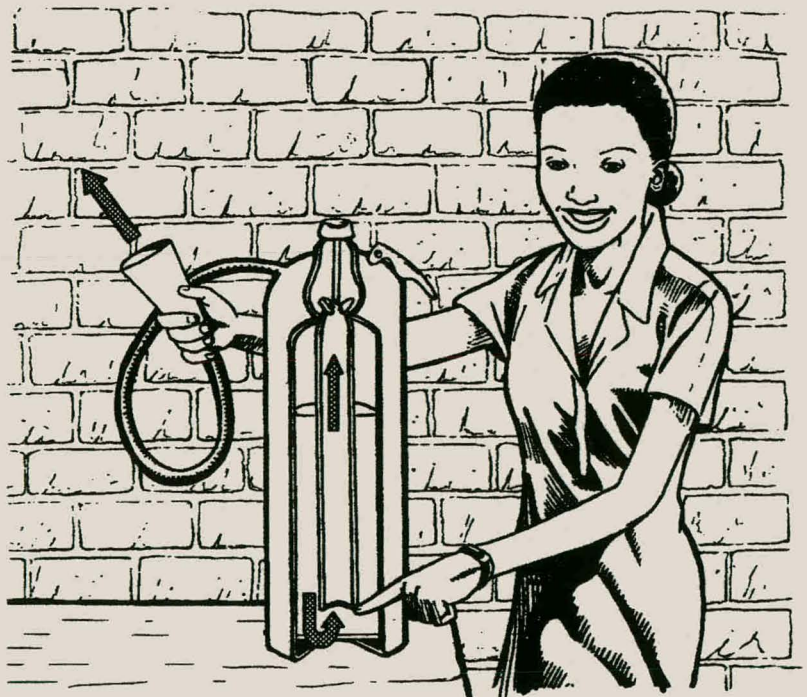
- Safety pin
- Pressure release disk
- CO₂ gas
- Opening at the bottom of the central tube
- White powder
- Hollow central tube
- Piercer
- Strike knob

Question 2

Underline the correct answer.

What do the arrows show you in the picture?

- a) Dangerous parts of the extinguisher.
- b) Where an extinguisher can break.
- c) How the gas and powder travels out of the extinguisher when you use it.
- d) What happens when the extinguisher is empty
- e) All the above answers are wrong.



Question 3

Underline the correct answer.

What is the girl doing in the picture?

- a) She is pulling the extinguisher.
- b) She is hitting the strike knob.
- c) She is lifting the extinguisher.
- d) She is hitting the central tube.
- e) All the above answers are wrong.



Question 4

Underline the correct answer.

The picture of the fire extinguisher on the right shows us:

- a) The inside of an extinguisher.
- b) A drawing of the outside of an extinguisher.
- c) A broken extinguisher.
- d) Parts on the outside of the extinguisher.
- e) All the above answers are wrong.



Question 5

Underline the correct answer

This picture shows us that the fire extinguisher is:

- a) Big and red in colour.
- b) Flat at the bottom and round at the top.
- c) The central tube.
- d) Flat and wide at the bottom.
- e) All the above answers are wrong.



Question 6

How would you like to learn about a fire extinguisher?

Mark your choice with a large ✓ Choose only one of **A)**, **B)**, or **C)**.

A) Words and pictures of this girl explaining what is happening



You cannot use the extinguisher if you do not remove the pin. This stops the piercer from making a hole in the pressure release disk

or

B) Words and pictures of this girl explaining what is happening



You cannot use the extinguisher if you do not remove the pin. This stops the piercer from making a hole in the pressure release disk

or

C) Just words without any pictures

You cannot use the extinguisher if you do not remove the pin. This stops the piercer from making a hole in the pressure release disk

Question 7

Which of these two pictures do you like the most?

Put a large ✓ next to one of the following answers.

- a) I like picture A the most
- b) I like picture B the most
- c) I like them both the same

Give one reason why you liked picture A more than picture B, or liked picture B more than picture A., or liked them both the same.

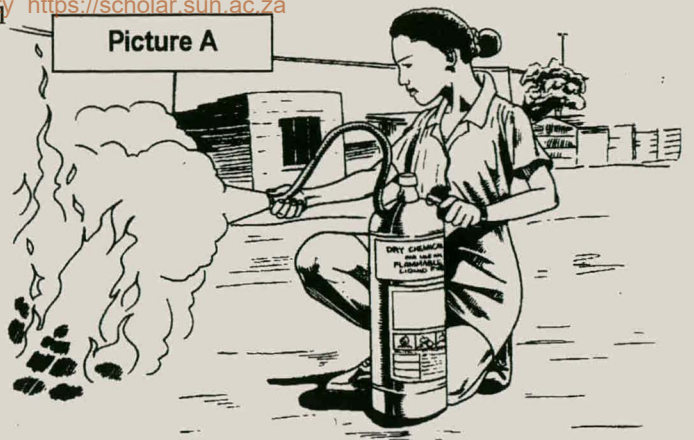
Answer

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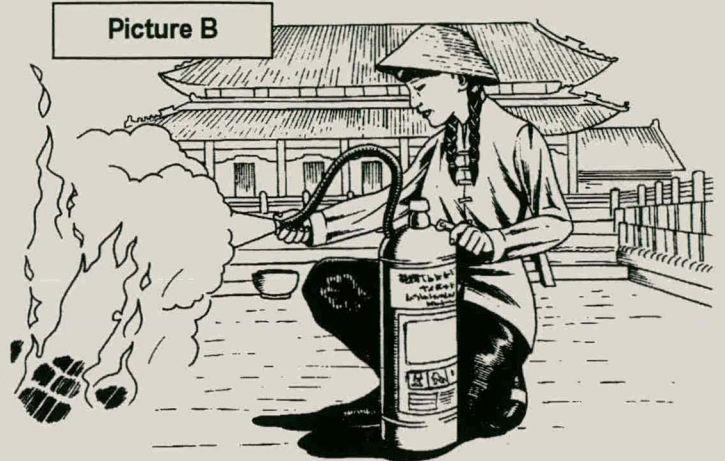
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Picture A



Picture B



Question 8

Is there something that you like or do not like in this picture?

If your answer is yes, what is it?

Answer

.....

.....



Is there something that you like or do not like in this picture?

If your answer is yes, what is it?

Answer

.....

.....



Addendum 3.27

SETIMAMOLLO

Ho bonolo ho ka tseba ditimamollo. O tla di fumana di leketla maboteng a meaho le ho tse ding tsa dikolo. Bongata ba ditimamollo ke mofuta wa khabono daeokosaete (carbon dioxide) (CO₂) mme di tlatsitswe ka phofo e tshweu mme di be di budulelwa ka gase e bitswang khabonodaekosaete. Ditimamollo di tla ka boholo bo fapaneng. Ho nale tse nnyane le tse kgolo.

Karolo e kgolo ya setimamollo e nale silindara e matla e tjhithja ya tshepe. Silindara e otlollohile ka tlase mme e tjhithja ka hodimo. Ho nale peipi bohareng ba silindara e bulehileng ka mahlakoreng. Peipi eo e bitswa tjhupu e bohareng (central tube). Tjhupu e bohareng e bulehile ka tlase. Tjhupu e bohareng e kwetswe ka hodimo ka sekwahelwana se lokollang kगतello (pressure release disk). Ka hodima setimamollo ho nale hloohwana e otlwang (strike knob). Ho nale sepekere se tabolang se bohale se matla qetellong ya hloohwana e otlwang. Sepekere sena se bitswa piercer. Sepekere sena se supile ntlheng ya sekwahelwana se lokollang kगतello se hodima tjhupu e bohareng (central tube). Ho nale pene ya polokeho e lokollwang ka lehlakoreng ho hloohwana e otlwang. O ke ke wa sebedisa setimamollo ebang o sa tlase pene. Pene eo ya poloketseho e lokollwang e thibela sepekere se tabolang ho ka phunya lesoba ho sekwahelana se lokollang kगतello ebang o ka otlala hloohwana ka phoso.

Peipi ya rabara e hlahella ho tswa silindareng haufi le hloohwana e otlwang. Qetellong ya peipi ya rabara ho nale molomo polasetiki.

Ebang o batla ho sebedisa setimamollo o tshwanetse hore o qale ka ho tlosa pene ya polokeho. Otlala hloohwana ka letsoho. Hloohwana e tla sutumelletsa sepekere ka hara sekwahelwana se lokollang kगतello (release disk). Ha jwale sekwahelwana se lokollang kगतello se tla ba le lesoba. Gase e peteditsweng ka hara silindara e tla suthumelletsa phofo tlase qetellong ya silindara. Gase e peteditsweng mmoho le phofo, di tla tsamaya ka hara peipi di ntano tswa lesobeng ka hara sekwahelwana se lokollang kगतello (release disk). Phofo ha mmoho le gase jwale di tla be di kena ka hara peipi ya rabara e leng ka hodima silindara di ntano tswa le molomong wa polasetiki. Tobisa molomo ntlheng ya mollo. Gase e boima ho feta moya mme e tla apara mollo jwaloka kobo. Mme seo se tla tebela moya o motjha (oxygen) mollong. Mollo o tla tima. Ho nale dibaka tse ding tseo o ka nnang wa fumana ditimamollo ho tsona.

Addendum 3.28

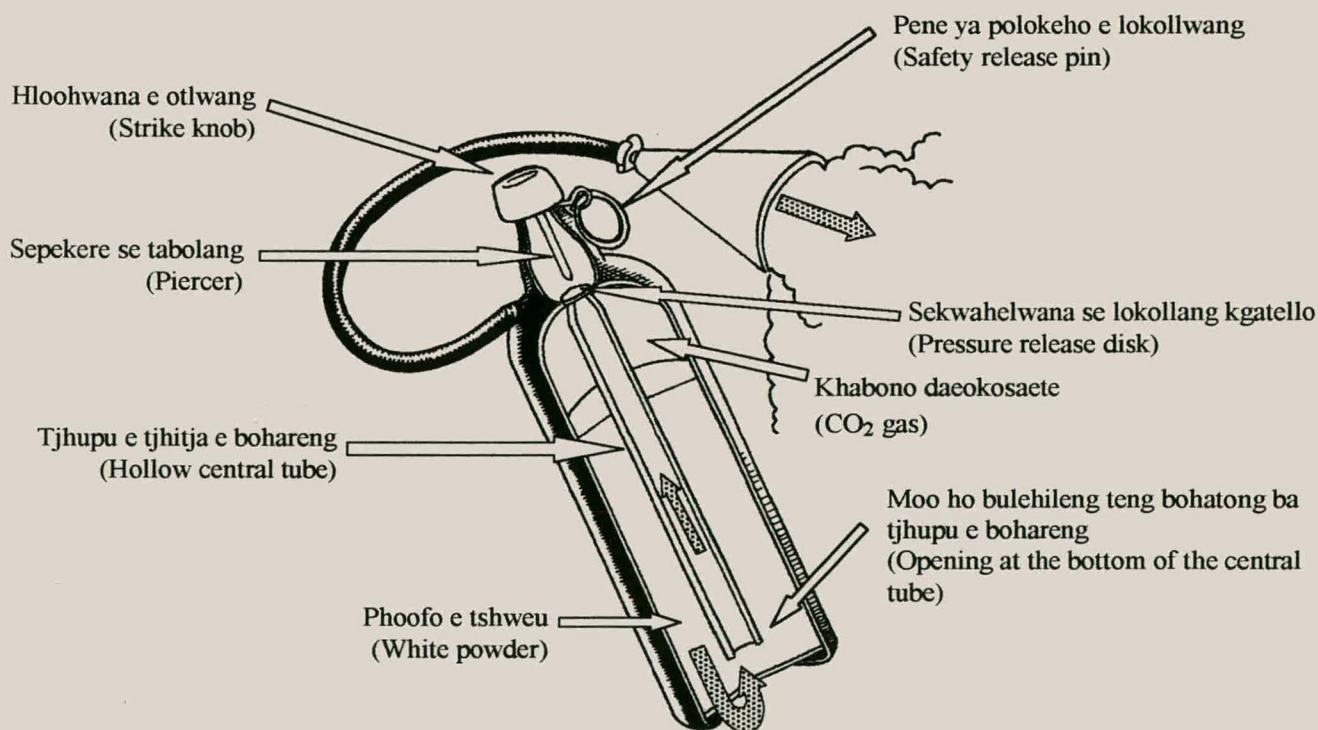
SETIMAMOLLO

Ho bonolo ho ka tseba ditimamollo. O tla di fumana di leketla maboteng a meaho le ho tse ding tsa dikolo. Bongata ba ditimamollo ke mofuta wa khabono daeokosaete (carbon dioxide) (CO₂) mme di tlatsitswe ka phofo e tshweu mme di be di budulelwa ka gase e bitswang khabonodaeokosaete. Ditimamollo di tla ka boholo bo fapaneng. Ho nale tse nnyane le tse kgolo.

Karolo e kgolo ya setimamollo e nale silindara e matla e tshitiya ya tshpe. Silindara e otlohohile ka tlase mme e tshitiya ka hodimo. Ho nale peipi bohareng ba silindara e bulehileng ka mahlakoreng. Peipi eo e bitswa tjhupu e bohareng (central tube). Tjhupu e bohareng e bulehile ka tlase. Tjhupu e bohareng e kwetswe ka hodimo ka sekwahelwana se lokollang kगतello (pressure release disk). Ka hodima setimamollo ho nale hloohwana e otlwang (strike knob). Ho nale sepekere se tabolang se bohale se matla qetellong ya hloohwana e otlwang. Sepekere sena se bitswa piercer. Sepekere sena se supile ntlheng ya sekwahelwana se lokollang kगतello se hodima tjhupu e bohareng (central tube). Ho nale pene ya polokeho e lokollwang ka lehlakoreng ho hloohwana e otlwang. O ke ke wa sebedisa setimamollo ebang o sa tlase pene. Pene eo ya poloketseho e lokollwang e thibela sepekere se tabolang ho ka phunya lesoba ho sekwahelana se lokollang kगतello ebang o ka otlala hloohwana ka phoso.

Peipi ya rabara e hlahella ho tswa silendareng haufi le hloohwana e otlwang. Qetellong ya peipi ya rabara ho nale molomo polasetiki.

Ebang o batla ho sebedisa setimamollo o tshwanetse hore o qale ka ho tlosa pene ya polokeho. Otlala hloohwana ka letsoho. Hloohwana e tla sutumelletsa sepekere ka hara sekwahelwana se lokollang kगतello (release disk). Ha jwale sekwahelwana se lokollang kगतello se tla ba le lesoba. Gase e peteditsweng ka hara silindara e tla sutumelletsa phofo tlase qetellong ya silindara. Gase e peteditsweng mmoho le phofo, di tla tsamaya ka hara peipi di ntano tswa lesobeng ka hara sekwahelwana se lokollang kगतello (release disk). Phofo ha mmoho le gase jwale di tla be di kena ka hara peipi ya rabara e leng ka hodima silindara di ntano tswa le molomong wa polasetiki. Tobisa molomo ntlheng ya mollo. Gase e boima ho feta moya mme e tla apara mollo jwaloka kobo. Mme seo se tla tebela moya o motjha (oxygen) mollong. Mollo o tla tima. Ho nale dibaka tse ding tseo o ka nngang wa fumana ditimamollo ho tsona.



SETIMAMOLLO

Addendum 3.29



Ho bonolo ho ka tseba ditimamollo. O tla di fumana di leketla maboteng a meaho le ho tse ding tsa dikolo.



Bongata ba ditimamollo ke mofuta wa khabono daeokosaete (carbon dioxide) (CO_2) mme di tlatsitswe ka phofo e tshweu mme di be di budulelwa ka gase e bitswang khabonodaeokosaete.



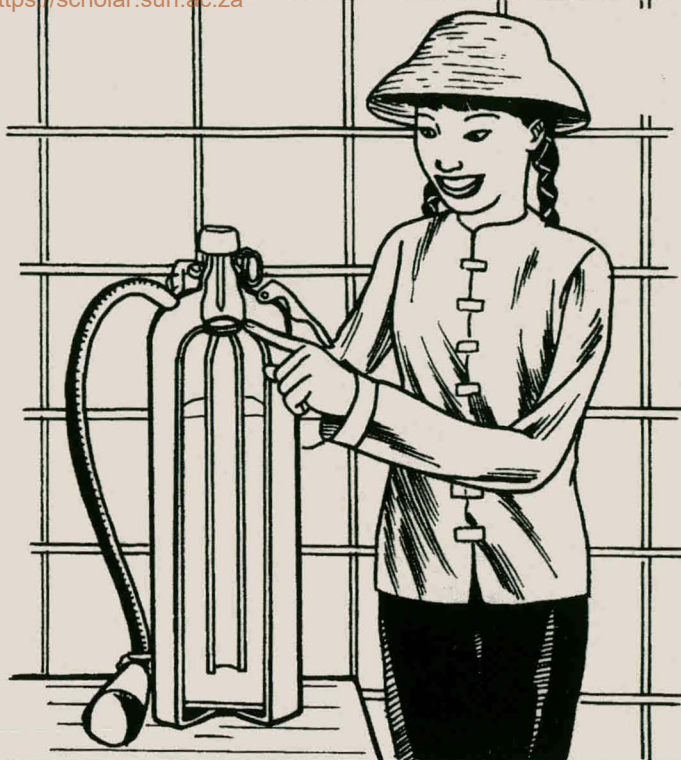
Karolo e kgolo ya setimamollo e nale silindara e matla e tshitjha ya tshepe. Silindara e otlollohile ka tlase mme e tshitjha ka hodimo.



Ditimamollo di tla ka boholo bo fapaneng. Ho nale tse nnyane le tse kgolo.



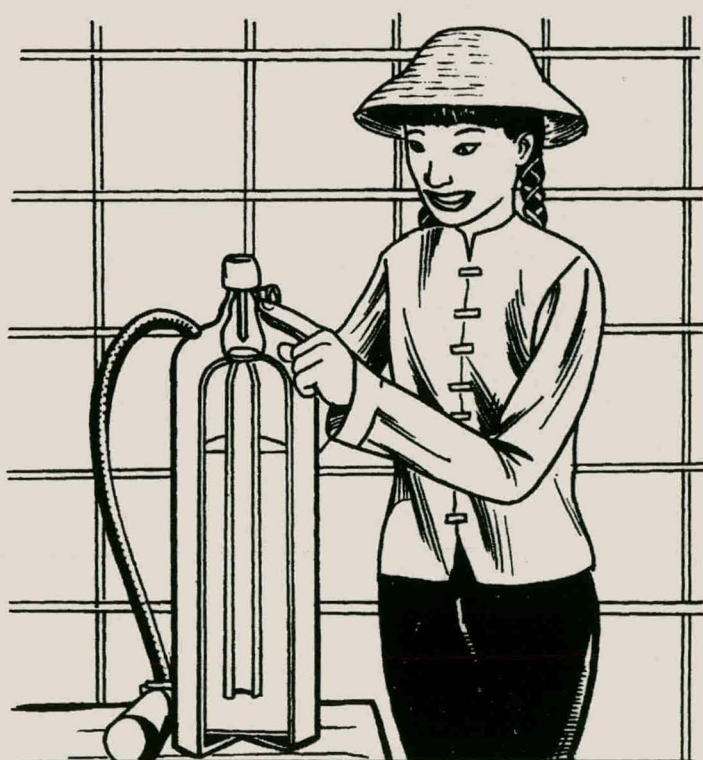
Ho nale peipi bohareng ba silindara e bulehileng ka mahlakoreng. Peipi eo e bitswa tjhupu e bohareng (central tube). Tjhupu e bohareng e bulehile ka tlase.



Tjhupu e bohareng e kwetswe ka hodimo ka sekwahelwana se lokollang kगतello (pressure release disk).



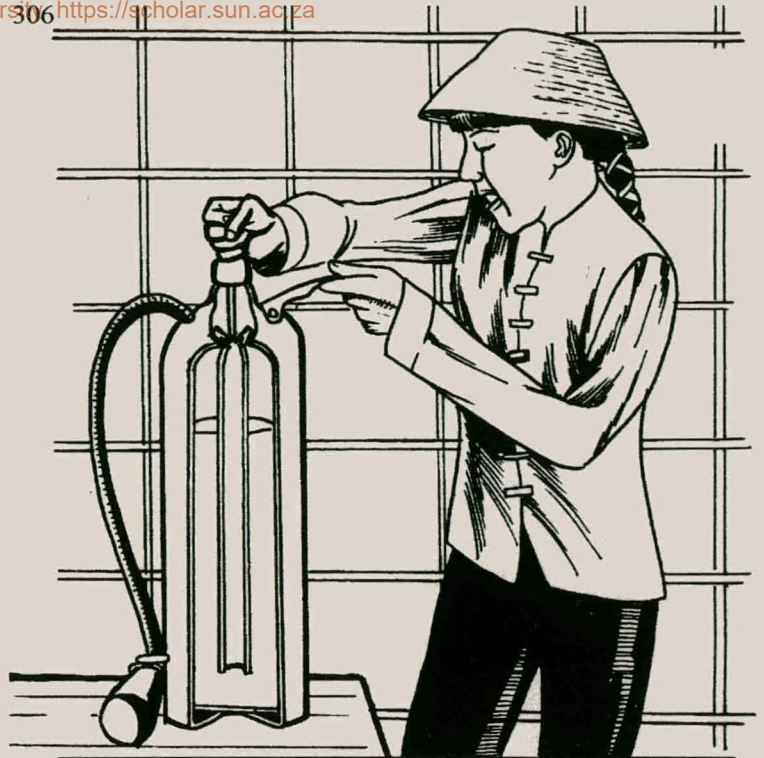
Ka hodima setimamollo ho nale hloohwana e otlwang (strike knob).



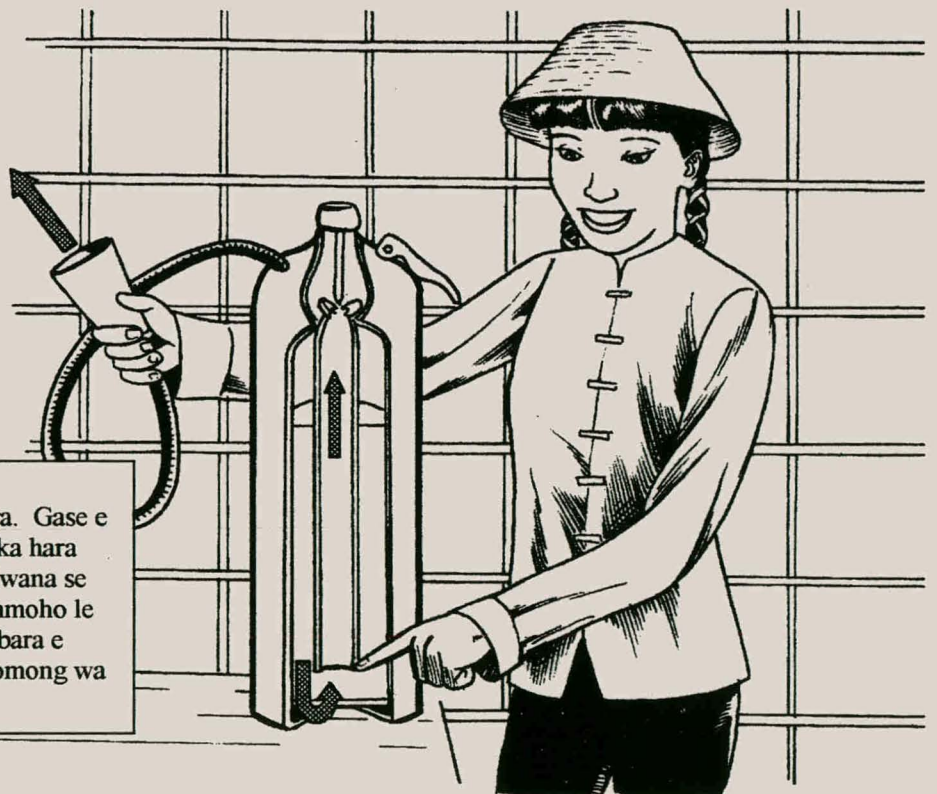
Ho nale sepekere se tabolang se bohale se matla qetellong ya hloohwana e otlwang. Sepekere sena se bitswa piercer. Sepekere sena se supile ntlheng ya sekwahelwana se lokollang kगतello se hodima tjhupu e bohareng (central tube).



Ho nale pene ya polokeho e lokollwang ka lehlakoreng ho hloohwana e otlwang. O ke ke wa sebedisa setimamollo ebang o sa tlose pene. Pene eo ya poloketseho e lokollwang e thibela sepekere se tabolang ho ka phunya lesoba ho sekwahelana se lokollang kगतello ebang o ka otl'a hloohwana ka phoso. Peipi ya rabara e hlahella ho tswa silindareng haufi le hloohwana e otlwang. Qetellong ya peipi ya rabara ho nale molomo polasetiki.



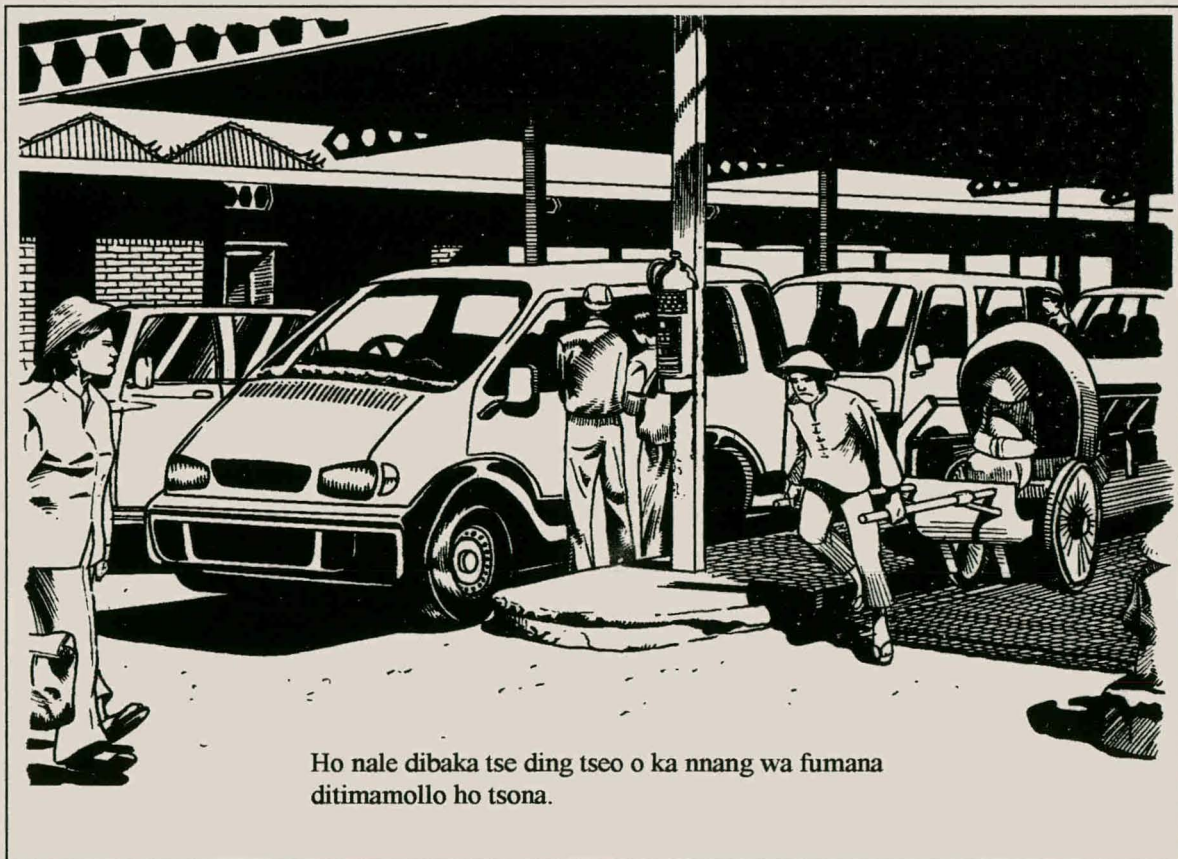
Ebang o batla ho sebedisa setimamollo o tshwanetse hore o qale ka ho tlosa pene ya polokeho. Otl'a hloohwana ka letsoho. Hloohwana e tla sutumelletsa sepekere ka hara sekwahelwana se lokollang kगतello (release disk). Ha jwale sekwahelwana se lokollang kगतello se tla ba le lesoba.



Gase e peteditsweng ka hara silindara e tla sutumelletsa phofo tlase qetellong ya silindara. Gase e peteditsweng mmoho le phofo, di tla tsamaya ka hara peipi di ntano tswa lesobeng ka hara sekwahelwana se lokollang kगतello (release disk). Phofo ha mmoho le gase jwale di tla be di kena ka hara peipi ya rabara e leng ka hodima silindara di ntano tswa le molomong wa polasetiki.



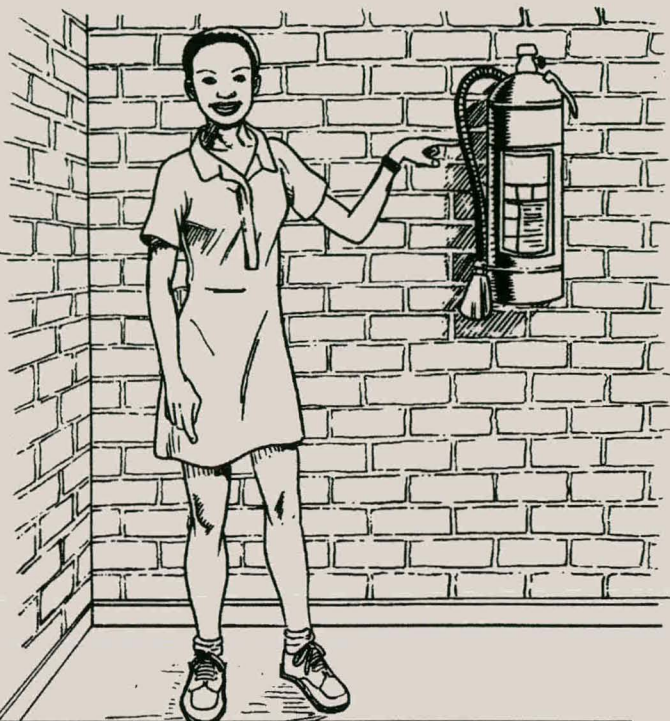
Tobisa molomo ntlheng ya mollo. Gase e boima ho feta moya mme e tla apara mollo jwaloka kobo. Mme seo se tla tebela moya o motjha (oxygen) mollong. Mollo o tla tima.



Ho nale dibaka tse ding tseo o ka nnang wa fumana ditimamollo ho tsona.

Addendum 3.30

SETIMAMOLLO



Ho bonolo ho ka tseba ditimamollo. O tla di fumana di leketla maboteng a meaho le ho tse ding tsa dikolo.



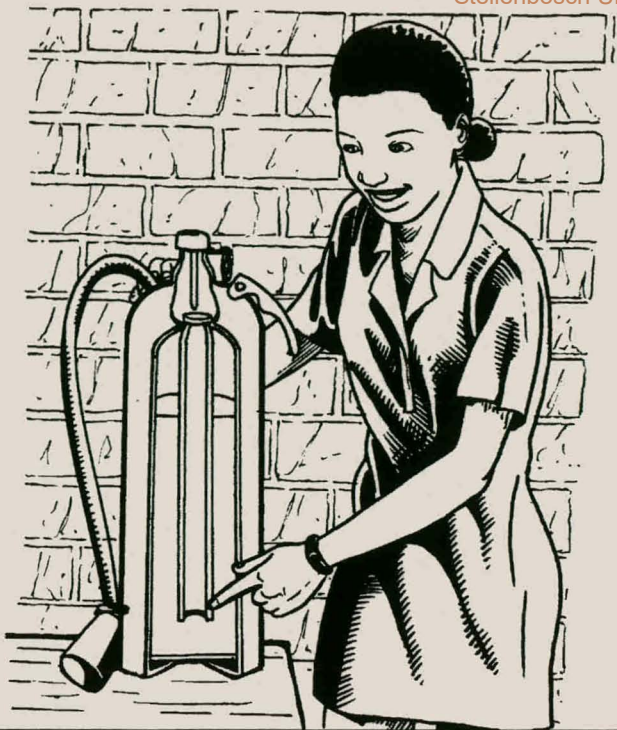
Bongata ba ditimamollo ke mofuta wa khabono daekosaete (carbon dioxide) (CO₂) mme di tlatsitse ka phofo e tshweu mme di be di budulelwa ka gase e bitswang khabonodaeokosaete.



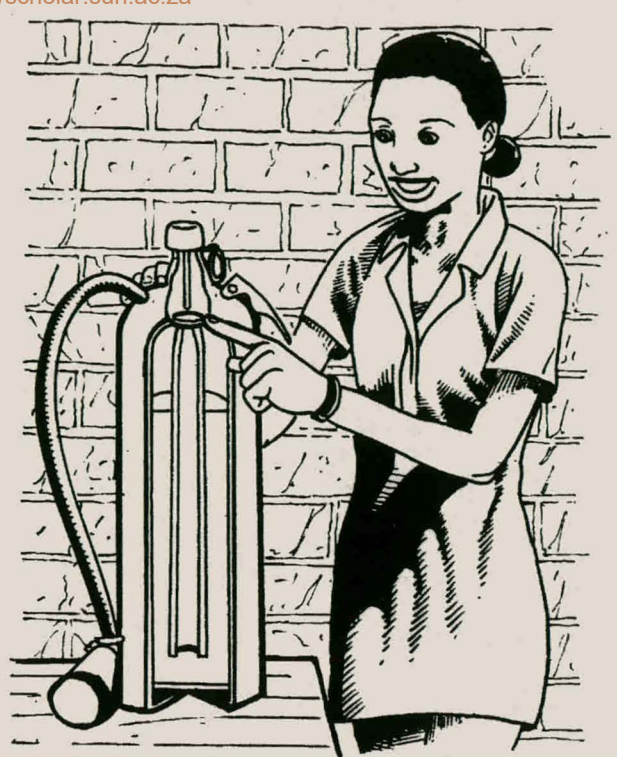
Karolo e kgolo ya setimamollo e nale silindara e matla e tjhithja ya tshepe. Silindara e otlollohile ka tlase mme e tjhithja ka hodimo.



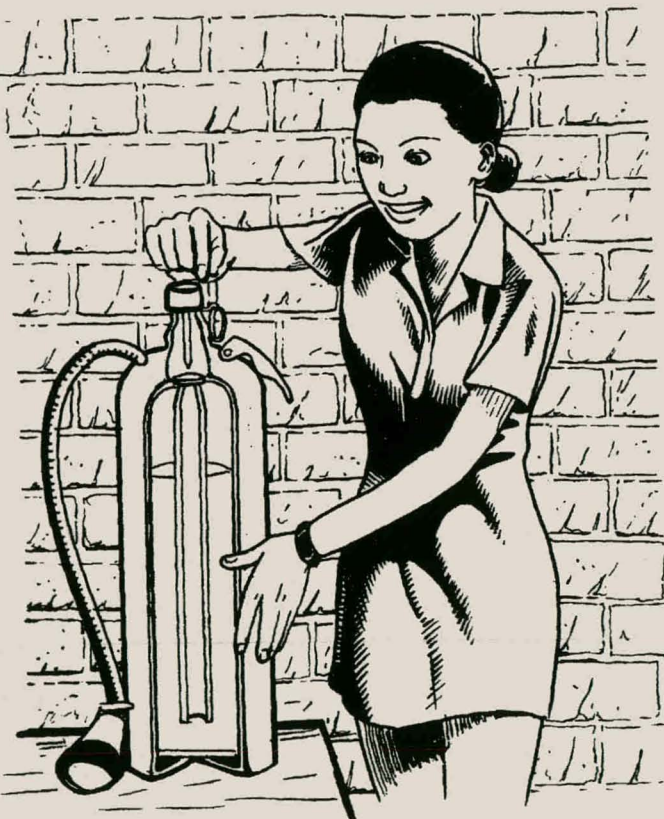
Ditimamollo di tla ka boholo bo fapaneng. Ho nale tse nnyane le tse kgolo.



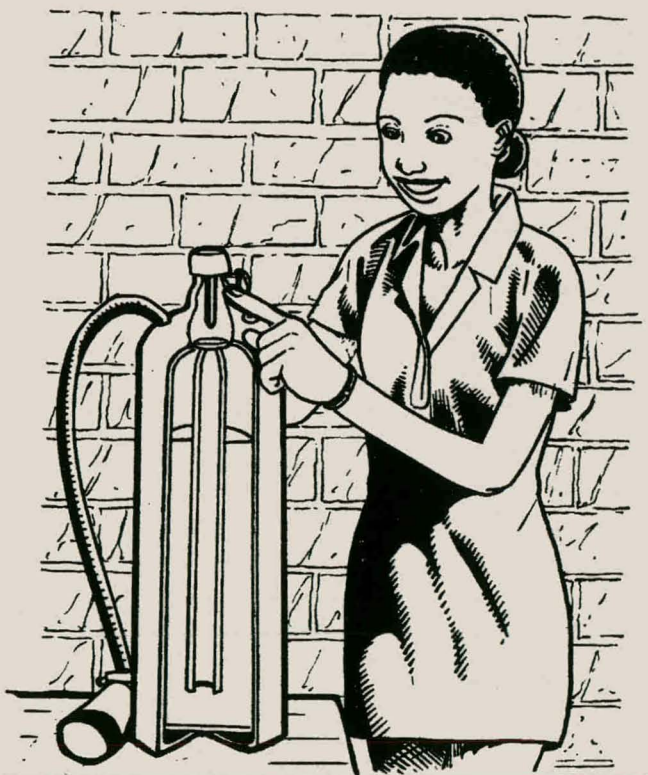
Ho nale peipi bohareng ba silindara e bulehileng ka mahlakoreng. Peipi eo e bitswa tjhupu e bohareng (central tube). Tjhupu e bohareng e bulehile ka tlase.



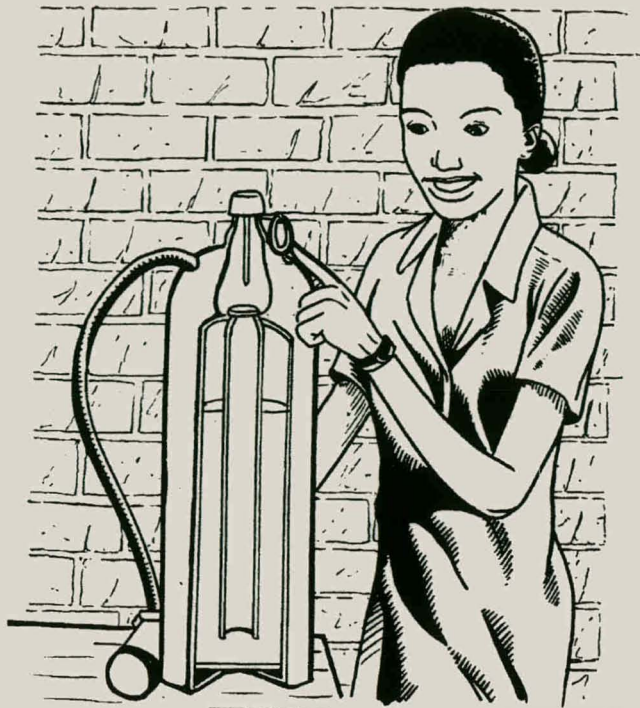
Tjhupu e bohareng e kwetswe ka hodimo ka sekwahelwana se lokollang kगतello (pressure release disk).



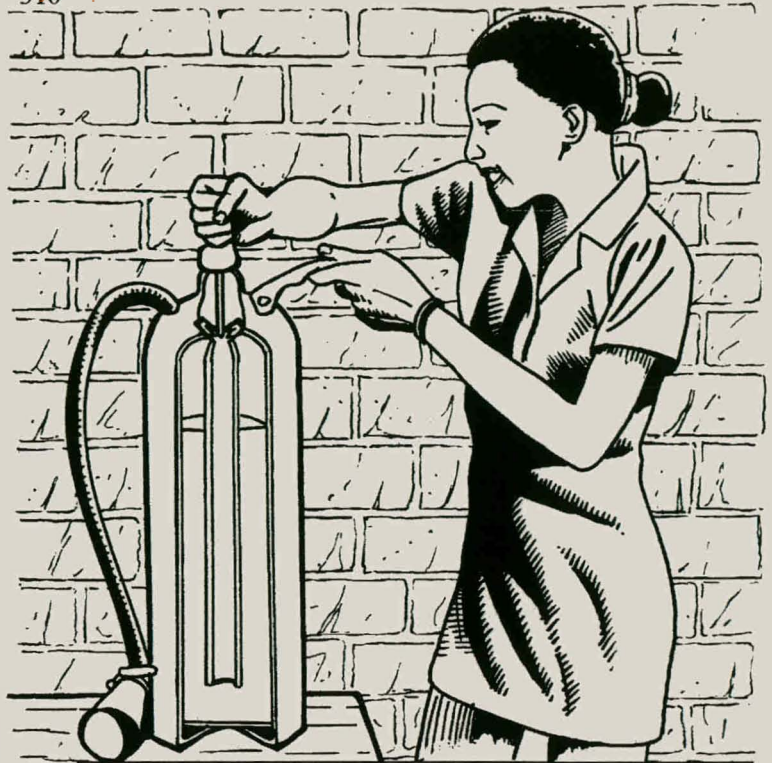
Ka hodima setimamollo ho nale hloohwana e otlwang (strike knob).



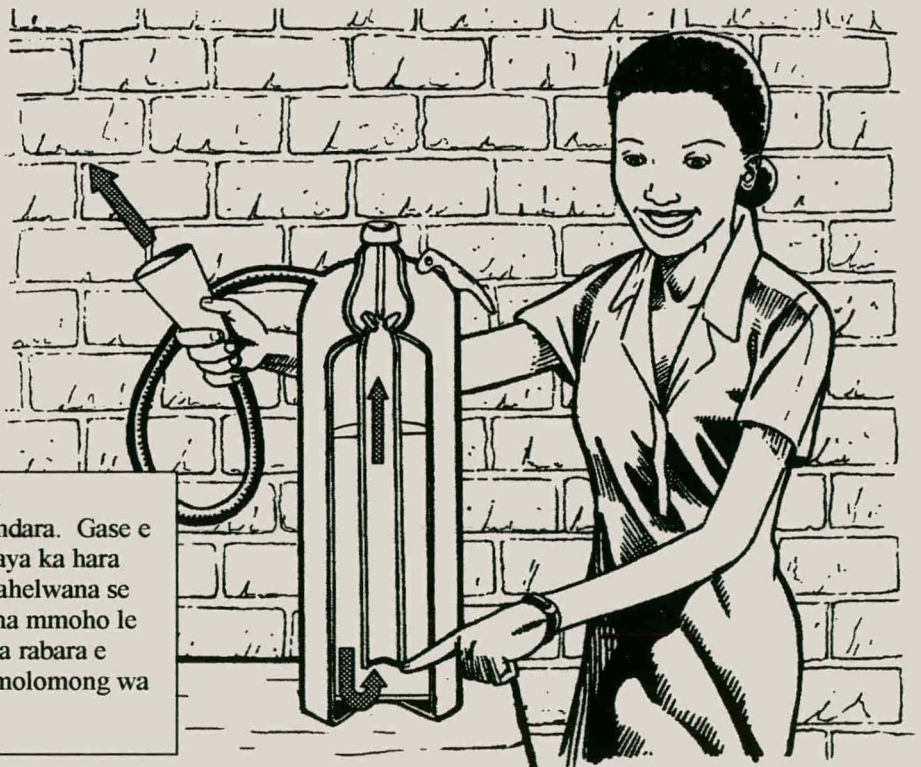
Ho nale sepekere se tabolang se bohale se matla qetellong ya hloohwana e otlwang. Sepekere sena se bitswa piercer. Sepekere sena se supile ntlheng ya sekwahelwana se lokollang kगतello se hodima tjhupu e bohareng (central tube).



Ho nale pene ya polokeho e lokollwang ka lehlakoreng ho hloohwana e otlwang. O ke ke wa sebedisa setimamollo ebang o sa tlose pene. Pene eo ya poloketseho e lokollwang e thibela sepekere se tabolang ho ka phunya lesoba ho sekwahelana se lokollang kगतello ebang o ka otlala hloohwana ka phoso. Peipi ya rabara e hlahella ho tswa silendareng haufi le hloohwana e otlwang. Qetellong ya peipi ya rabara ho nale molomo polasetiki.



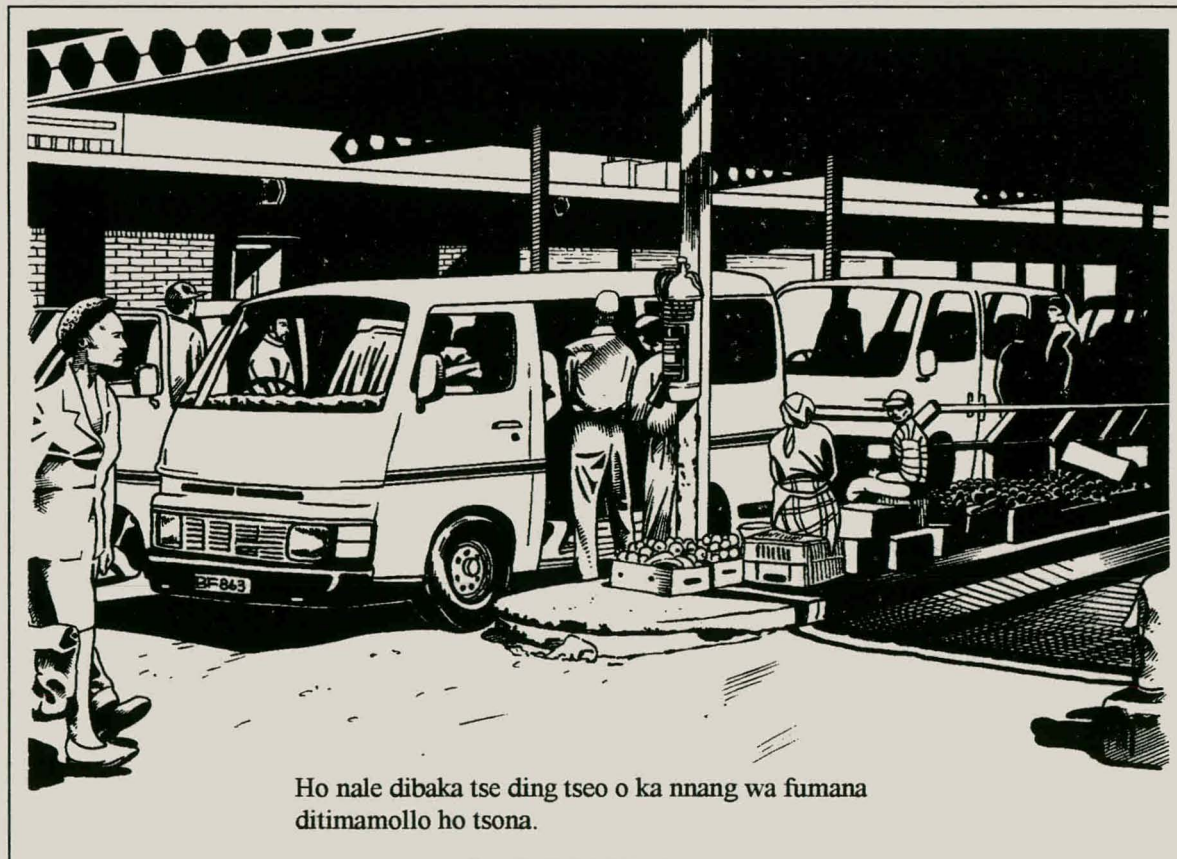
Ebang o batla ho sebedisa setimamollo o tshwanetse hore o qale ka ho tlosa pene ya polokeho. Otlala hloohwana ka letsoho. Hloohwana e tla sutumelletsa sepekere ka hara sekwahelwana se lokollang kगतello (release disk). Ha jwale sekwahelwana se lokollang kगतello se tla ba le lesoba.



Gase e peteditsweng ka hara silindara e tla sutumelletsa phofo tlase qetellong ya silindara. Gase e peteditsweng mmoho le phofo, di tla tsamaya ka hara peipi di ntano tswa lesobeng ka hara sekwahelwana se lokollang kगतello (release disk). Phofo ha mmoho le gase jwale di tla be di kena ka hara peipi ya rabara e leng ka hodima silindara di ntano tswa le molomong wa polasetiki.



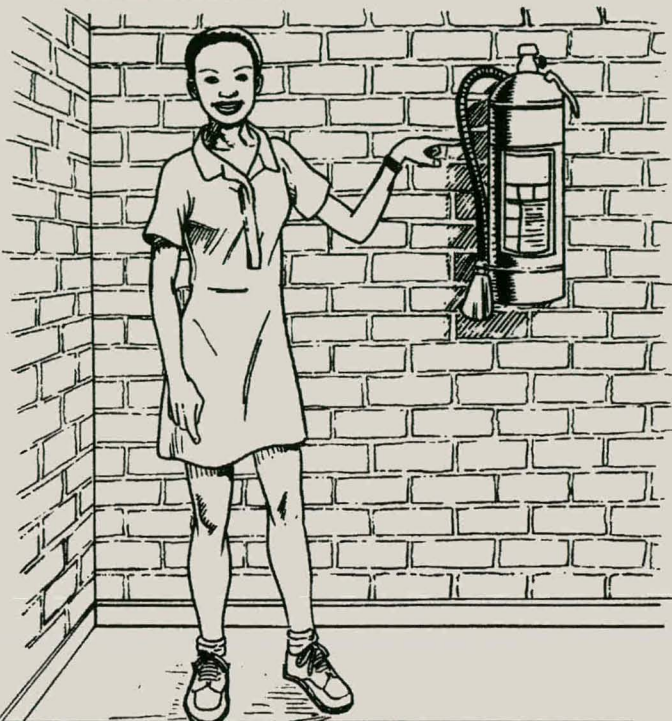
Tobisa molomo ntlheng ya mollo. Gase e boima ho feta moya mme e tla apara mollo jwaloka kobo. Mme seo se tla tebela moya o motjha (oxygen) mollong. Mollo o tla tima.



Ho nale dibaka tse ding tseo o ka nngang wa fumana ditimamollo ho tsona.

SETIMAMOLLO

Addendum 3.31



Ho bonolo ho ka tseba ditimamollo. O tla di fumana di leketla maboteng a meaho le ho tse ding tsa dikolo.



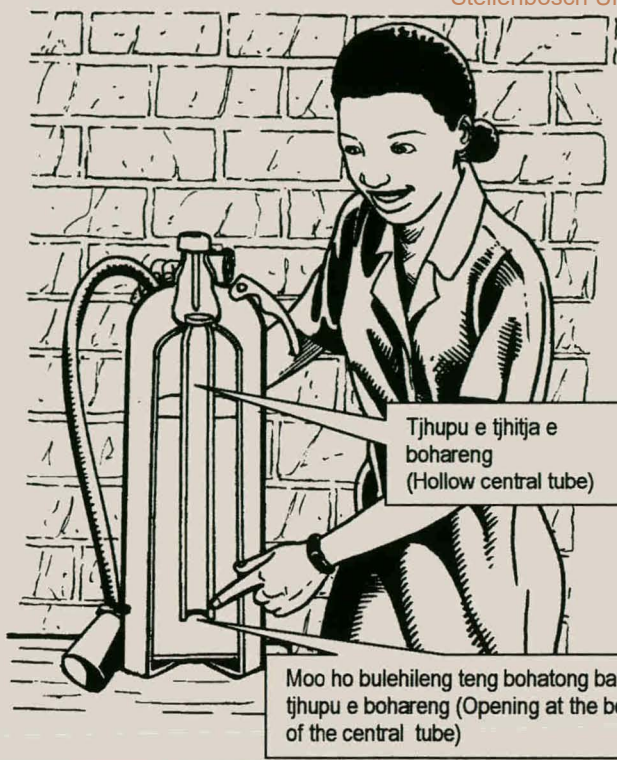
Bongata ba ditimamollo ke mofuta wa khabono daeokosaete (carbon dioxide) (CO₂) mme di tlatsitswe ka phofo e tshweu mme di be di budulelwa ka gase e bitswang khabonodaeokosaete.



Karolo e kgolo ya setimamollo e nale silindara e matla e tjihitja ya tshepe. Silindara e otlollohile ka tlase mme e tjihitja ka hodimo.



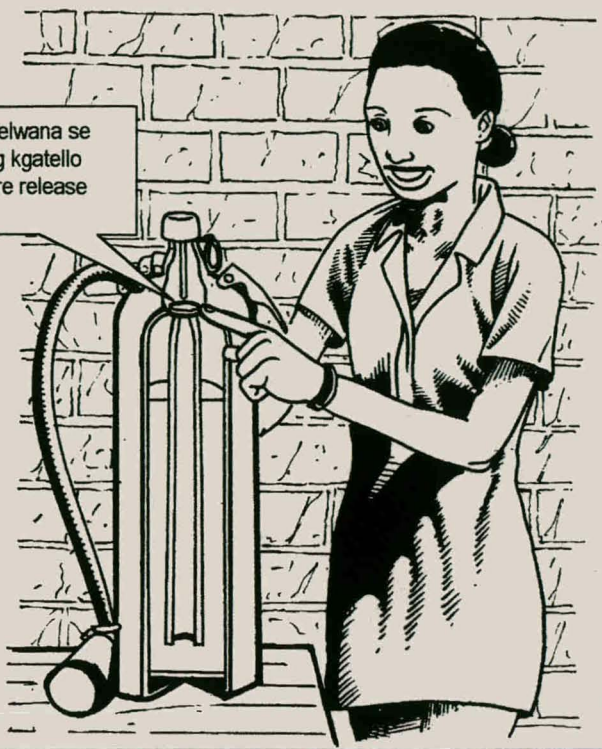
Ditimamollo di tla ka boholo bo fapaneng. Ho nale tse nnyane le tse kgolo.



Tjhupu e tshitja e bohareng (Hollow central tube)

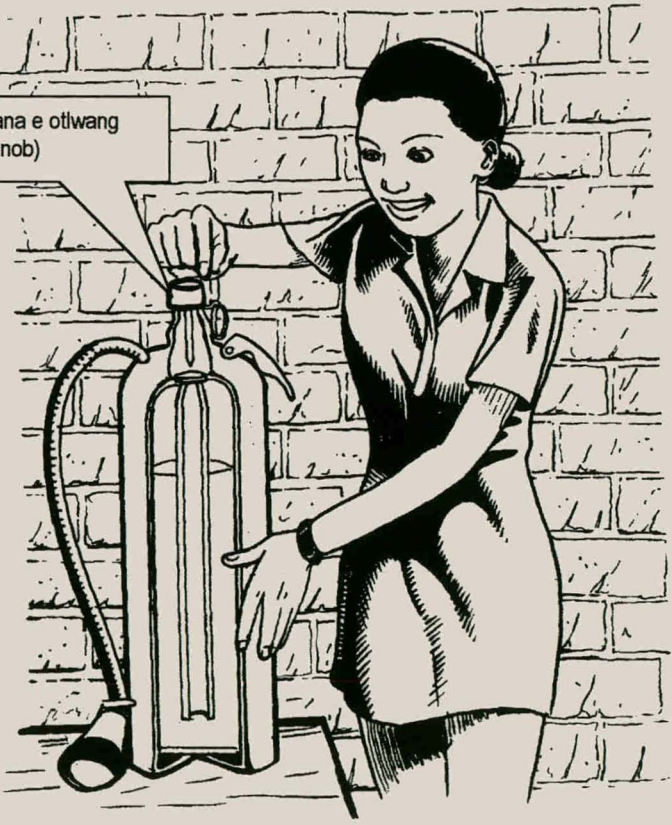
Moo ho bulehileng teng bohotong ba tjhupu e bohareng (Opening at the bottom of the central tube)

Ho nale peipi bohareng ba silindara e bulehileng ka mahlakoreng. Peipi eo e bitswa tjhupu e bohareng (central tube). Tjhupu e bohareng e bulehile ka tlase.



Sekwahelwana se lokollang kgatello (Pressure release disk)

Tjhupu e bohareng e kwetswe ka hodimo ka sekwahelwana se lokollang kgatello (pressure release disk).



hloohwana e otlwang trike knob)

Ka hodima setimamollo ho nale hloohwana e otlwang (strike knob).



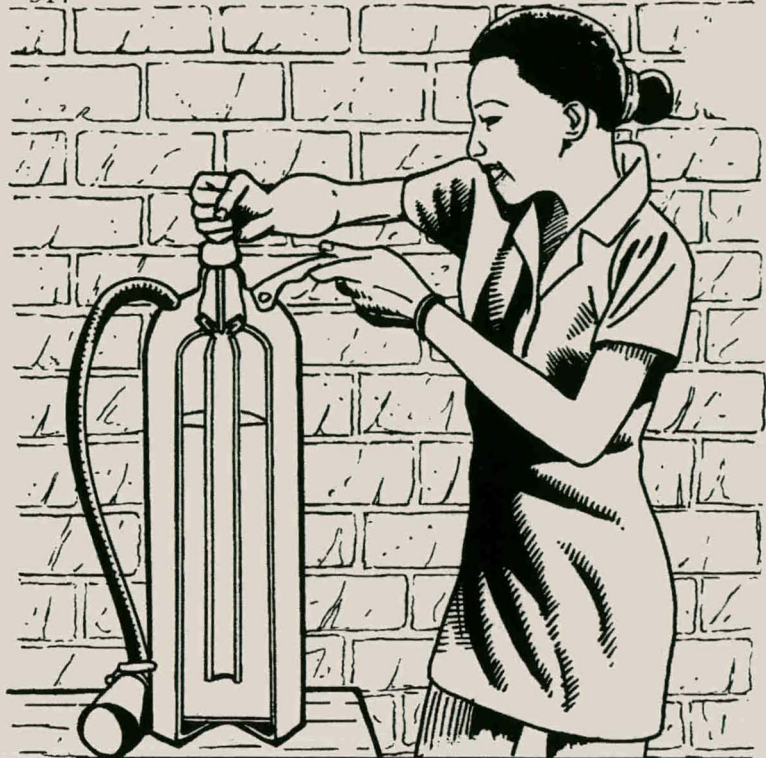
Sepekere se tabolang (Piercer)

Ho nale sepekere se tabolang se bohale se matla qetellong ya hloohwana e otlwang. Sepekere sena se bitswa piercer. Sepekere sena se supile ntlheng ya sekwahelwana se lokollang kgatello se hodima tjhupu e bohareng (central tube).

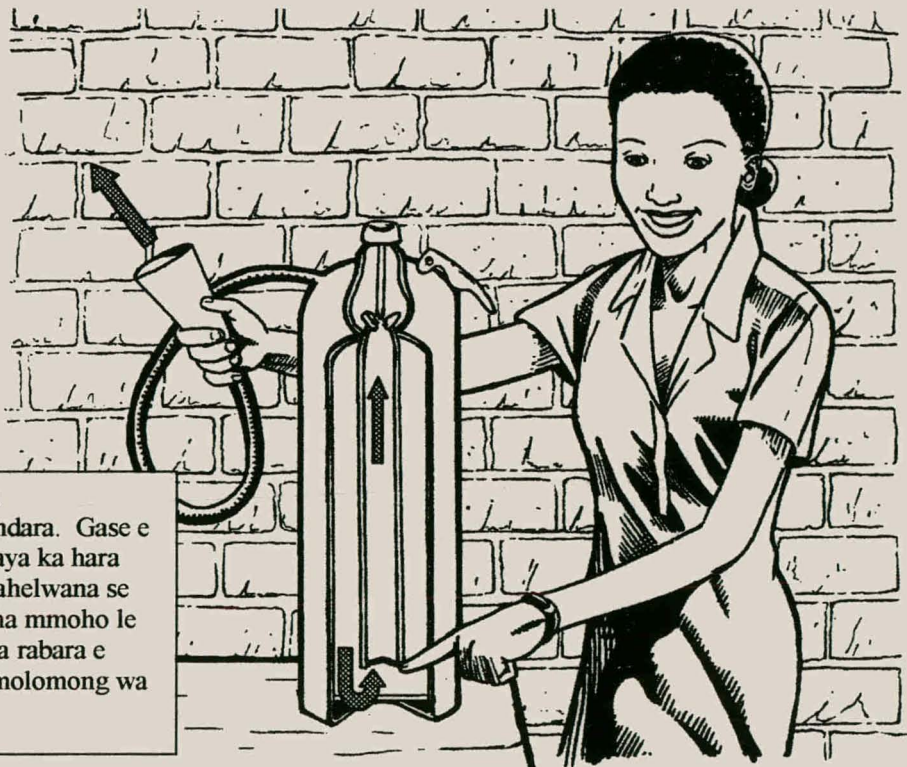
Pene ya polokeho e lokollwang (Safety release pin)



Ho nale pene ya polokeho e lokollwang ka lehlakoreng ho hloohwana e otlwang. O ke ke wa sebedisa setimamollo ebang o sa tlose pene. Pene eo ya poloketseho e lokollwang e thibela sepekere se tabolang ho ka phunya lesoba ho sekwahelana se lokollang kगतello ebang o ka otl'a hloohwana ka phoso. Peipi ya rabara e hlahella ho tswa silendareng haufi le hloohwana e otlwang. Qetellong ya peipi ya rabara ho nale molomo polasetiki.



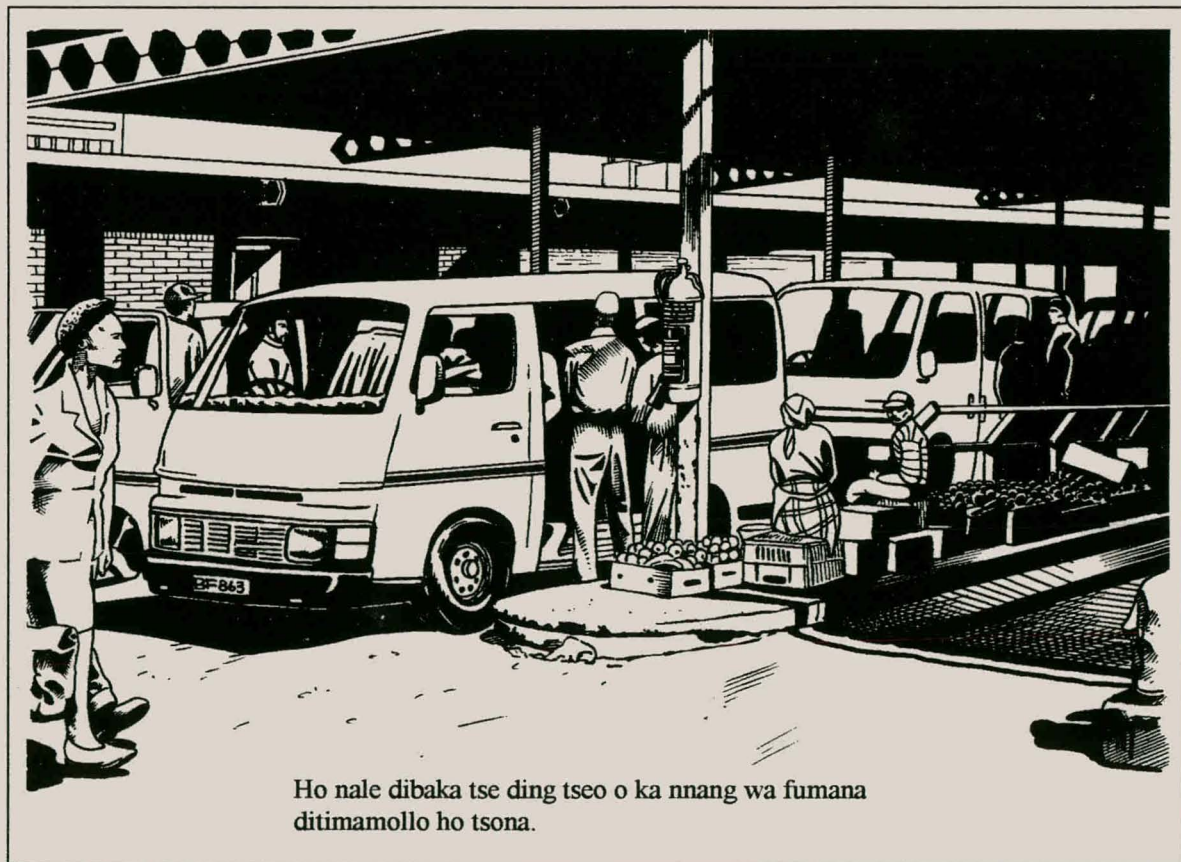
Ebang o batla ho sebedisa setimamollo o tshwanetse hore o qale ka ho tlosa pene ya polokeho. Otl'a hloohwana ka letsoho. Hloohwana e tla sutumellelsa sepekere ka hara sekwahelwana se lokollang kगतello (release disk). Ha jwale sekwahelwana se lokollang kगतello se tla ba le lesoba.



Gase e peteditsweng ka hara silindara e tla sutumellelsa phofo tlase qetellong ya silindara. Gase e peteditsweng mmoho le phofo, di tla tsamaya ka hara peipi di ntano tswa lesobeng ka hara sekwahelwana se lokollang kगतello (release disk). Phofo ha mmoho le gase jwale di tla be di kena ka hara peipi ya rabara e leng ka hodima silindara di ntano tswa le molomong wa polasetiki.



Tobisa molomo ntlheng ya mollo. Gase e boima ho feta moya mme e tla apara mollo jwaloka kobo. Mme seo se tla tebela moya o motjha (oxygen) mollong. Mollo o tla tima.



Ho nale dibaka tse ding tseo o ka nnang wa fumana ditimamollo ho tsona.

Addendum 3.32

SETIMAMOLLO

ehella mola ka tlasa karabo e nepahetseng.

-) **Ho bonolo ho ka supa ditimamollo. O ka fumana ditimamollo:**
) Di leketla maboteng ka ntle meahong.
) Di leketla ka hara ofisi ya hlooho ya sekolo.
) Di leketla maboteng ka hara meaho.
) Di leketla ka mathoko ho dikoloi tsa ditimamollo.
) Kaofela karabo tse ka hodimo di fosahetse.

-) **Bongata ba ditimamollo di tlatsitswe ka:**
) CO²
) CoO
) CO₂
) C₂O
) Kaofela karabo tse ka hodimo di fosahetse.

-) **Ditimamollo tse nnyane di batla di lekana ka boholo le:**
) Botlolo e kgolo ya Coca-Cola.
) Lekotikoti le lehlo la Coca-Cola.
) Botlolo e nnyane ya Coca-Cola.
) Ngwana e monnyane.
) Kaofela karabo tse ka hodimo di fosahetse.

-) **Ditimamollo tse kgolo di botelele ba:**
) Botlolo e kgolo ya Coca-Cola.
) Ngwana e monnyane.
) Sete ya thelevishini.
) Monna ya mokgutshwanyane.
) Kaofela karabo tse ka hodimo di fosahetse.

-) **Karolo e kgolo ya setimamollo e nale:**
) Silindara ya tshepe e petlletseng.
) Silindara e petlletseng e matla e tshija.
) Silindara e matla e petlletseng.
) Silindara e matla e tshija.
) Kaofela karabo tse ka hodimo di fosahetse.

-) **Tjhupu e bohareng ya setimamollo e:**
) Tshija ebile e kwalehile ka tlase mme e nale sekwahelwana se lokollang kगतello.
) Tshija ebile e kwalehile ka tlase mme e nale sepekere se tabolang.
) Tshija ebile e kwalehile ka hodimo mme e nale sepekere se tabolang.
) Tshija ebile e kwalehile ka hodimo mme e nale sekwahelwana se lokollang kगतello.
) Kaofela karabo tse ka hodimo di fosahetse.

-) **Sepekere se tabolang sa setimamollo:**
) Ke sepekere se bohale ka hara tjhupu e bohareng.
) Ke sepekere se bohale ka hara silindara.
) Ke sepekere se bohale qetellong ya hloohwana e otlwang.
) Ke sepekere se bohale qetellong ya sekwahelwana se lokollang kगतello.
) Kaofela karabo tse ka hodimo di fosahetse.

- 8) **Ho tla etsahalang ebang o ka otlia hloohwana e otlwang ntle le ho tlosa pene ya polokeho?**
 a) Pene ya polokeho e tla robaha.
 b) Sekwahelwana se lokollang kगतello se tla robaha.
 c) Sepekere se tabolang se tla robaha.
 d) Tjhupu e laolang e tla robaha.
 e) Kaofela karabo tse ka hodimo di fosahetse.

- 9) **Ho tla etsahalang ebang tjhupu e bohareng e kwalehile ka tlase mme e be ele hore o tlosa pene ya polokeho o be o otlia hloohwana?**
 a) Setimamollo se ka nna sa phatlaha.
 b) Gase le phofo di tla dula di le ka hara silindara.
 c) Setimamollo se tla lahlehelwa ke gase ya sona kaofela.
 d) Gase le phofo di tla kena ka tjhupung e bohareng.
 e) Kaofela karabo tse ka hodimo di fosahetse.

- 10) **Ke eng se tla beng se le phoso ebang gase le phofo di dutlela kantle ho setimamollo ho sena motho ya se sebedisang ?**
 a) Pene ya polokeho e robehile.
 b) Ho nale lesoba sekwahelwaneng se lokollang kगतello.
 c) Ho nale lesoba tjhupung e bohareng.
 d) Ho nale lesoba tjhupung e laolang.
 e) Kaofela karabo tse ka hodimo di fosahetse.

- 11) **Ho tla etsahalang ebang sekwahelwana se lokollang kगतello se ka ba le lesoba?**
 a) Tjhupu e bohareng e tla robaha.
 b) Gase e tla tswela kantle mme e tlohele phofo morao.
 c) Phofo e tla tswela kantle mme e tlohele gase morao.
 d) Phofo le gase di tla tswela kantle.
 e) Kaofela karabo tse ka hodimo di fosahetse.

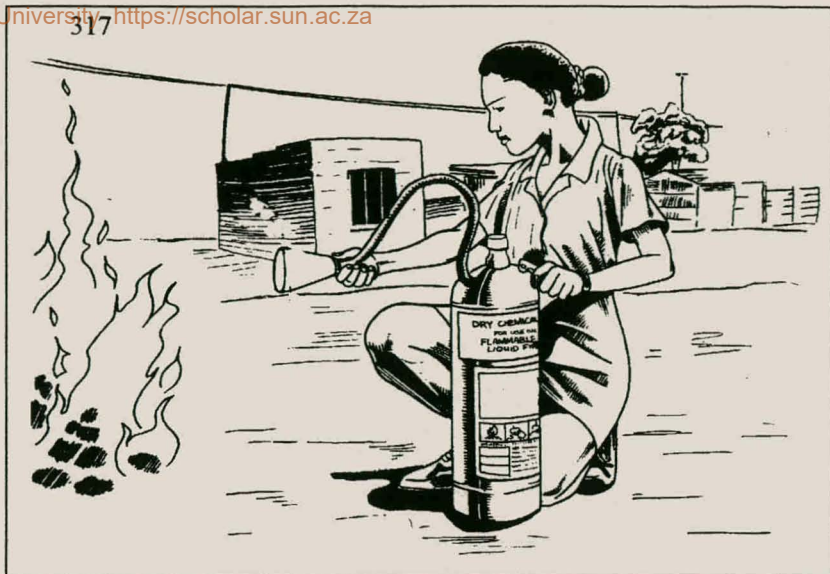
- 12) **Mohlomong motho o tlosa sepekere se tabolang setimamollong. Ho tla etsahalang ha o sebedisa setimamollo?**
 a) Tjhupu e bohareng e tla robaha.
 b) Gase e tla tswela kantle mme e tlohele phofo morao.
 c) Phofo e tla tswela kantle mme e tlohele gase morao.
 d) Phofo le gase di tla tswela kantle.
 e) Kaofela karabo tse ka hodimo di fosahetse.

- 13) **Ho tla etsahalang ha o ka tlosa pene ya polokeho?**
 a) Ke gase feela e tla tswelang kantle.
 b) Ke phofo feela e tla tswelang kantle.
 c) Gase le phofo di tla tswela kantle.
 d) Ha ho phofo kapa gase e tla tswelang kantle.
 e) Kaofela karabo tse ka hodimo di fosahetse.

- 14) **Mohlomong motho o kenya lebesa bakeng sa gase ya khabonodaekosaete le phofo ka hara setimamollo. Ho tla etsahalang ha o sebedisa setimamollo?**
 a) Lebesa le tla tswela kantle.
 b) Ha ho lebesa le tla tswelang kantle.
 c) Sepekere se tabolang ha se na sebetsa ka nepahalo.
 d) Tjhupu e bohareng ha e na sebetsa ka nepahalo.
 e) Kaofela karabo tse ka hodimo di fosahetse.

Potso ya 15. Qetella setshwantsho.

Tshwantsha gase le phofo tse tla tswela kante ho setimamollo.



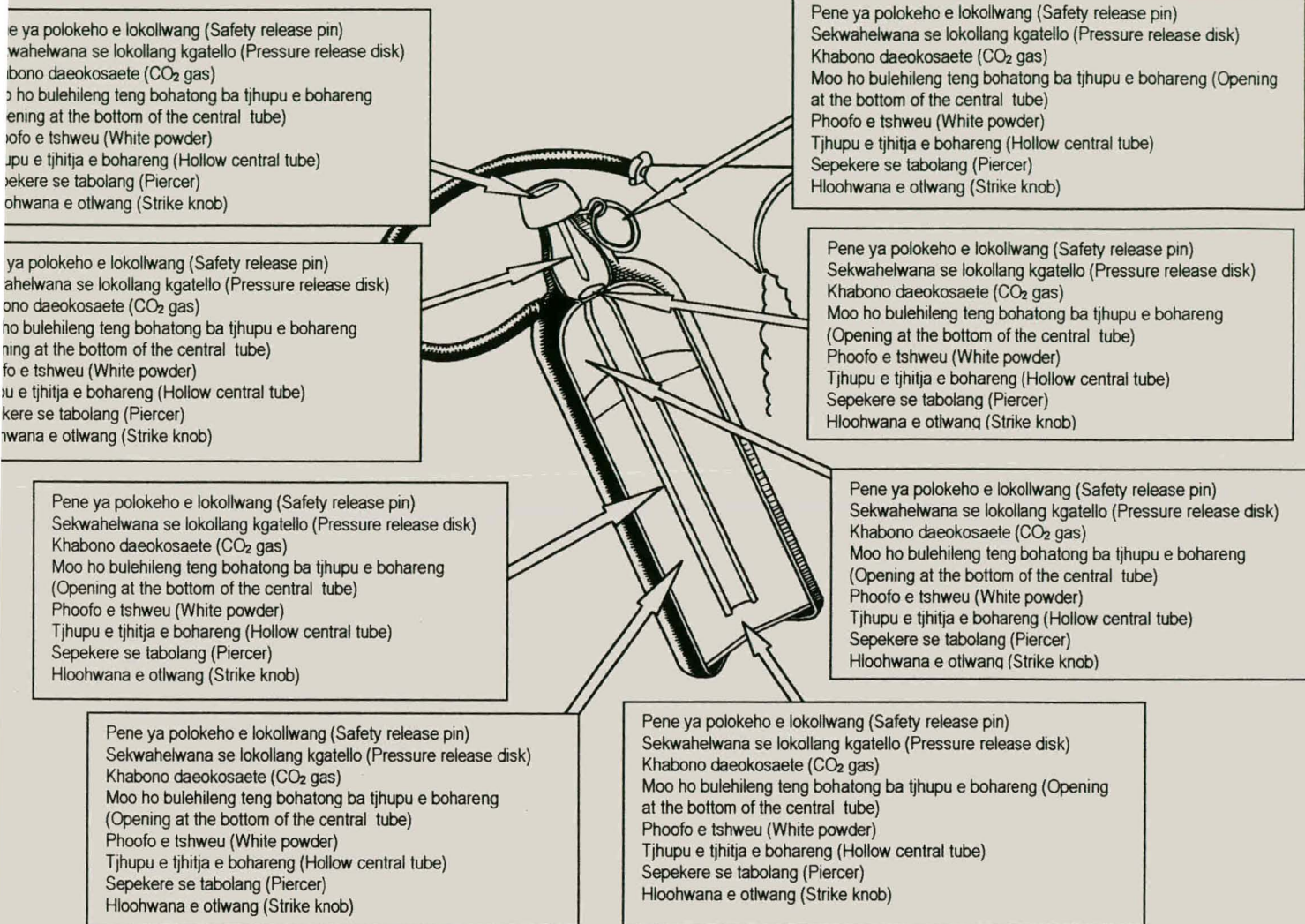
Potso ya 16. Qetella setshwantsho.

Bontsha ka ho etsa sefapano setshwantshong moo o ka nna wa fumana setimamollo.



Potso ya 1

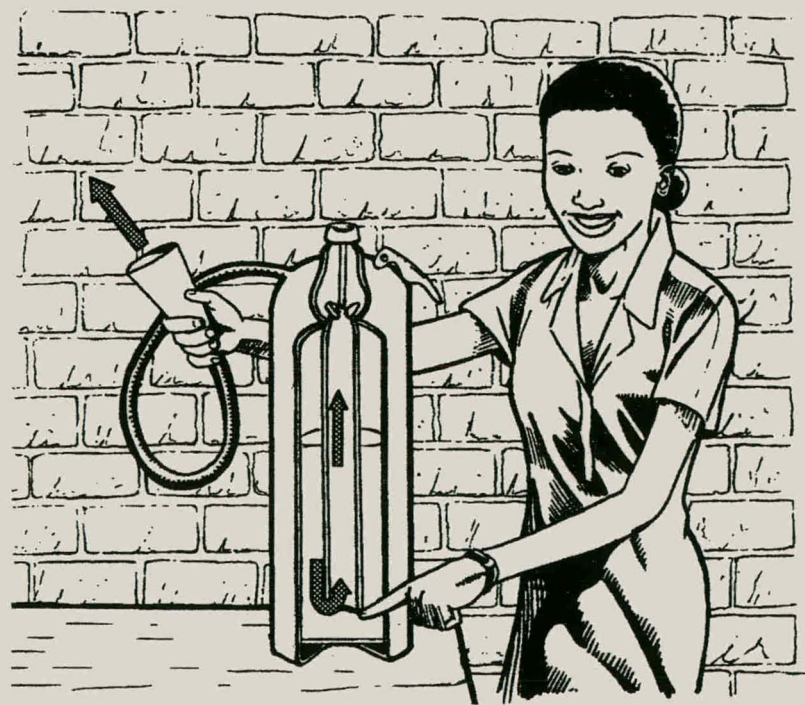
Sehella mola ka tlasa lebitso le nepahetseng mabapi le karolo e nngwe le e nngwe



Potso ya 2

Sehella mola ka tlasa karabo e nepahetseng. Metsu e setshwantshong e ho bontshang?

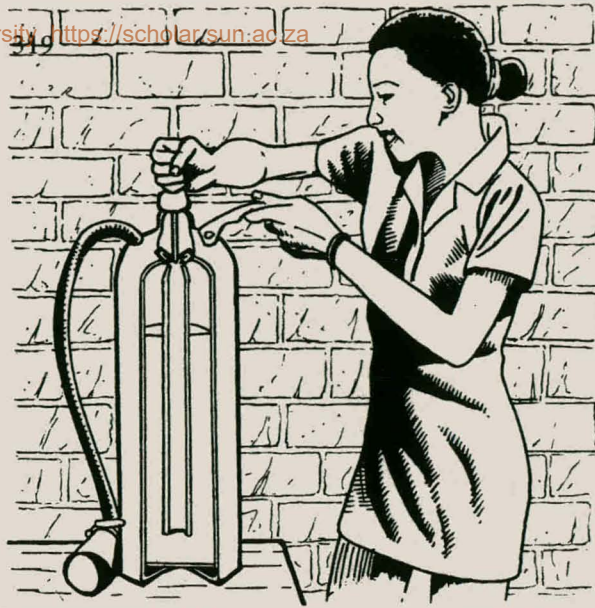
- a) Dikarolo tse kotsi tsa setimamollo
- b) Moo setimamollo se ka nngang sa robeha teng
- c) Ka moo gase le phoofo di tsamayang le ho tswa ka teng setimamollong ha o se sebedisa.
- d) Se etsahalang ha setimamollo se fedile
- e) Kaofela karabo tse ka hodimo di fosahetse.



Potso ya 3

Sehella mola ka tlasa karabo e nepahetseng.
Ngwanana ya setshwantshong o etsang?

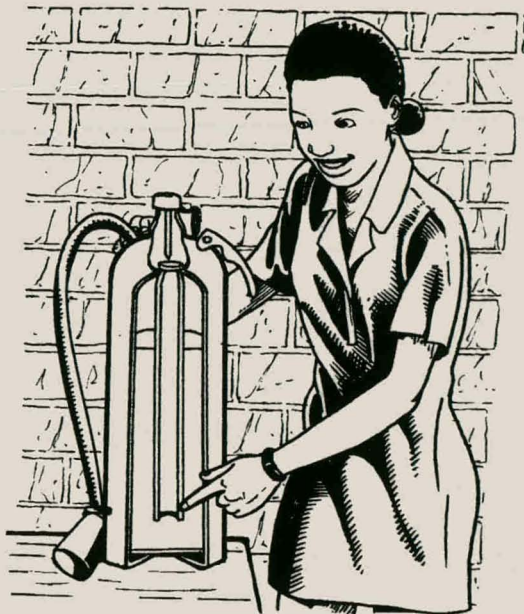
- a) O hula setimamollo.
- b) O otla hloohwana e otwang.
- c) O phahamisa setimamollo.
- d) O otla tjhupu e bohareng.
- e) Kaofela karabo tse ka hodimo di fosahetse.



Potso ya 4

Sehella mola ka tlasa karabo e nepahetseng.
Setshwantsho sa setimamollo se ka lehlakoreng le letona se re bontsha:

- a) Bokahare ba setimamollo.
- b) Setshwantsho sa bokantle ba setimamollo.
- c) Setimamollo se robهيلeng.
- d) Dikarolo ka ntle ho setimamollo.
- e) Kaofela karabo tse ka hodimo di fosahetse.



Potso ya 5

Sehella mola ka tlasa karabo e nepahetseng.
Setshwantsho sena se re bontsha hore setimamollo se:

- a) Seholo ebile se se kgubedu ka mmala.
- b) Petleletse karolong e ka tlase mme se tjihitja ka hodimo.
- c) Tjhupu e bohareng.
- d) Petleletse se sephara ka tlase.
- e) Kaofela karabo tse ka hodimo di fosahetse.



Potso ya 6

Ke se feng sa tse na tse pedi ditshwantsho seo o se ratang ka ho fetisisa?

Tshwaya kgetho ya hao ka letshwao le leholo la ✓



Ke se feng sa tse na tse pedi ditshwantsho seo o se ratang ka ho fetisisa?

Tshwaya kgetho ya hao ka letshwao le leholo la ✓



Ke se feng sa tse na tse pedi ditshwantsho seo o se ratang ka ho fetisisa?

Tshwaya kgetho ya hao ka letshwao le leholo la ✓



CHAPTER 4

CONCLUSION AND RECOMMENDATIONS FOLLOWING THE LITERATURE STUDY AND THE EMPIRICAL EXPERIMENTS

4.1 INTRODUCTORY COMMENTS

This chapter consists of eight sections. The first section will draw conclusions from the literature study, the second section will draw conclusions from Experiments 1 - 5, the third section will draw conclusions from Experiments 6a – 6c, and the fourth section will propose a learner-centred theory for the picture facilitating effect. The fifth section of this chapter will recommend guidelines for the design and development of picture-text learning material. The sixth section will recommend an instrument in the form of a model for the analysis of pictures in instructional material. The seventh section will provide concluding statements on the results and conclusions of this study. The last section is a summary of Chapter 4. Each section will begin on a new page so as to provide a logical physical demarcation of each section.

4.2 CONCLUSIONS FROM THE LITERATURE STUDY

Four aims were proposed in the first chapter with regard to the literature study. These are repeated in order to provide a perspective on the conclusions that were derived from the literature study. These aims were:

- * To isolate variables and regularities that influence the facilitating effect of pictures when these pictures are used together with instructional text material aimed at subjects from developed and developing communities.
- * To present these variables and regularities as factors with generalisable possibilities that are applicable to subjects from developed and developing communities.
- * To recommend variables that instructional designers must consider when designing picture-text material aimed at developing communities.
- * To isolate existing theories that explain the picture facilitating effect.

These aims were realised by the literature study that was presented in Chapter 2. This chapter provided a review of published research results and theories that are applicable to this study. This review was presented under several headings and summarised in tables at the end of sections. The sections under which the literature study was completed, and which contain the aims as set out in Chapter 1, are:

- * Communication models and cultural aspects in picture communication materials.
- * A taxonomy of pictures in instructional text.
- * When pictures do not facilitate learning.
- * Evidence for the facilitation effect of pictures in instructional text.
- * Factors that influence the facilitating effect of pictures in instructional text.
- * Factors that influence the facilitating effect of pictures in instructional text aimed at developing communities.
- * Theoretical explanations for the picture facilitating effect.
- * Research across cultures in picture and picture-text instructional material.
- * Critical observation of some of the methods that are used in picture-text research.

There is sufficient evidence in the empirical literature that pictures can assist learning and sometimes distract from learning, for example when decorative and irrelevant pictures are combined with instructional text. This assistance is referred to as *the Picture Superiority Effect* or the *Picture Facilitating Effect*. The latter term is used for this study.

The effect, however, appears to be influenced by small nuances in a test or learning condition, which can cause no measurable facilitating effect, as reported by Kliese and Over (1993:183). They replicated a study by Mayer and Gallini (1990), but found that pictures that illustrated technical text (text about pumps, relays and thermostats) in a step-wise manner did not help students to understand more about the principles governing the operation of these systems. The study by Mayer and Gallini (1990:725) found that their students learned more about the operation of technical systems. In their

discussion Kliese and Over (1993:185) mentioned that there is no obvious reason why their experiment did not show beneficial effects for their learners, as the two studies employed the same design and procedures. They suggested that possible different approaches to learning by the students could have contributed to this effect.

Several generalisations are possible from the published research - broad generalisations that are applicable to all learners and specific generalisations that are applicable to learners from developing communities. These broad and specific generalisations are summarised in the tables at the end of each subsection in Chapter 2. There are thirteen conclusions, relating to the process, empirical results, research methods and developing communities, which can be drawn from these tables and the subsections in the literature review.

These conclusions are presented in a numerical format and are as follows:

- 1 The picture facilitating effect is possible with a variety of learners and learning material and under diverse learning conditions.
- 2 This effect appears to be robust but at the same time is constrained by narrow boundaries that define the direction and extent of the facilitating effect.
- 3 The picture facilitating effect in picture-text learning material must only be regarded as having a potential facilitating effect, as the facilitating effect can be negated by the learner, test conditions and measurement instruments.
- 4 Studies that report a facilitating effect have always one item in common, namely that the pictures in the text material are text-relevant. Text-irrelevant and decorative pictures do not contribute to learning.
- 5 The broad factors that contribute to the facilitating effect can be generalised to learners from developing communities with the provision that they fulfil the criteria for those conditions to become active.
- 6 The specific factors that contribute to the facilitating effect for learners from developing communities must rather be regarded as guidelines. Individuals within developing communities can have a wide range of experience and visual and verbal literacy, all of which affect their reaction to and the benefit they derive from picture-text learning material.

- 7 Cultural background, including socio-economic conditions and visual and verbal literacy levels, are factors that influence subjects' reactions to picture-text learning material and the benefit they derive from the material.
- 8 Picture-text learning material aimed at developing communities must be designed for a specific target group to accomplish greater effectiveness.
- 9 Sociocultural variables in visual and text material are more significant for subjects from developing communities than subjects from urbanised and developed communities.
- 10 The picture facilitating effect can be described as a multivariate interactive process. The main variables that play a role in the realisation of the picture facilitating effect can broadly be grouped under text, pictures, learners, and assessment procedures. The literature identified several subcategories under the main variables that in turn interact with each other and interact across categories. The extent of the picture facilitating effect can be manipulated by varying text, picture, and assessment variables.
- 11 A picture facilitating effect can be realised during experimental conditions, but might not produce the same effect or the same extent of the effect in a real-life situation.
- 12 Most of the studies that were reviewed in the literature study used convenience samples rather than representative samples. The results from several studies, however, provide similar tendencies resulting in broad principles that are generalisable.
- 13 Theories that attempt to explain the picture facilitating effect appear to focus on one element in a picture-text learning process. A combination of these theories might provide a broad perspective on the process of picture facilitation, as well as a method for predicting and explaining the picture facilitating effect.

4.3 CONCLUSION FROM EXPERIMENTS 1 – 5

The aims of the empirical work, as stated in Chapter 1, was twofold, namely:

- * To determine if the subjects prefer pictures that are culturally modified for them more than pictures that are not modified.
- * To determine if culturally modified pictures facilitate recall, problem-solving skills and comprehension more than pictures that are not modified when they are used to support instructional text.

The conclusions that are given in this section are made with reference to the aims of the empirical work.

This section consists of three subsections. The first subsection will provide a brief summative overview of the experiments, the second subsection will provide a brief review of the most important results, and the last subsection will provide the conclusions for Experiments 1 – 5.

4.3.1 Introductory summary

Two hundred and twenty-three Grade 6 subjects from four different schools participated in the first five experiments. The first four experiments were conducted at urban schools. The fifth experiment was conducted at a peri-urban school.

The subjects who participated in Experiments 1 - 4 came from varying language and cultural backgrounds. The medium of instruction at the urban schools where the first four experiments took place was English. Most of the fifty subjects in Experiment 5 spoke Sesotho and Tswana at home ($n = 47$). Sesotho was the main communication medium at the school where the fifth experiment took place.

Material for the first experiment came from a History textbook, whilst the material for the rest of the experiments came from a Science textbook aimed at Grade 6 children. Representative pictures illustrated the text, which was set in English. Changes in the material, methods and assessment for each experiment was determined by the results or

difficulties that occurred in a previous experiment. Experiment 1 used a control group and one experimental group, whilst the other four experiments used two experimental groups and one control group in their experimental designs.

The main aim of all the experiments was to determine whether pictures in picture-text learning material, which are modified to visual aspects of the learners' culture and environment, namely food, clothing, symbols, physical features, environment and other items of the learners, could increase the subjects' recall and comprehension of such learning material. Other objectives of the experiments were to explore the possibility of using primary-school children as subjects in a larger study, and to test the feasibility of a paired control group experimental design, different preference testing techniques and different learning and testing times, in order to pilot a delayed post-test and to test the materials, methods and questions with subjects from a developing community. Individual conditions at schools and the length of the learning material and test resulted in immediate assessment tests, a one-day delayed assessment test and a delayed assessment test after seven days. The assessment test tested recall of information that was presented in the text and which was illustrated with representative pictures.

It was hypothesised that the picture groups would perform better than the text-only groups; that the subjects who received the modified pictures with their text would perform better than the subjects who received unmodified pictures with their text; that the subjects would prefer the pictures that were modified for them; and that the picture groups would forget relatively less in a delayed test than the text-only group. Comparisons were made between the mean scores of the groups, and the subjects' preference for modified or unmodified pictures was determined. ANOVA, Tukey's HSD and the Z-test for proportions were used to analyse the data.

4.3.2 A summary of the most important results of Experiments 1-5

This summary will not provide the actual scores and the results of the statistical tests obtained by the various groups in the experiments, as these are available in Chapter 3. The aim of this section is to provide a brief overview of the results so as to provide a framework for the concluding remarks.

Experiment 1 took longer to complete than was anticipated due to the difficulty that the children had in expressing themselves in English. The primary-school children that participated in this experiment were not the ideal subjects due to a language barrier and the type of assessment test (open-ended questions) that was used. This barrier only became apparent after the completion of the experiment. It was not possible to either reject or not to reject the hypothesis, as no inferential statistics were applied to the data because the equivalence of the two groups could not be verified.

The mean recall scores of the subjects in Experiments 2 and 3 increased significantly when representational pictures were added to the text. Modified and unmodified pictures assisted the subjects to recall more information on the safety rules of electricity and more information on the steps in an experiment on how to test for starch in a leaf. Modified pictures, however, did not increase recall more than unmodified pictures.

The two picture groups in Experiment 4 forgot relatively less in a delayed test than the text-only or control group. The expression on the children's faces in the pictures, followed by their clothing, were the main factors that determined the subjects' comments and their indicated preferences. The subjects showed a significant preference for unmodified pictures. This was not expected, but could have been caused by the small graphic nuances in the pictures, namely the children's facial expressions and clothing as depicted in the pictures. The pictures that were used to test the subjects' preference consisted of six pictures of the children depicted in the learning material. The face of a child in one of these pictures appeared less friendly than the corresponding unmodified picture. It is this facial expression that could have affected the subjects' choices and comments.

Subjects in the fifth experiment were more homogeneous concerning their mother tongue and cultural background than any of the previous samples that participated in an experiment. The two picture-text groups scored significantly higher with a question that tested for a procedure in the immediate post-test. The modified picture group, however, did not score significantly higher than the unmodified picture group in the immediate or in the delayed post-test. The subjects showed a significant preference for the modified pictures and a significant dislike for the unmodified pictures. The preference was for branded consumer products and for pictures of African children, as opposed to Chinese children, in the pictures.

The contradiction between the results of the subjects' preference in Experiment 4 and Experiment 5 could be as a result of various factors. The children who participated in Experiment 5 came from a different socio-economic background to those who participated in Experiment 3. There were also a few Chinese children in the school where Experiment 4 took place, while there were only African children in the school where Experiment 5 took place. Twelve pictures were used in Experiment 5 to test for preferences, whilst six pictures were used in Experiment 4.

4.3.3 The conclusion of Experiments 1-5

This subsection provides the conclusions from Experiments 1 - 5 in ascending order of importance.

The conclusions are based on the premise that the text is short, that it is narrative in nature, that the learners have a low prior knowledge of the information presented in the text, that the pictures are representative in nature, and that the pictures repeat the information presented in the text. The learning conditions must be such that the learners can read the learning material more than once. These conclusions, in the form of generalisations, would apply only to similar subjects that were used in the experiments.

The conditions, as stated above, were present when the experiments were conducted. Each of the conditions has the potential to change the results of an experiment. A learner with high prior knowledge, for example, does not necessarily need pictures to help him/her to recall information in the text, and pictures that do not repeat the information presented in the text are irrelevant and cannot assist with the recall and comprehension of the information in the text.

- 1) Pictures that play a supporting role to instructional text and which are modified to reflect the learners and known branded products, might not be any more helpful in assisting the recall of information that is presented in the text than pictures that are not culturally modified.
- 2) Pictures that illustrate a sequence of events can assist the recall of the sequence if the pictures illustrate every step of the sequence, if the text verbalises every step of the sequence and if the learner is requested to write down the steps of the sequence in chronological order.

- 3) Subjects might be able to forget relatively less after seven days with pictures that illustrate a sequence of events if the pictures illustrate every step of the sequence and if the text verbalises every step of the sequence.
- 4) Subjects will show a preference for branded products if they are familiar with these products.
- 5) Subjects (children) will show a preference for children of their own ethnic background in learning material. This preference might become neutral if the subjects live in a multicultural learning environment.
- 6) Graphic nuances in pictures could be misinterpreted if subjects have no knowledge of these items.
- 7) Subjects with poor visual and verbal encoding skills and with poor decoding skills might not display picture facilitating effects in an assessment test.

The aims of the empirical work were to determine whether the subjects prefer pictures that are culturally modified for them and whether these culturally modified pictures facilitate recall, problem-solving skills and comprehension more than pictures that are not modified.

It was hypothesised that scholars would prefer culturally modified pictures more than pictures that are not modified to their culture, and that modified pictures in printed educational text would facilitate recall, problem-solving skills and comprehension more than text without modified pictures.

The research hypothesis, in terms of the five experiments, is partially rejected in favour of the alternative hypothesis. There was only a preference for modified pictures in the fifth experiment, and modified pictures did not increase the picture facilitating effect more than pictures that were not modified.

Both the modified and unmodified pictures, however, assisted subjects in Experiments 2, 3 and 5 to recall steps in a procedure and assisted subjects in Experiment 4 to recall relatively more information than a text-only group over a period of seven days.

Also see Table 4.1 on the next page for a summary of the results in a graphic format.

TABLE 4.1

A summary of the results of Experiments 1 – 5 by experiment and by questions.

	Experiment 1	Experiment 2		Experiment 3		Experiment 4		Experiment 5	
	Text and modified pictures	Text and unmodified pictures	Text and modified pictures	Text and unmodified pictures	Text and modified pictures	Text and unmodified pictures	Text and modified pictures	Text and unmodified pictures	Text and modified pictures
All the questions One-day delayed test		**	**		**				
Question 3 One-day delayed test		**	**	**	**				
All the questions									
Question 3 Immediate post-test								**	*
Question 3 Delayed post-test									
Question 3 Difference between the immediate and the delayed test						**	*		

* Significant difference when compared to the text-only group when $p = 0.1$.

** Significant difference when compared to the text-only group when $p = 0.05$.

The grey shaded areas indicate that the questions do not apply to the experiment.

The blank spaces indicate that there was no difference.

4.4 CONCLUSIONS FROM EXPERIMENTS 6a – 6c

This section consists of three subsections. The first subsection will provide a brief summative overview of the three experiments, the second subsection will provide a brief review of the most important results, and the last subsection will provide the conclusions for Experiments 6a – 6c.

The conclusions that are given in this section are made with reference to the aims of the empirical work.

4.4.1 Introductory summary

Experiment 6 consisted of three separate experiments and was conducted at five different schools. Two of these schools were situated in a rural area, and three schools were situated in a peri-urban area.

A total of five hundred and thirteen subjects participated in the three experiments. The majority of the subjects used Sesotho as their home language ($n = 464$). The rest of the subjects spoke Setswana, Zulu and Xhosa.

The experimental design varied for each experiment, but consisted of one control group (text-only) and different experimental groups. The different experimental groups consisted of a text-and-one-picture group, an unmodified picture-text group, a modified picture-text group, a modified picture-text group with labels, and a modified picture-text group with labels and colour. The subjects in Experiment 6a did not receive an instruction to attend to the pictures, but the subjects in the last two experiments were instructed to look at the pictures and to make use of the pictures when studying the material.

The text-only material consisted of a section of technical text about the parts and working mechanism of a fire extinguisher. One experiment used the text in English, while the other two experiments used the same text in Sesotho. The English text was four hundred and fifteen words long, while the Sesotho text was four hundred and six words long. The unmodified and modified experimental groups used thirteen explanative and representational pictures to repeat and explain essential issues mentioned in the text. The picture in the text-and-one-picture group consisted of a cross-section of a fire extinguisher with labels and arrows for different parts of the fire extinguisher.

All the subjects wrote an immediate post-test and a delayed post-test. The immediate post-test consisted of questions that tested the subjects' recall of factual information that was presented in the text as well as in the pictures. It also tested problem-solving skills, the subjects' ability to recall information embedded in the pictures but not in the text, as well as their recall of factual information over a period of seven or ten days. The post-test also tested the subjects' relative visual literacy, asked for their comments on the pictures, and determined their preferences for some of the pictures.

The length of the material and the duration of the post-test were restricted by the Free State Department of Education and the various schools.

It was hypothesised that the picture groups would perform better than their respective control groups (text-only groups), that the modified picture groups would perform better than all of the other groups, that pictures would help the subjects to forget relatively less over a period of time, and that subjects would prefer modified pictures to unmodified pictures. Comparisons were made between the mean scores of all the groups and students were probed for their preference for a modified or unmodified picture. Statistical analyses on the groups' mean scores were done with ANOVA, post-hoc tests were done with Tukey's HSD test, and differences in proportions of pictures preferred were tested with the Z- test for proportions.

A summary of the results is given in Table 4.2 (p. 336) at the end of this subsection.

The findings of these three experiments fall into two groups: Those findings that are related to the set hypothesis of this study, and those results that were unanticipated.

There are also two groups of conclusions that can be drawn: Those conclusions drawn from the direct results, and those conclusions inferred from the results that have hypothetical merit.

4.4.2 A summary of the most important results of Experiments 6a – 6c

This summary will not provide the values obtained by the different groups, nor will it provide the statistical test results, as these details are available in the preceding tables and sections. The aim of this subsection is to provide a brief review of the results to provide a framework for the concluding remarks.

There was no significant statistical difference between the mean scores of all the groups in all three experiments in the questions that tested recall and problem-solving skills.

Some of the groups that received the modified and unmodified pictures with their text scored significantly better than the text-only group and the text-and-one-picture group respectively in the picture-based questions. This was expected, as the information that was probed for was only available in the pictures and not in the text. The majority of the subjects showed no specific preference for modified pictures if given a choice of equal preference, but do prefer pictures that are modified to their culture if they must choose between unmodified and modified pictures.

The unanticipated results were that some of the text-and-one-picture groups scored significantly better in their delayed test than some of the other picture groups and their respective control groups. They also forgot relatively less than the other groups over a period of seven to ten days. Subjects who received labels and even labels with colour as graphic cues did not seem to be more positively influenced than those subjects who did not receive these cues.

The subjects' relative visual literacy score, or their mean understanding, of four pictures was similar for all the subjects from the different schools.

4.4.3 The conclusions of Experiments 6a – 6c

This subsection will discuss the conclusions that are drawn from the three experiments in ascending order of importance.

The conclusions are based on the premise that the text is short, that it is of a technical nature, that the learners have a low prior knowledge of the text, that the pictures are explanative and representative in nature, that the pictures repeat the information in the text, and that the pictures visually portray technical items that are mentioned in the text. The learning conditions must be such that the learners can read the learning material more than once.

The conditions, as stated above, were present when the experiments were conducted. Each of the conditions has the potential to change the results of an experiment. A learner with high prior knowledge, for example, does not necessarily need pictures to help him/her to recall information in the text, and pictures that do not repeat the information presented in the text are irrelevant and cannot assist with the recall and comprehension of the information in the text.

- 1) Pictures that play a supporting role to instructional text and which are modified to reflect the learners and their environment, might not be any more helpful in assisting recall of information and improving problem-solving skills than pictures that are not culturally modified.
- 2) One appropriate picture with corresponding labels and with a representative or explanative nature can be more helpful and practical in assisting the recall of information than a sequence of representative and explanative pictures that portray the same information. The precondition must be that the same picture must be used in the learning material and in the assessment test. Appropriate in this context would be a picture that contains all the information that a subject will be tested on. Corresponding labels in this context are call-out labels with words that are mentioned in the text.
- 3) Subjects might be able to forget relatively less after seven days with one appropriate picture with corresponding labels and with a representative/explanative nature than with a sequence of representative and explanative pictures portraying the same information. The precondition must be that the same picture must be used in the learning material and in the assessment test. Appropriate in this context would be a picture that contains all the information that a subject will be tested on. Corresponding labels in this context are call-out labels with words that are mentioned in the text.
- 4) Subjects will show a preference for pictures that are modified to their culture, but this might only become evident if they are obliged to make a choice of preference.
- 5) Pictures act as a strong cue in assessment tests if the same picture is used in the learning material and in the assessment test.
- 6) Using pictures to assess the value of pictures in picture-text experiments could be a more effective procedure to measure picture facilitation than the traditional method of comprehension and multiple-choice questions.
- 7) Low mean scores in picture-text experiment assessment tests will obscure all the potential benefits of pictures and graphic cues that were used in the experiment.

Hypothetical conjectures

- 8) Subjects who experience picture-text learning material and the subsequent assessment tests as being difficult, might not show a measurable picture facilitating effect.
- 9) Subjects who experience picture-text learning material and the subsequent assessment tests as being difficult, might not benefit from multiple cues that have the potential to increase picture facilitation, namely labels, a verbal instruction to utilise pictures, and the use of localised colour to draw attention to a particular part of a picture.
- 10) Subjects might under-utilise pictures if they perceive the material as being difficult and if they have sufficient time to read the material more than once.

The research hypothesis, in terms of these last three experiments, is partially rejected in favour of the alternative hypothesis. Subjects showed a preference for modified pictures, but only if they were forced to choose between modified and unmodified pictures. The modified pictures did not help the subjects with recall or problem-solving skills more than the unmodified pictures.

However, one picture that showed a cross-section of a fire extinguisher and which was used with the text, assisted subjects in Experiment 6b to recall relatively more information over a period of ten days than all the other groups. This phenomenon is explained in terms of the stimulus generalisation theory, which states that learning is improved when the test situation is similar to the learning situation. The same picture that was used in the learning situation was also used in the assessment test ten days later.

Also see Table 4.2 on the next page for a summary of the results in a graphic format.

TABLE 4.2

A summary of the results of Experiments 6a – 6c by condition and by questions.

	Text and one picture			Text and unmodified pictures			Text and modified pictures			Text and modified pictures with labels			Text and modified pictures with labels and colour		
	Experiment 6a	Experiment 6b	Experiment 6c	Experiment 6a	Experiment 6b	Experiment 6c	Experiment 6a	Experiment 6b	Experiment 6c	n.a.	Experiment 6b	Experiment 6c	n.a.	n.a.	Experiment 6c
Factual-recall questions															
Problem-solving questions															
Picture-based questions				*	*	*	*	**			**				*
Delayed post-test	*	***													
Differences between the immediate and delayed tests	*	***													

* Significant difference when compared to the text-only group.

** Significant difference when compared to the text-only and the text-and-one-picture group.

*** Significant difference when compared to all the other groups.

The first row of asterisks represents the Grade 9 subjects, and the second row the Grade 11 subjects.

There were no Grade 11 subjects in Experiment 6b. The rural subjects from Experiment 6a are not reflected, as there were no significant differences between their groups.

The blank spaces indicate that there was no difference. n.a. = not applicable, as the experiment did not make use of this experimental group.

4.5 A LEARNER-CENTRED THEORY FOR THE PICTURE FACILITATING EFFECT

This subsection will propose a learner-centred theory for the picture facilitating effect and will illustrate the theory with a model. A review of theories and frameworks that were presented previously in Chapter 2 (Section 2.8, *Vide.* p. 90), as well as additional models, theories and hypotheses presented by other researchers, will provide a background to the proposed learner-centred theory. The recommendation for this theory and the model is a result of the central position that the learner occupied in the reported experiments and how this affected the outcomes of the experiments.

4.5.1 Existing theories, a principle, a hypothesis, an explanation and generalisations: A background to and a framework for the learner-centred theory for picture facilitation.

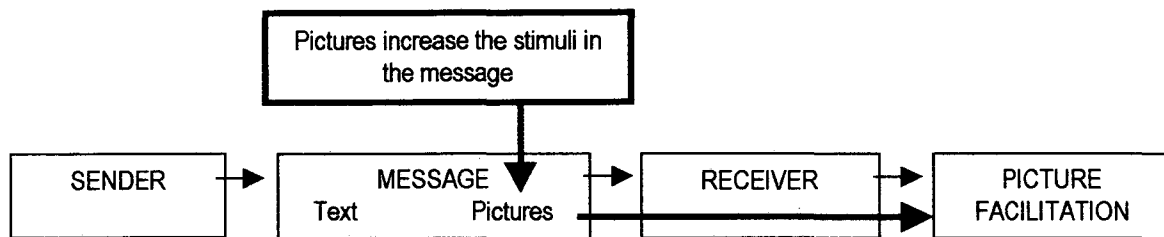
Section 2.8 in Chapter 2 provided theories, frameworks and explanations for the facilitating effect of pictures in picture-text learning material. This subsection will briefly summarise these and other theories, frameworks and explanations for the picture facilitating effect, and will illustrate each summary with a simplified model. Each model will show the position of the focal area in a sender-message-receiver communication model.

4.5.1.(a) *The cue summation theory*

The cue summation theory (Hartman, 1961) predicts that learning will increase if the number of cues and stimuli in reading material is increased. Pictures are cues and therefore contribute to the stimuli of reading material. The attention, clarifying, repetition and reinforcing effect of pictures can, in part, be explained by the cue summation theory. This effect is illustrated in a simplified model in Figure 4.1 on the next page.

FIGURE 4.1

A model of the cue summation theory for picture facilitation.



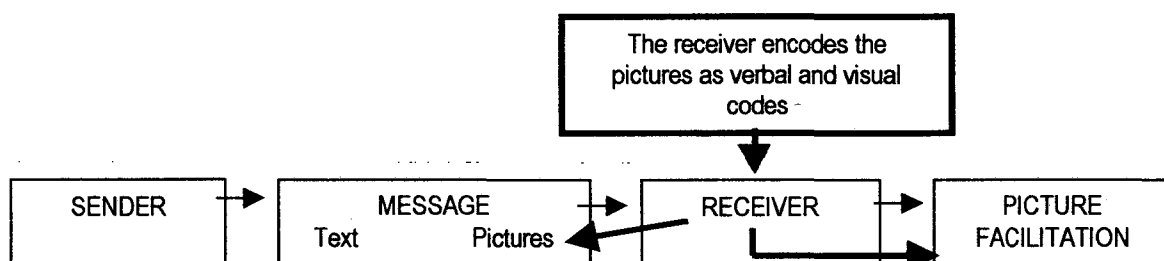
The focus of the cue summation theory lies with the message and the effect of how pictures can increase the stimuli of the message. The arrows in the above model indicate that pictures in a message can explain increased learning (picture facilitation) in picture-text learning material.

4.5.1.(b) *The dual coding theory*

The dual coding theory (Paivio, 1971 and 1973) proposes two processing systems - one for words and one for pictures. These processing systems are independent from each other and interact with each other. Pictures can, however, be stored as non-verbal and verbal codes and are therefore available in two codes. The totalling (additive) effect of these two codes can help learners to recall information better than in the case of just one code (verbal or non-verbal) and so assists learning. A simplified model, explaining this process, is presented in Figure 4.2.

FIGURE 4.2

A model of the dual coding theory for picture facilitation



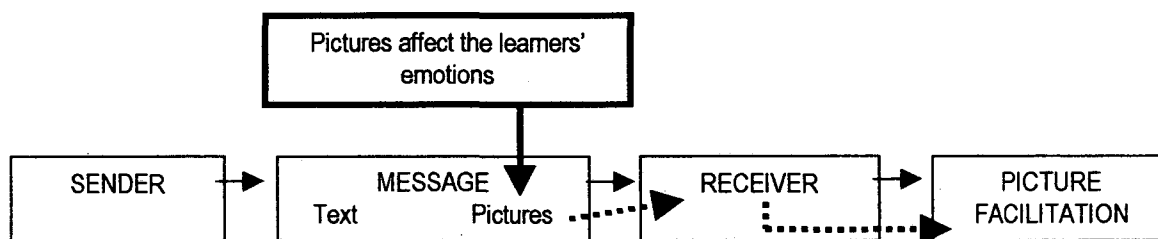
The focus of the dual coding theory lies with the receiver's encoding process concerning the pictures. The arrows in the above model indicate that an individual's cognitive ability could partially explain the picture facilitating effect.

4.5.1.(c) *The motivational theory*

The motivational theory is based on the argument that affective factors could influence the behaviour of learners and their ability to retain information (Solman and Wu, 1995:228). This theory is related to the *attentional* and *affective* function of pictures (Levie and Lentz, 1982:219) and is illustrated in Figure 4.3.

FIGURE 4.3

A model of the motivational theory for picture facilitation.



The focus of this theory lies with the effect of the picture on the receiver's emotions. The arrows between pictures, receiver and picture facilitation are given in a broken format, as there appears to be little evidence in the literature that affective factors created by pictures can, in terms of the framework of this study, contribute to a subject's cognitive ability. Peeck (1987:117) reported that because researchers considered the emotional benefits of pictures as being too obvious for serious consideration, there is limited reported research in this area.

Graphic elements in pictures with an emotive content, as found in propaganda and advertising material, fall outside the scope of this study.

4.5.1.(d) *The principle of least effort*

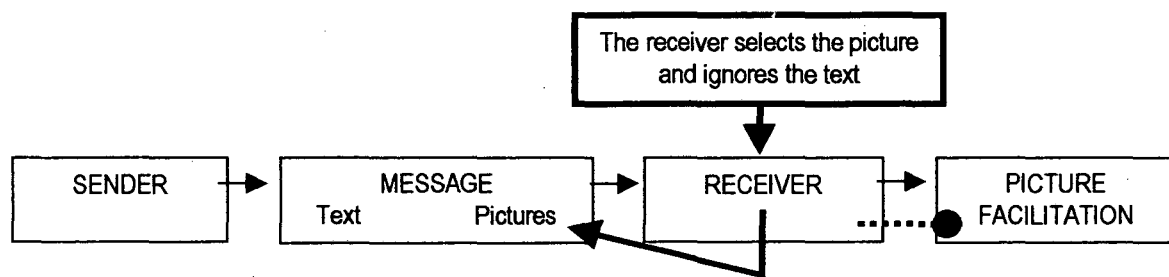
The principle of least effort is more an explanation by Samuel (1970:400) than an established and debated theory. It is an explanation of why some pictures actually interfere with the process of learning how to read, rather than an explanation for the picture facilitating effect. This principle states that a learner will select that item from a complex stimulus that will require the least amount of effort to produce a correct response. This could, in part, explain why beginner readers attend more readily to pictures when they are presented with pictures and text in reading material. This principle is graphically illustrated in Figure 4.4 on the next page.

This principle is in contrast to the motivational theory. A picture with emotive content within a picture-text learning context could, for beginner learners, provide a route where the least amount of effort is required to produce a correct response, not only because of the picture, but also because of the attention-getting value of the picture.

Comparing the possible reasons for the *motivational* and *principle of least effort* theories appears to indicate that the type of learner could determine whether such a theory is supported or not.

FIGURE 4.4

A model of the principle of least effort theory for picture facilitation.



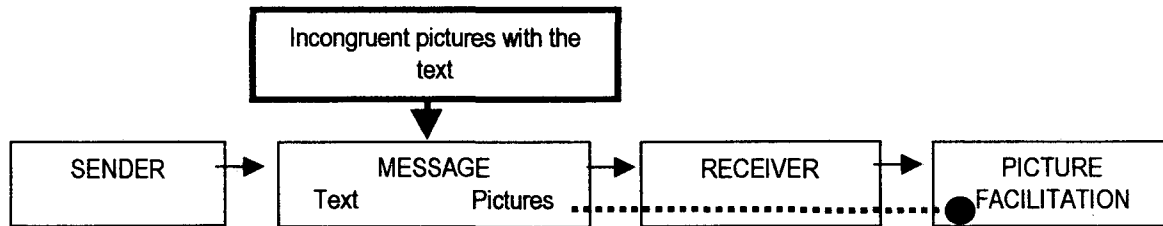
The focus of this principle lies with the receiver who selects the pictures, ignores the text and does not benefit from pictures in picture-text learning material. The broken line and rounded terminal at the end of the line indicates that no picture facilitation takes place according to this theory.

4.5.1.(e) *The Stroop effect theory*

The Stroop effect theory is a cognitive interference phenomenon, established by Stroop in 1935 (Stroop, 1935). This theory states that subjects will experience an interference effect when the picture and the text in learning material are not congruent with each other. This phenomenon is illustrated in Figure 4.5 on the next page.

FIGURE 4.5

A model of the Stroop interference effect theory for picture facilitation.



The focus of this theory lies with the picture that is incongruent with the text. The broken line with the round terminal indicates that no picture facilitation will take place. The Stroop interference effect is also an explanation of why it is important that for pictures to be effective, they must apply to the text, they must be relevant to the text, and they must not be in conflict with the text (Levin *et al.*, 1987:73-77).

4.5.1. (f) Levin and Mayer's explanation

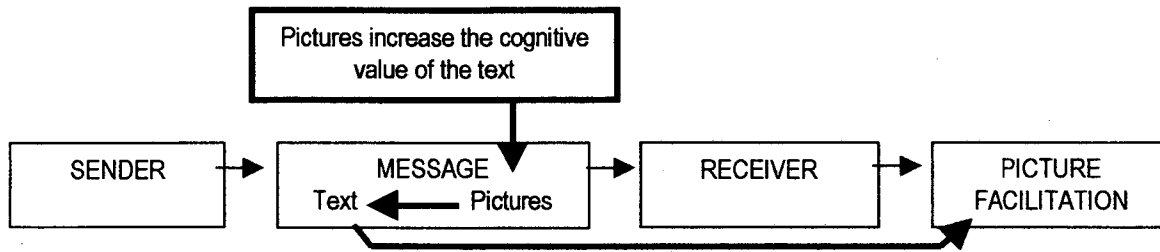
Levin and Mayer's explanation (1993:97-103) cites seven propositions as to why pictures facilitate learning. Their explanations are of a functional nature. Pictures can facilitate learning because they:

- *concentrate* and focus the attention of the reader on critical text information;
- *compact information* by converting the text into a more informationally efficient form;
- make information *concrete* by providing a concrete image that is mentioned in the text;
- make information *coherent* by organising difficult text systematically;
- make information *comprehensible* by turning difficult text into more understandable material;
- make information *correspondent* by providing a pictorial relationship (pictorial analogy) between what the reader knows and that which is unfamiliar to the reader; and
- make information *codable* by using mnemonic techniques.

This process is illustrated in Figure 4.6 on the next page.

FIGURE 4.6

A model of Levin and Mayer's explanation for picture facilitation.



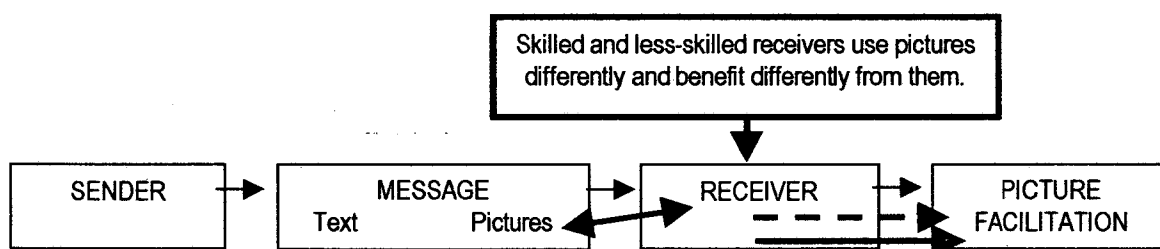
The main focus of Levin and Mayer's explanation is on how pictures help the text to become, for example, more coherent, concrete and comprehensible, and how this *value-added text* affects learning.

4.5.1. (g) Waddill and McDaniel's framework theories

Waddill and McDaniel's framework theories propose that readers benefit from pictures but that this benefit is related to the readers' characteristics. Pictures help skilled and less-skilled readers and comprehenders differently and readers also react differently towards pictures in picture-text learning material (Waddill and McDaniel, 1992:480-481). Some learners benefit more from pictures than others, whilst other learners do not benefit from pictures. This process is illustrated in Figure 4.7.

FIGURE 4.7

A model of Waddill and McDaniel's framework theory for picture facilitation.



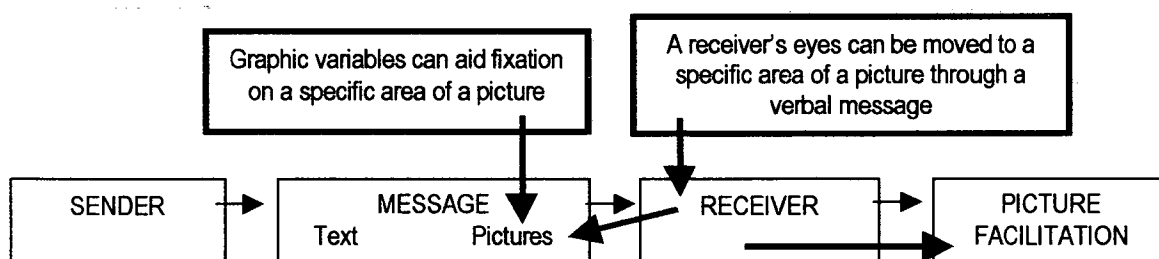
The focus of Waddill and McDaniel's theory is on the differentiated benefit that different receivers derive from pictures. The broken line indicates that a receiver might obtain more benefit or less benefit from a picture than another receiver.

4.5.1.(h) Spoehr and Lehmkuhle's generalisations

Spoehr and Lehmkuhle's generalisations (1982:163-181), derived from a review of research on picture processing, state that specific graphic variables in a picture can aid fixation on that area during a scanning process. A receiver will also involuntarily focus on an area in a picture if he/she listens to prose that mentions this area and if he/she is allowed to look at the picture. This process is illustrated in Figure 4.8.

FIGURE 4.8

A model of Spoehr and Lehmkuhle's generalisations for picture facilitation.



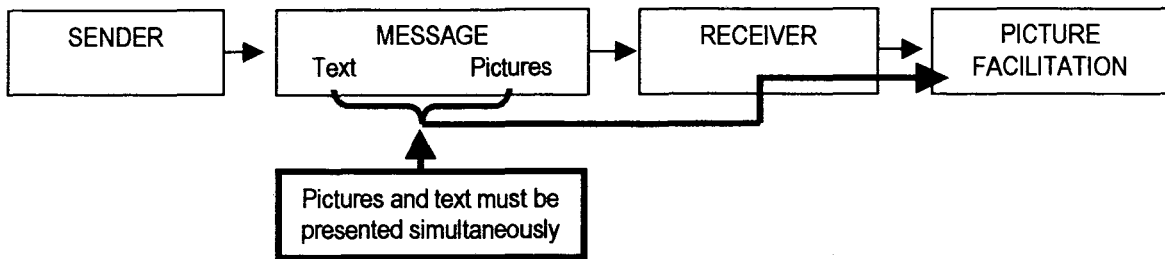
The focus of Spoehr and Lehmkuhle's generalisations is on focussing attention on the picture and thereby contributing to the facilitating effect. Diverse graphic variables and words that focus a receiver's attention or eyes voluntarily or involuntarily on a specific part of a picture, are similar to the *cue summation theory*, except that the focus is now specifically on aspects of the picture and not on the value-added effect of the picture in the message.

4.5.1.(i) The contiguity principle

The contiguity principle states that the effectiveness of instruction increases when the media involved in the instruction (pictures and text) are presented simultaneously (Mayer and Anderson, 1992) rather than separated from each other when, for example, the picture appears after the text on the next page. This principle is illustrated in Figure 4.9 on the next page.

FIGURE 4.9

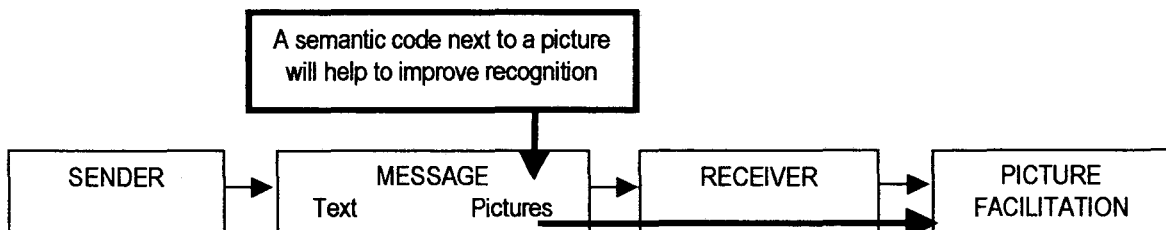
A model illustrating the contiguity principle.

**4.5.1.(j) The semantic code hypothesis**

The semantic code hypothesis suggests that a semantic code, for example in a label next to a picture, will help to improve recognition of the pictorial code (Beck, 1991:16). This is illustrated in Figure 4.10. It is similar to the cue summation theory and the requirement for pictures to be accompanied by appropriate labels and captions for them to increase their potential facilitating value.

FIGURE 4.10

A model illustrating the semantic code hypothesis.

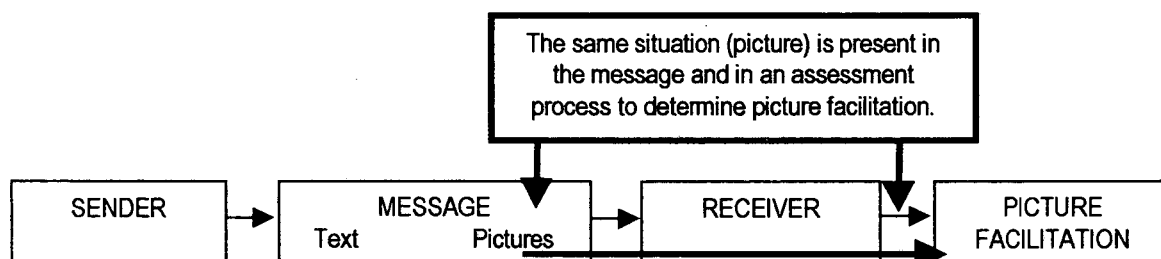
**4.5.1.(k) The stimulus generalisation theory**

The stimulus generalisation theory states that learning is improved when the test situation is similar to the learning situation (Hartman, 1961; Wu and Dwyer, 1990; Beck, 1990). This theory explains the results that were obtained in Experiment 6b where the same picture that was used in the learning situation for one group was also used in

an assessment test ten days later. This group scored significantly better in the assessment test than any of the other groups. This theory is illustrated in Figure 4.11.

FIGURE 4.11

A model illustrating the stimulus generalisation theory.



4.5.1.(l) *The generative theory*

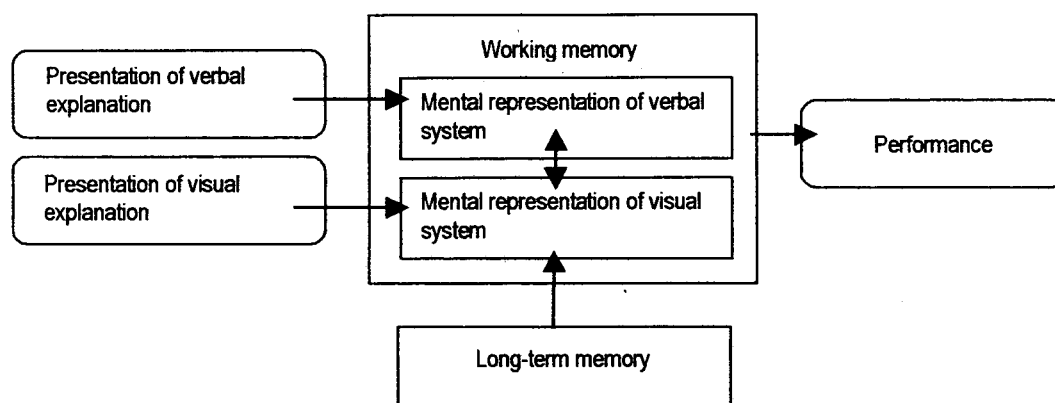
The generative theory is a three-phase constructive process in which learners first select and organise from a text base to form a verbal representation, then secondly select and organise pictures from a picture base to form a visual representation, and thirdly integrate these representations or build a one-to-one correspondence between the representations (Mayer *et al.*, 1995:32-33).

Mayer and Sims (1994:390) provided an extension and a modification of the dual coding theory and summarised it in a three-phase constructive model. Their model provides an account of how visual and verbal material might be integrated within a learner's working memory during learning. Their model illustrates the cognitive process of building separate visual and verbal representations (visual and verbal encoding) of the text and pictures and then the construction of referential connections between the two (visual and verbal) representations.

The dual coding theory of multimedia learning of Mayer and Sims (1994:390) in Figure 4.12 on the next page is a visualisation of the generative theory presented as a dual-coding model of multimedia learning.

FIGURE 4.12

Mayer and Sims's *dual coding model of multimedia learning*
(Mayer and Sims, 1994:390)



4.5.1(m) Pettersson's (1982) comprehensibility model

Pettersson's comprehensibility model, previously given in Section 2.2 (*Vide.* p. 35), is centred on the sender's writing process, the message, and the receiver's reading process. The sender's writing process and the receiver's reading process are both affected by terminology, earlier experiences and linguistic quality, whilst credibility, aesthetics, reading value, readability and legibility are factors affecting the message. What is apparent from Pettersson's model is that the sender's and the receiver's linguistic ability, for example, can either interfere or facilitate in the process of transferring a message from the sender to the receiver.

Poor legibility in a message, for example a too small typeface, can interfere in the communication process, whilst convincing arguments can add credibility and enhance the comprehensibility of a message. The value of Pettersson's model, in term of this study, is that it highlights several factors that can either interfere with or facilitate the picture facilitating effect in picture-text learning material.

4.5.2 Towards a model for a learner-centred theory for the picture facilitating effect

The models in the previous section are presented in a simplified graphic format in order to aid the understanding of explanatory theories for picture facilitation. A more realistic and complex model, which is used to present a learner-centred theory, must include

areas where message and picture encoding and decoding take place. Such a model must also make provision for factors that interfere with and facilitate the picture facilitating effect.

The model for a learner-centred theory in this section differs from the model presented in Chapter 5. The model in Chapter 5 attempts to explain and predict the picture facilitating effect. The aim of the model presented in this section is to present a model for the picture-text learning process where the learner or receiver is the focus of the model. The central position that the learner appeared to have occupied in the experiments during the empirical work motivated the proposal of this theory and the subsequent model. The learners' ability and their socio-economic and cultural backgrounds all influenced the outcomes of the experiments.

The concept of the sender in the traditional communication model is replaced by the instructional designer, while the receiver is replaced by the learner. Encoding and decoding processes take place at several points in this model. The message must be encoded, the learner must decode the message, the learner must encode the text and picture in a text-picture message, and the learner must understand the assessment test and must have the necessary skills to encode an answer. A traditional communication model concludes with the receiver, whilst this model will conclude with a picture facilitating effect as experienced by the learner. The outcome of pictures in picture-text learning material should be to assist learning and a model must, therefore, conclude with the effect of pictures on the receiver, or in the case of this model, the learner.

Different components of the model are discussed in the next subsection to aid the interpretation of the graphic structure and the composition of the model.

4.5.3 The different components of the model

The model in Figure 4.13 (p. 352) is a graphic representation of the process from the person developing the material to the picture facilitating effect. The model does not attempt to explain the reasons for the facilitating effect, nor does it attempt to predict the outcome of a picture-text learning condition. A model for the prediction and explanation of the picture facilitating effect is presented in Chapter 5.

The red arrows indicate the flow of the facilitation process that takes place from the instructional designer to the facilitating effect.

There are three columns in the model:

The **GENERAL FACTORS** (left-hand column) provides general factors that could influence each segment of the facilitation process in the model. The **FACTORS RELATED TO DEVELOPING COMMUNITIES** (right-hand column) provides particular factors, in addition to the general factors, which play a role in or could influence each segment of the facilitation process in the model. The **PROCESS** in the middle column provides eight processes in the learner-centred theory for the picture facilitating process.

The model for the process of picture facilitation is pivoted around the learner. The centrality of the learner in the model is a function of the relationship of the segments to the learner. The instructional designer must develop picture-text material for specific learners. Learners who, for example, have low prior knowledge of a specific subject are more likely to display a picture facilitating effect than learners who do not have a low prior knowledge (Kliese and Over, 1993) when given the same material, test and assessment conditions. The design process, under ideal conditions, should involve participation by members of the target audience in the design process of the material through formative research processes, whether in small focus groups or a larger quantitative study. The message and the medium must be relevant and appropriate for the learner, especially for learners from developing communities (Hugo and Smit, 1998). Assessment procedures are only effective if they are understood by the learner and if they allow the learners to demonstrate their acquired learning. A learner without sufficient verbal decoding skills might not be able to provide written answers to a written test, but might be able to provide a verbal description in his/her home language in a verbal assessment test.

The model is presented at the end of this section in Figure 4.13 (p. 352). The purpose of this model, within the framework of the study, is to accentuate the position of the learner in the field of learning from picture-text instructional material. This study investigated the effect of culturally modified pictures when they are combined with printed educational text. The focus is on the learner in terms of recall, problem-solving skills and comprehension of information in picture-text instructional material.

The model must be interpreted with the aid of the following numeric sections, which correspond with those numbered sections in the model.

1. INSTRUCTIONAL DESIGNER

The model for a learner-centred theory for the picture facilitating effect begins with the instructional designer. The instructional designer, in the context of the model, consists of several persons who initiate and develop the instructional material. The designers are in turn influenced by budget constraints, their own linguistic and picture-creating abilities, their understanding of the end-user or learner, and their interpretation of the instructional objective. Designers must give priority to sociocultural issues in pictures and text if the message is aimed at developing communities.

2. DESIGN PROCESS

The design process entails the transformation of the instructional objective into a text and a picture code to form a message. This process should preferably include a design process whereby the material is tested with a sample of the target market and where the target market provides an input into the material before it is finalised (Mody, 1991; Linney, 1995). This can prove to be a valuable process, especially when the material is aimed at a developing community or where the designers and end-users are from heterogeneous backgrounds.

3. MESSAGE

The encoding process must produce a single picture-text message where the pictures support the text, they must be central to the text (Schallert, 1980), they must be relevant to the text (Levie and Lentz, 1982; Dwyer, 1978; Levin *et al.*, 1987), and the text and pictures must be presented simultaneously (Mayer and Anderson, 1992). The text and pictures must be understood by the learners.

4. MEDIUM

The medium not only comprises the carrier but also the process whereby the message is transferred. The teacher, the learning environment and the learner's socio-economic conditions all contribute to the medium of communication between the instructional designer (sender) and the learner (receiver).

An inappropriate medium, for example expensive full-colour textbooks or overhead transparencies aimed at developing communities, might deny the potential effectiveness of the picture facilitating effect due to cost and the lack of electricity and equipment in these communities. A poor or a positive teaching culture at a school is an additional factor in the transfer process that could distract from or contribute to the final picture facilitating effect.

The medium must not only be cost-effective but also affordable for developing communities.

5,6 AND 7. LEARNER, TEXT AND PICTURE

The learner receives the message in the form of text and pictures through a particular medium. This message is an integration of the text and pictures. The learner must be able to decode or to transform the text message into an understandable code, transform the incoming picture message into an understandable code, and connect these two understandable codes as analogous. The learner must then be able to decode the message in its totality. This process, or *generative theory*, is explained by Mayer *et al.* (1995) as a three-phase constructive process that they adapted from the dual coding theory of Paivio (1971 and 1986) and Clark and Paivio (1991). This process can also be explained as follows by using the terminology of Mayer (1994) and Mayer *et al.* (1995): The learner must construct a mental representation of the verbal or text *message (building a verbal representational connection)*, then construct a mental representation of the visual or picture message (*building a visual representational connection*), and lastly construct a relationship between the two representations of the instructional message (*construction of a referential connection*). The learners' visual and verbal literacy and skills will determine if they are able to decode the message and construct the connection between the text and pictures (the two representations of the instructional message).

8. ASSESSMENT

Assessment must take cognisance of the learning objective and the level of the learners' decoding skills (Levin *et al.*, 1987). Assessment tests must test for information that is represented in pictures and the text (Mayer, 1993). The extent of the picture facilitating effect is only measurable in an appropriate comparative testing procedure. The assessment must use an appropriate medium. The learner can, for example, be tested in his/her home language to avoid a possible communication barrier.

9. DECODING and ENCODING

The learner must correctly understand or decode the assessment test and must be able to formulate an answer or encode an answer that is understood by the assessor. The level of the learners' visual and verbal literacy can determine to what extent they are able to understand the assessment test and encode comprehensible answers.

10. PICTORIAL LEARNING FACILITATION

Picture learning facilitation is possible if certain factors are considered when designing instructional picture-text material. These factors are discussed in Chapter 2, Sections 2.6 and 2.7 (*Vide.* p. 60 – 89). The extent of picture facilitation will only become evident in

an appropriate comparative learning situation and where valid measurement instruments are used. Sample size, level of significance, homogeneity of the sample, and learning or test conditions are factors that could influence the observable extent of the picture facilitating effect.

The model for a learner-centred theory for the process of the picture facilitating effect is presented in Figure 4.14 on the next page.

4.6 RECOMMENDED GUIDELINES FOR THE DESIGN AND DEVELOPMENT OF PICTURE-TEXT LEARNING MATERIAL

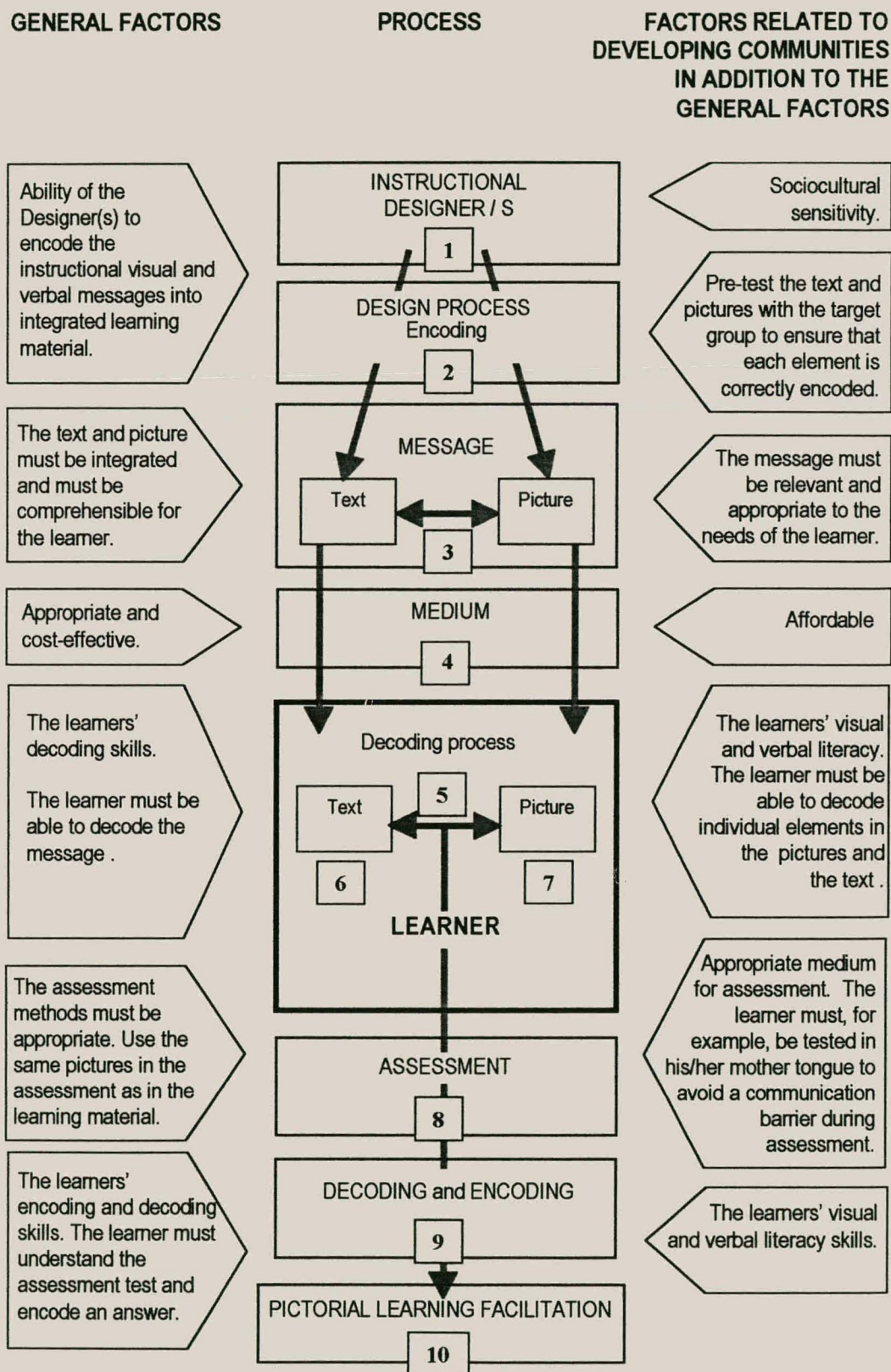
4.6.1 Introductory comments

The development of text and pictures, and the integration of the text and pictures into a common element, constitute the main processes of developing picture-text learning material. The development of pictures (illustrations, photographs and other graphic elements) normally, but not always, takes a secondary place to the development of text in learning material. The readability of text is measurable through reading indices and is adapted by changing words, sentence length, and the construction of the text passage. Quantifying pictures in the precise manner that text is quantifiable is a more complex task due to the multivariate nature of visual items. This multivariate nature of pictures is compounded by sociocultural variables when the target group is from a developing community. A current barrier in the form of cultural differences between the picture designers in Southern Africa and the receivers of such illustrations or pictures further complicates the development of appropriate pictures in support of text-learning material. The illustrators' socioeconomic and cultural backgrounds as well as their training contribute to the barrier between the designers of pictures and the receivers from developing communities.

This section will discuss this barrier and will recommend solutions to this barrier as a framework for guidelines for the development of picture-text learning material. This will be followed by the guidelines in the form of a model presented as a flow diagram.

FIGURE 4.13

A model for a learner-centred theory for the process of the picture facilitating effect.



4.6.2 The barrier between picture developers and the receivers of these pictures in developing communities

Learners from developing communities sometimes have difficulty in the interpretation of Eurocentric picture-based information and graphic conventions. It is theorised that some of these difficulties are due to unfamiliar cultural imagery, little exposure to Western graphic conventions, and a low level of visual and verbal literacy (Ajayi-Dopemu, 1982; Zimmerman and Perkin, 1982; Herbst and Beukes, 1986; Van Aswegen and Steyn, 1987; Tzeng and Trung, 1990; Boeren, 1995). This difficulty is a well-known phenomenon that is especially noted by scholars in health communication education (Hugo and Skibbe, 1991; Hugo, 1994; 1995; 1996a and 1996b; Hugo and Smit, 1998).

The practice of creating pictures and developing information-bearing pictorial messages falls within the broad field of graphic design practice. Graphic design, when compared to the established human and natural sciences, is in a developmental phase concerning research, the publishing of research findings, and academic discourse. The visual nature and the practice-centred activities of graphic designers could be some of the reasons for a deficit in formal graphic design research methods. Designers and artists are also more inclined to practise their discipline than to write about it.

Graphic designers in Southern Africa have a training background that is influenced by a European orientation. Their training at universities and technikons, for example, focuses on European art history whilst their design training encourages Western graphic conventions, namely perspective, symbolism and latent messages. Subjects from developing communities do not always understand Eurocentric-oriented messages and the Western-oriented graphic conventions, i.e. movement, sequence and perspective. Illustrators also aim to develop visually attractive pictures instead of aiming to inform a specific target group, resulting in visuals with little educational value (Hugo and Skibbe, 1991: 47). There are those who suggest that making the visuals more indigenous to the target group will improve the communicative and educational value of the visual images (Cripwell, 1989; Patel, et al., 1990). Hugo and Smit (1998:93) describe this as probably the single most important guideline and recommend “ ... *to put each and every media message in a particular socio-cultural context, and to follow an audience-centred rather than a technology-centred or information-centred approach ...*”. Hugo and Smit’s comments refer to health communication messages in the African context, but their generalisations are applicable to picture-text learning material aimed at developing communities. Adults who are not exposed to a variety of visual messages, for example

magazines, posters, television and books, might never develop a basic picture-reading ability. Their frame of reference and level of understanding could possibly extend only to the limited visuals with which they have been in contact.

The difficulties that some subjects in developing communities have in understanding visuals, call for a shift from a "trial-and-error intuitive" picture development practice to a more theoretical design-science approach. Design practices without a sound scientific base, and design decisions based on experience, intuition (Sims-Knight, 1992:325-333), personal preference and predetermined design styles, cannot improve visually based messages aimed at developing communities. Multiculturalism, diverse languages, varying levels of literacy, education and exposure to mass media are some of the variables that require scientific-based design decisions when solving visual communication problems. A mass-media approach in developing pictures might work in homogeneous countries where language, culture and educational background are similar, but will not necessarily be as effective in heterogeneous developing communities. It is, therefore, crucial for picture designers to make use of sound research methods to develop effective messages.

4.6.3 Picture-development research methods for the improvement of pictures in picture-text material aimed at developing communities

This study investigated the effect of culturally modified pictures when they are combined with printed instructional text. One of the aims was to propose guidelines for the design and development of picture-text learning material for subjects from developed and developing communities. Developing pictures for the learning material is one facet in the development of picture-text learning material. The purpose of this section is to comment on research methods used for the development of such pictures.

Picture designers can make use of three research methods to improve the potential effectiveness of pictures in picture-text learning material. These are formative design, evaluation research, and experimental design research. These are audience- or target-centred approaches and take place during the formative stages and post-design stages of the picture-design process.

This subsection will briefly discuss these methods and will comment on sampling procedures in developing communities and on social factors that can introduce bias in picture-design research.

Formative design is when individual subjects and focus groups from the intended target population participate in continuous discussion and selection of the rough concepts through to the final designs. This process normally takes the form of a qualitative study. Picture designers can also use existing knowledge from scientific journals to improve their visual messages and design products. One weakness of focus groups and individual testees during formative research in developing communities is the subservient role that they play in the developmental stage of design projects. Behaviour and response patterns of the testees are affected where a form of reward or payment is offered in the consultation sessions. Subjects could withhold their honest response and opinions for fear of losing current and future rewards. Researchers without appropriate training in focus-group interviews could create the impression of a paternalistic, “*I know better than you*” or “*I decide for you*” or “*I know what you need*” approach, thereby generating unreliable results. An indigenous approach, whereby a population group is empowered to develop their own visual communication models, is the ideal. A process whereby a designer would empower indigenous social workers, health workers, community leaders and teachers to complete the formative research process of a design product could be one solution to obtain more reliable results from a developing community (Mody, 1991; Linney, 1995). In this way, the design directives will come more from “*bottom up*” and less from “*top down*”.

Evaluation design research, also known as post-testing or summative evaluation, can take the form of a qualitative or quantitative study. Questionnaires and observation surveys are employed to collect data after the design is released to the designated target market. Comprehension tests, also called recognition tests, are one of the methods employed to test finished design. Subjects are shown a particular symbol or graphic and then asked to name the use of that particular symbol or graphic. Answers during the interview will suggest which elements cause misunderstanding (Mathews *et al.*, 1993 and 1994; De Lange, 1995).

This form of research can also be used to pre-test a design or product, before the design is altered or a new design is developed. Another post-design evaluation procedure is a matching test. Subjects are asked to select a given referent from a range of symbols or graphics. Data obtained during this procedure are used to adapt current designs and to formulate theoretical guidelines for future designs.

Experimental design research is a form of research that is well known by educators and psychologists, and has its roots in the natural sciences where quantitative studies provide data for statistical analyses. It is used to investigate the value or the effect of a particular design or picture variable, for example what the ideal type size and line length is for optimum legibility in a book or newspaper.

Designers and artists do not always employ experimental research methods, as they require statistical routines and the control of external variables, and often operate within a rigid methodological framework. These scientific procedures and the rigor required for sound experimental work are normally not taught to graphic designers or illustrators on diploma and graduate level and are seen by the wider art community as an activity belonging to the scientific community.

One particular problem with visual images (Fletcher, 1978) is the non-verbal message and the non-verbal response by viewers. Facial expressions and gestures are examples of non-verbal messages in pictures, whilst interest and beauty are some examples of non-verbal responses by viewers. It is easy to measure and record comprehension, recall and legibility of pictures in experimental work, but aspects of beauty and preferences are more difficult to quantify. Differential scales can be employed to measure these variables, but variables unique to developing communities at times conceal the true reasons and cloud out the experimental variable. Controlling extraneous variables during experimental work poses a different set of problems in developing communities. Perception of time, the exclusivity of non-testees in an experiment, which can be seen as discriminatory, cultural differences between tester and testee, and language barriers that a design-researcher must overcome in developing communities, are some of the difficulties. Experimental design research is, however, a sensitive method whereby small nuances of picture effects can be measured, quantified and compared with each other. The parallel introduction of qualitative research methods could confirm or question the results obtained through experimental work.

This combined-methodology process with a pragmatic approach to developing material for health education, for example, is aptly described by Hugo (1995:11) as “*pluralistic*” and “*sensible*”. Qualitative methods are valuable instruments that can account for nuances in the cultural environment of the target audience and can indicate how these variables may influence the development of picture-text learning material.

4.6.3.(a) A comment on sampling in developing communities

Criteria for good research are that it must be repeatable, it must use valid methods to obtain reliable data, and samples must be representative of a chosen population. True random sampling is not always possible due to economic and time restraints. Convenience sampling, an alternative and more economical and popular process is, however, normally not representative of a wider population. Some populations in developing communities are heterogeneous due to the rapid urbanisation of subjects in the population. Rapid urbanised populations in peri-urban areas are characterised by different languages, cultures, and levels of visual and verbal literacy. ~~A heterogeneous sample will decrease the generalisability of research results to a wider population.~~ Picture designers in developing communities can partly overcome these by collecting a wide range of demographic, social and economic data from the testees. Multivariate analyses of the data should enable the designer-researcher to isolate the variable that influences the dependent variable under investigation. Selective and systematic sampling of testees with predetermined biographic variables from a narrowly defined population, can provide a sample with homogeneous traits. This sampling process can reveal the extent of an undesirable or preferred variable in a picture. The standard deviation of a homogeneous sample will be smaller and this will make it easier to obtain statistically significant results with inferential statistics.

4.6.3.(b) Social factors that can introduce bias in design research

Social factors in developing communities, hidden at times from designers with a Eurocentric background, can introduce bias in research data. Some examples where customs in Africa differ from Eurocentric practices are, for example, greeting a superior, courtesy towards strangers, hospitality customs, the idea of time, social structures, and the decision-making process. The European decision-making process for an individual is self-centred, in that the individual is placed before the group. In some developing communities in Africa and South America, the group is regarded as more important than the individual. A designer-researcher might obtain a representative sample of a given population, obtain the services of an interpreter, and obey all the procedures to be accepted and trusted by the community, but could still obtain unreliable results. Individual testees, without being aware of it themselves, might respond to questions and visual prompts by the researcher in a manner that the group expects them to behave. Testees could also, for example, withhold a response for fear of being wrong or not being courteous enough. The project-oriented approach of designers

with a European background is in conflict with the people-oriented approach of many developing communities in Africa.

Aesthetically pleasing pictures without a communicative and cognitive value are mere decorations of instructional text. The development of instructional pictures, based on an illustrator's intuition and own interpretation of the problem and without formative research, can be confusing and could lose some of its intended value. The result of little or no formative research is more severe in developing communities, due to the higher level of illiteracy and the cultural differences that exist between the developers of the pictures and the receivers. An indigenous approach, whereby the targeted community is empowered to develop pictorial imagery, could partly assist designers in developing countries. Post-design research, or summative research, is of value to the designer when the data are generated through scientific sampling procedures and take cognisance of social and cultural differences. Experimental work can supply picture designers with reliable information on how to effect better visual images.

4.6.4 Guidelines for the development of picture-text learning material

The guidelines for the development of picture-text learning material are presented in Figure 4.14 (p. 360). This flowchart is aimed at developers of picture-text learning material, which is aimed at learners both from developing and developed or urban communities.

Learning materials aimed at school children are by nature mass communication materials. Provincial education departments purchase material from national publishers, which produce these outcomes-based materials on a national basis. Provincial initiatives sometimes produce learning material for regional use by social, health and development workers, as well as educators. The ideal situation is, of course, to target a specific group when developing learning material and thereby develop appropriate and relevant material. This approach is, however, not always possible. Learning material aimed at a larger market could, by virtue of its generalistic approach, include sociocultural text and pictures that are insensitive, misunderstood, and irrelevant to a smaller segment in a larger target group. The compromise then could be to develop material that excludes insensitive visuals for most of the intended market, rather than material that includes items that are relevant.

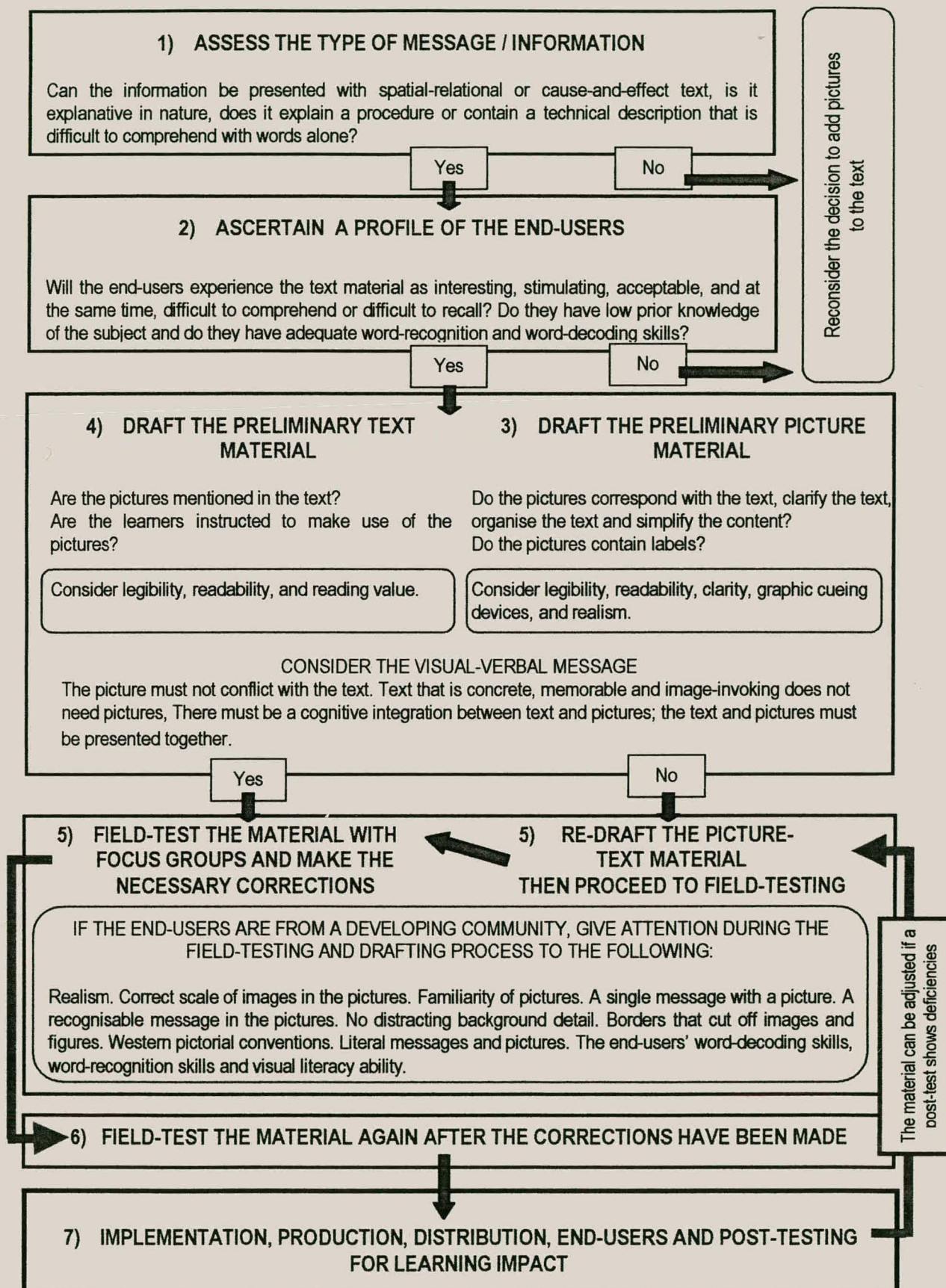
The seven guidelines in Figure 4.14 (p. 360) are indicated by numerals and are enclosed in rectangles. Suggestions to developers of picture-text learning material are placed in rectangles with rounded corners.

The seven recommended guidelines in the design and development of appropriate picture-text learning material are:

- 1) Assess the type of message and the requirements of the message that must be encoded into learning material. A decision can be made as to whether pictures are required or not.
- 2) Ascertain the target audience that will use the material. This step will enable the message designers to decide if the learner requires pictures.
- 3) Draft the text.
- 4) Draft the pictures. The process of developing the pictures and text must be a combined activity between the person who designs the picture and the person or persons who writes the text. The final picture-text message must form an integrated set of instructional material.
- 5) Field-test the material with focus groups from the intended target group. Give special attention to picture variables if the end-users are from developing communities. Make corrections to the material if required.
- 6) Field-test the material again after the corrections have been made.
- 7) Produce the material, distribute to the end-user and post-test the material to determine the impact on learning. The material can be adapted if the post-test indicates this need.

Figure 4.14, which presents the guidelines in a graphic format, is given on the next page.

FIGURE 4.14
Recommended guidelines in the design of picture-text learning material.



4.7 AN INSTRUMENT FOR THE CLASSIFICATION OF PICTURES IN PICTURE-TEXT EDUCATIONAL MATERIAL

The instrument presented at the end of this section is a tool that instructional designers can use for the analysis of pictures in picture-text educational material. This instrument, in the form of a flow chart, can be used for classifying pictures in educational text as pictures that have no potential to facilitate learning, through to pictures that have a high potential to facilitate learning.

4.7.1 Introductory comments

Textbooks for schools in South Africa are developed and produced by several independent publishers. These textbooks are based on the authors' interpretation of the syllabi, on national and regional needs and on market demands. Authors of these textbooks, and not the publishers, normally determine the type and content of the pictures in conjunction with an illustrator or photographer. South African textbooks that make use of pictures are normally those that deal with geography, history, health education, physics, chemistry, environmental education, biological sciences and technical subjects, for example woodwork. Subjects dealing with numbers, namely accountancy, mathematics and computer sciences, seldom use pictures to support the text.

4.7.2 A model for the analysis of illustrations in textbooks

The main sections in Chapter 2 isolated factors that influence the facilitating effect of pictures when they are combined with instructional text. The review of the literature also isolated several preconditions that apply before pictures can become potentially beneficial in a learning situation. The potential benefit of a picture is not only determined by the picture itself, but also by its syntax and, to a lesser extent, by its graphic qualities.

Several factors can affect the facilitating effect of pictures when they are combined with text. These factors include the learner characteristics, the text content of the learning material, the evaluation methods to determine the learning outcome, and the pictures themselves. These factors are fully discussed in Section 2.6 and graphically illustrated

with Figure 2.8 (p. 75) and Figure 2.9 (p. 79). The effectiveness of verbo-visual material is normally determined or measured in experimental situations where experimental variables, unrelated to the above-mentioned factors, can influence the facilitating effect under investigation, for example the Hawthorne effect.

Each of these main factors, namely text content, pictures, learners and evaluation methods, have conditions that regulate their effectiveness, which in turn could change the measure of picture facilitation in a section of verbo-visual material. An appropriate illustration, combined with appropriate text, could show no facilitation if, for example the learner is not able to comprehend the terms used as labels in the illustration. The learner's verbal illiteracy of the terms in the illustration is an example of a learner condition that could nullify the potential benefit of the illustration.

Pictures, including graphs, illustrations and photographs, can be analysed or audited in terms of their potential effectiveness. Pettersson's (1993:159-165) concepts of picture quality and picture readability are useful criteria for evaluating a picture, whilst Mayer's (1993:274) model to demonstrate the effectiveness of explanative illustrations provides a direction for developing a model to determine the potential effectiveness of a picture.

An instrument for classifying pictures at varying levels of potential effectiveness is given in Figure 4.17 at the end of this section. This is an instrument for picture analysis when knowledge about the learner characteristics is absent, when the evaluation methods are not known, and when the text is not evaluated against the pictures.

This instrument is a sequel from a model proposed in Figure 2.9 (p. 79) and assisted by the information in Table 2.3 (p. 76). The model in Figure 2.9 is a graphic presentation of the main interrelating factors that have an influence on the picture facilitating effect, whilst Table 2.3 summarises the main factors that instructional designers must consider when developing picture-text material aimed at subjects from developing communities. The instrument is also influenced by Mayer's (1993:274) model, Hugo's (1997:272) model for appropriate media usage and sociocultural sensitivity, Pettersson's (1993:157-163) "*Legibility/Reading value*" rectangle, and the work of Levin *et al.* (1987:63).

Pettersson's rectangle and Mayer's model are given in Figure 4.15 and Figure 4.16 respectively on the next page. Guidelines are provided in Table 4.3 (p. 365), which can be used for decision making when using the instrument.

FIGURE 4.15

The “Legibility/Reading value” rectangle (Pettersson, 1993:163).

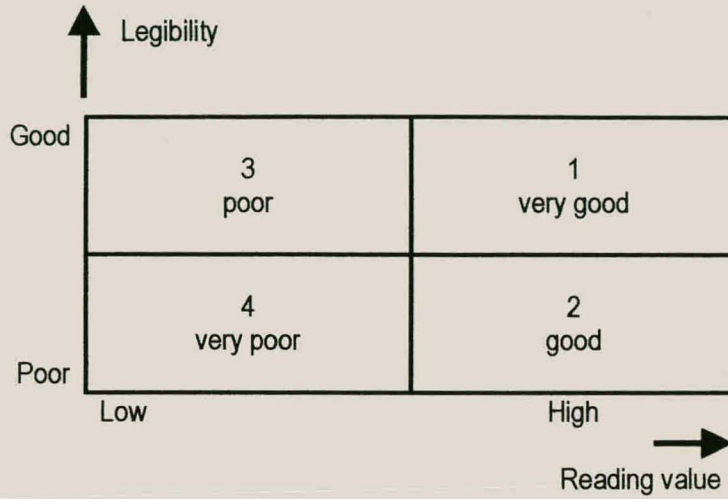


FIGURE 4.16

Four conditions for demonstrating the effectiveness of explanative illustrations

(Mayer, 1993:274).

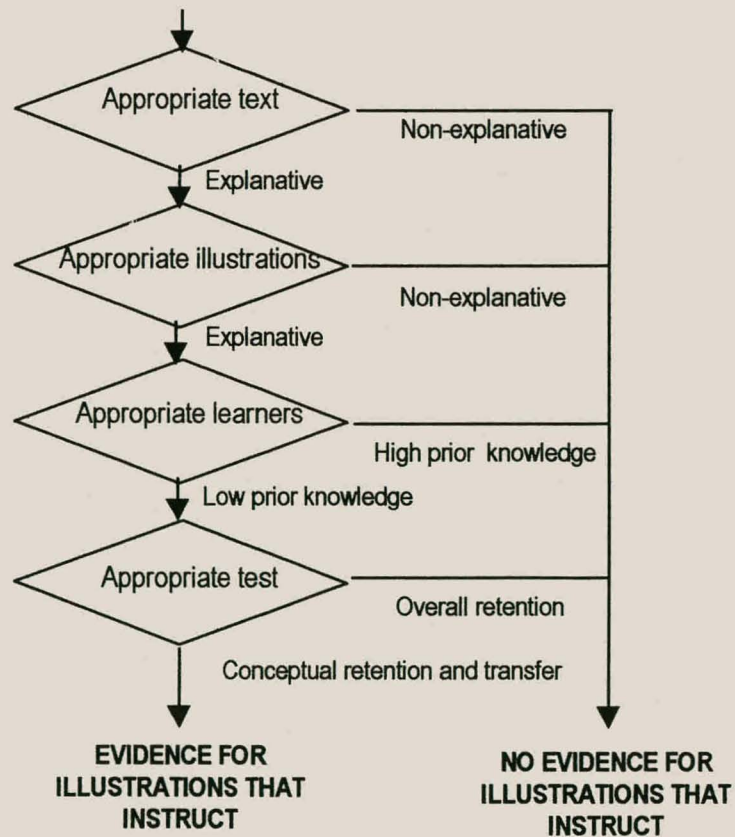


FIGURE 4.17

An instrument for classifying pictures in educational text according to their relative potential to facilitate learning.

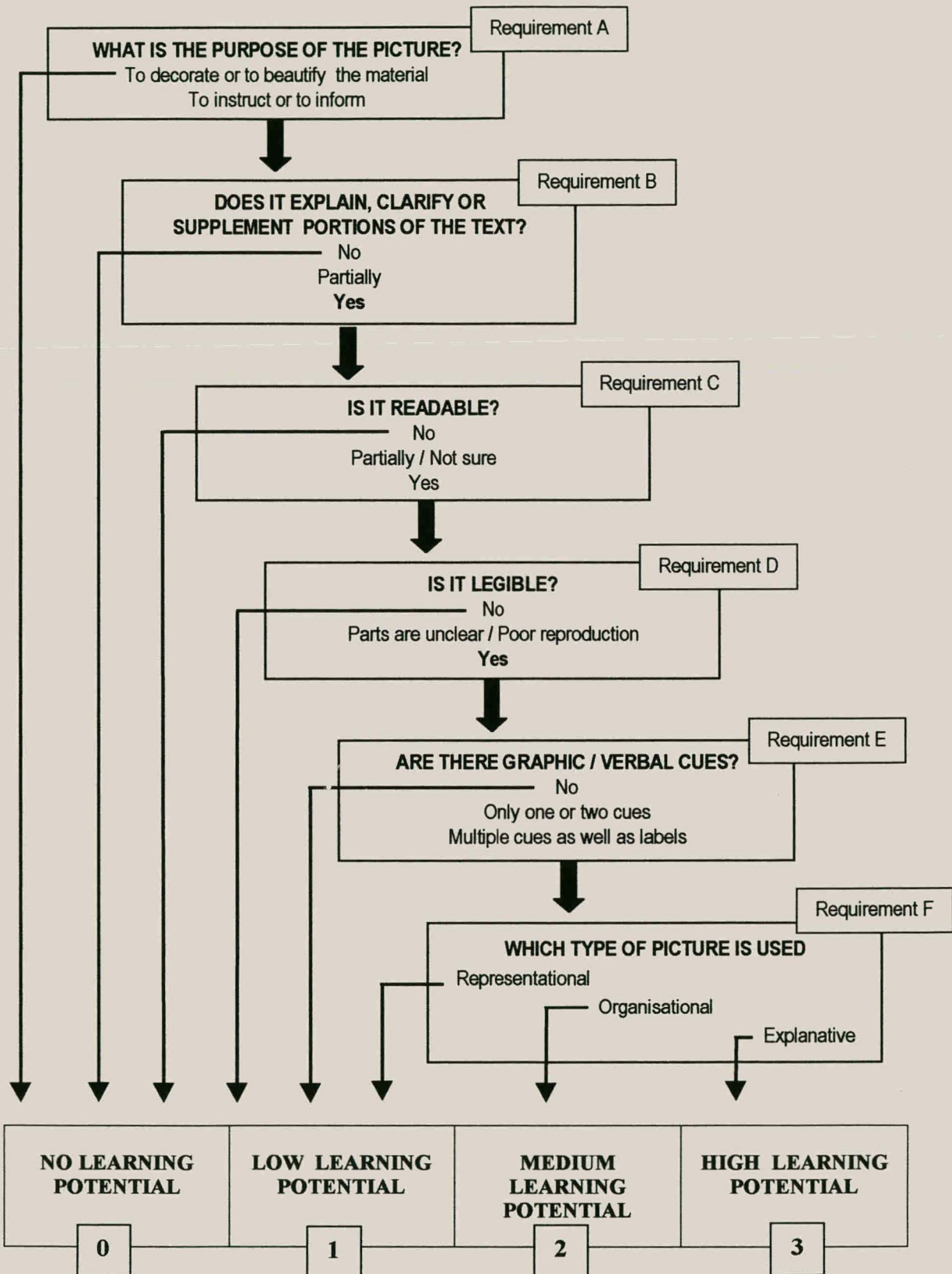


TABLE 4.3

Guidelines for interpreting the six decision-making requirements in Figure 4.17.

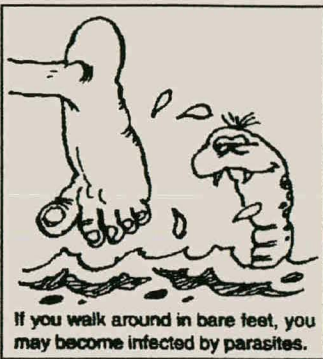

<p>Requirement A</p> <p>WHAT IS THE PURPOSE OF THE PICTURE?</p>	<p>Decorative pictures do not have the ability to facilitate recall, comprehension, or problem-solving skills (Levin, 1981; Mayer 1993; and Mayer and Gallini, 1990). Pettersson (1993:159) found that a picture must be unambiguous and not too “artistic”. An example of a picture with a decorative nature and unrealistic proportions is given below on the right (Clarke and Thoka, 1992:127). This picture accompanied text on parasites and was placed in a margin alongside the text.</p>	
<p>Requirement B</p> <p>DOES IT EXPLAIN, CLARIFY OR SUPPLEMENT PORTIONS OF THE TEXT?</p>	<p>Pictures must represent information presented in the text, organise the information in the text in a more concrete and memorable manner, or explain difficult-to-understand concepts before they will facilitate learning. Pictures that are unrelated to the text that they accompany will only facilitate the information that is represented in the picture. The picture on the right is an example of where the text did not relate to the picture. The text stated:</p> <p><i>“The famine in many parts of Africa has been caused by people failing to care for the grassveld”</i> (Clarke and Thoka, 1992:113)</p> <p>The picture appeared on the previous page. The picture of a starving child does not relate to the text, which is about a grassveld community.</p>	

TABLE 4.3 (continued)

Guidelines for interpreting the six decision-making segments in Figure 4.17.

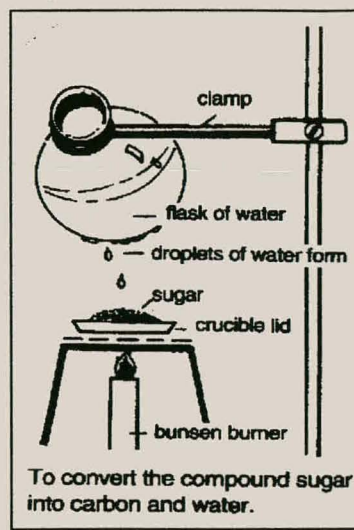
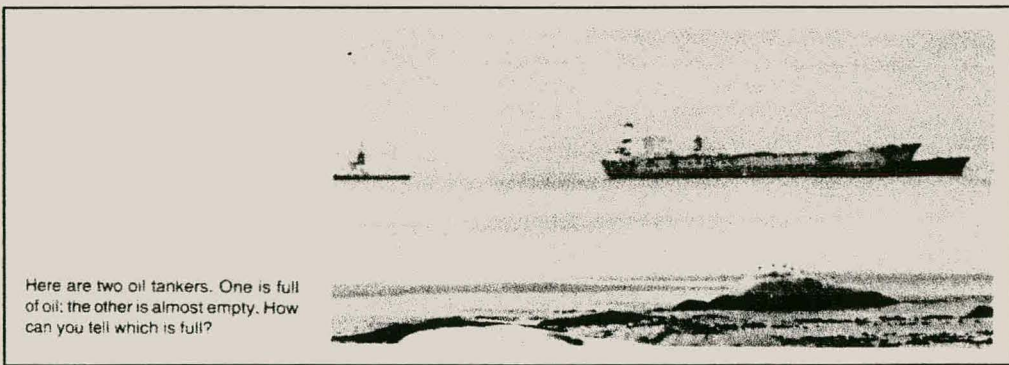
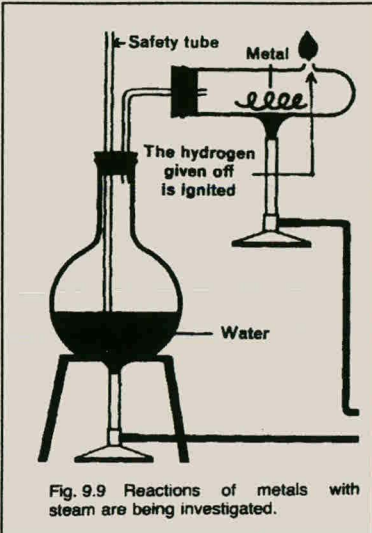
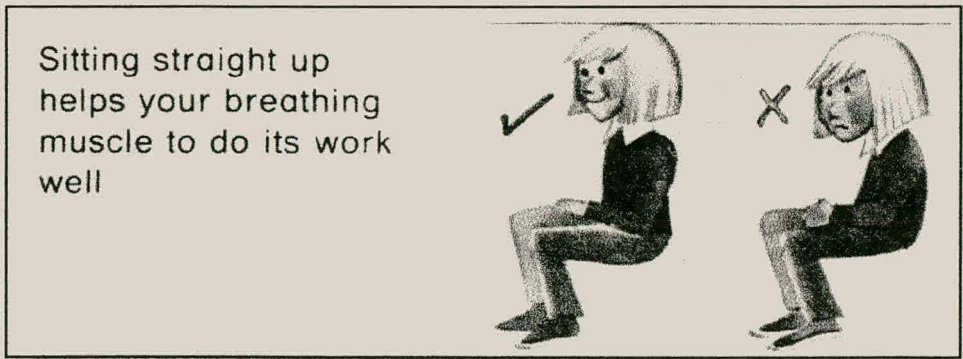
<p>Requirement C IS IT READABLE?</p>	<p>The reading value of a picture is determined by variables in the picture content. Picture readability is used as a term to describe the picture's ability to be read and comprehended by its intended market. A picture's readability is also determined by the picture variables that make up the picture content (Pettersson, 1993:160). The main criteria here would be to judge whether a picture could be interpreted by the learner. A complex medical illustration could prove to be unreadable for primary school children; similarly, a cartoon and a humorous medical illustration could possibly be ignored by university medical students.</p> <p>The picture on the right, taken from Clarke and Thoka (1992:25), suffers from poor readability because the flask of water is drawn in three dimensions whilst the rest of the illustration is in two dimensions. The neck of the flask, and how and where the clamp is attached to the flask, is unclear.</p>	
<p>Requirement D IS IT LEGIBLE?</p>	<p>This segment refers to the quality of the physical execution and duplication of a picture. Photographs where necessary detail is lost due to poor reproduction, or pictures which are too small, are typical examples of poor legibility. The picture below (Clarke and Thoka, 1993:40) suffers from poor legibility in that the second ship, protruding from behind the larger ship on the right, is dark and is difficult to distinguish from the foreground. The smaller ship on the left also creates confusion.</p>	

TABLE 4.3 (continued)

Guidelines for interpreting the six decision-making segments in Figure 4.17.

<p>Requirement E</p> <p>ARE THERE GRAPHIC / VERBAL CUES ?</p>	<p>Graphic cues can increase the facilitating value of a picture. Colour, arrows, labels and other graphic cues can emphasise a portion mentioned in the text, draw attention to specific detail in a picture or instruct the reader to take a certain course of action (Levie and Lentz, 1982; Peeck, 1993 and 1994; Beck, 1984).</p> <p>A picture's facilitating effect, however, will not necessarily increase in a linear manner if the graphic cues are increased. The picture on the right (Du P. Brink and Jones, 1985:120) is a good example of a picture with a descriptive label, labels in the picture and an arrow with a label, describing what is happening in the experiment.</p>	 <p>Fig. 9.9 Reactions of metals with steam are being investigated.</p>
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<p>Requirement F</p> <p>WHAT TYPE OF PICTURE IS USED</p>	<p>Pictures can have varying facilitating effects based on the function that they fulfil in the text. The different types of pictures and the functions that they fulfil are fully discussed in Section 2.3, a taxonomy of pictures in text. The decision here would be to assign to pictures that explain a process or an activity, a higher value than pictures, which merely repeat (representational pictures) information in the text (Mayer, 1993). The picture below, from (Taute and Monsingh, 1995), is an example of a representational picture with graphic cues (the ✓ and the ✕).</p>
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4.8 A CONCLUDING RESEARCH STATEMENT ON THE RESULTS AND CONCLUSIONS OF THIS STUDY

This study investigated the use of pictures in picture-text learning material and the value of culturally modifying pictures in such material to increase the facilitating effect of the pictures in the text. Pictures in the context of this study are images that support and repeat the text and which are used in union with the text. Pictures with an attentive and mood-creating function, for example in political, marketing and propaganda material, are excluded. Text in the context of this study is information presented in printed form that a learner can master without the assistance of pictures. Learners in the context of this study are persons who have the verbal skill to read and understand instructional text material that is written for their level.

Sociocultural variables in text and in pictures play an important role in picture-text learning material when such material is aimed at learners from developing communities. These variables become less important when the subjects move towards an urbanised, developed and heterogeneous community. Cultural appropriateness in pictures can affect the congeniality of picture-text learning material, but does not contribute on a cognitive level to the value of picture-text learning material. Inappropriate cultural conventions in text and pictures, however, can create a barrier to communication and thereby affect the cognitive value of such learning material. These last two sentences appear to be in conflict with each other. They can be synthesised by stating that inappropriate cultural conventions can distract from the general learning process and that appropriate cultural conventions will not distract from the learning, as opposed to assisting learning.

The picture facilitating effect is a function of interacting text, picture, learner, and environmental and assessment variables. These interacting variables can be presented in a model, which in turn can predict and explain the picture facilitating effect. The picture facilitating effect is robust in that it can be achieved with a variety of learners, text, pictures, media, and learning conditions. It is at the same time sensitive to identifiable and sometimes unknown variables that diminish or nullify the picture facilitating effect. The extent of the picture facilitating effect can be augmented through the addition of known picture, text and learning variables that facilitate learning. A learner-centred theory for the picture facilitation process accounts for the instructional designer, the design process of the message, the picture-text message, the medium, the assessment process, and an individual learner's decoding and encoding abilities.

4.9 A SUMMARY OF CHAPTER 4

This chapter contains the recommendations and conclusion of the study and consists of eight sections.

The first section draws conclusions from the literature study. Thirteen conclusions are drawn that are related to the picture facilitating process, research results reported by the empirical literature, research methods in this field, and the use of pictures and picture-text learning material by subjects from developing communities.

The second section draws conclusions from Experiments 1 – 5. These conclusions are given in the form of seven generalisations. The research hypothesis, in terms of the first five experiments, is partially rejected in favour of the alternative hypothesis. There was only a preference for modified pictures in the fifth experiment, and modified pictures did not increase the picture facilitating effect more than pictures that were not modified. Both the modified and unmodified pictures, however, assisted subjects in Experiments 2, 3 and 5 to recall steps in a procedure, and assisted subjects in Experiment 4 to recall relatively more information over a period of seven days than a text-only group.

The third section draws conclusions from Experiments 6a – 6c. These conclusions are presented as seven generalisations and three hypothetical conjectures. The research hypothesis, in terms of these last three experiments, is partially rejected in favour of the alternative hypothesis. Subjects showed a preference for modified pictures, but only if they were forced to choose between modified and unmodified pictures. The modified pictures did not help the subjects with recall or problem-solving skills more than the unmodified pictures. One picture that showed a cross-section of the fire extinguisher and which was used with the text, however, assisted subjects in Experiment 6b to recall relatively more information over a period of ten days than all the other groups. This phenomenon is explained in terms of the stimulus generalisation theory, which states that learning is improved when the test situation is similar to the learning situation.

The fourth section proposed a learner-centred theory for the picture facilitating effect. The purpose of this proposed theory and its model is to accentuate the central position of the learner in the learning process when the learning material consists of picture and text components. This study investigated the effect of culturally modified pictures when they are combined with printed educational text, with the focus on the learner in terms of recall, problem-solving skills, and comprehension of information in picture-text instructional material.

The fifth section proposes guidelines for the design and development of picture-text learning material for subjects from developed and developing communities. These

guidelines are graphically illustrated in a flow chart to assist with the decision-making process during the development of picture-text instructional material.

The sixth section recommends an instrument as a model that instructional designers could use for the analysis of pictures in picture-text instructional material. This instrument, in the form of a flowchart, can be used for classifying pictures in educational text as pictures that have no potential to facilitate learning, through to pictures that have a high potential to facilitate learning.

The seventh section provides a concluding statement on the results and conclusions of this study.

The last section is this section, the summary of Chapter 4.

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CHAPTER 5

A MODEL FOR THE EXPLANATION AND PREDICTION OF PICTORIAL LEARNING FACILITATION IN PICTURE-TEXT LEARNING MATERIAL

5.1 INTRODUCTORY COMMENTS

This chapter provides a model for the explanation and prediction of pictorial learning facilitation in picture-text learning material. The model consists of interrelated constructs, comprising the explanatory theories for the efficacy of picture-text material, factors that influence the picture facilitating effect, observations from empirical work, previously mentioned models, and hypothetical conjectures derived from the study.

The theories that explain picture facilitation and the factors that affect picture facilitation are discussed in Chapter 2, the empirical work is presented in Chapter 3, and the inferences or deductions and the hypothetical conjectures are presented in Chapter 4.

The development of this model will follow an inductive process whereby observations (experimental results) and the explanatory conjectures and conclusions developed from these observations will provide theoretical constructs, which in a composite arrangement will provide the analytical model for the evaluation and prediction of the picture facilitating effect in picture-text learning material.

There are four sections to this chapter. The first section presents the components that are required for the construction of a model. The second section presents the model and two variations of the model. The third section provides an application of the model so as to provide an example of the working of the model. The fourth section is a summary of Chapter 5.

5.2 THE COMPONENTS THAT ARE REQUIRED FOR THE CONSTRUCTION OF THE MODEL

Several components are required before a theoretical model with a graphic structure can be created. Section 5.2 will present these components, namely:

- A theoretical proposition of the model.
- The operational definitions of the terms used in the model.
- The constructs for the proposed model.
- A utility rectangle for estimating and allocating ordinal values to a picture-text relationship.
- A matrix to assign these ordinal values.
- A graphic representation and an explanation of the constructs.

The last section will assemble the model from the above components and will provide the same model in two alternative graphic and textual structures.

The dimensional values in the model and the graphic sections of the models are ordinal measurements and values and do not represent a comparative value or measurement with interval or ratio properties. The reasons for using an ordinal measure for the model are as follows:

The potential benefit that learners can derive from pictures when they are added to text material will only become evident if the extent of the benefit is measured in a comparative learning situation. These measurements are more reliable in experimental conditions than in a real-life classroom condition due to the control measures available in experimental designs. These measurements are at the same time regulated by the reliability and sensitivity of the measuring instrument in the experiment. The ideal situation would be to measure the extent of a certain variable in a comparative picture-text experiment and then to generalise the extent of this effect to a wider population in a real-life situation. Differences between experimental and real-life learning situations, however, make it difficult to predict the actual quantitative value of such picture-text learning material in a real-life situation. Circumstances in real-life learning situations can help a learner to master some learning material without pictures just as effectively as the learner who uses material with appropriate pictures. Some examples are the teacher, the learner's

peers, and additional time allotted to a learner to master the learning material. The assessment tests that are used to determine the outcome of picture-text material in experimental conditions are primarily designed to measure the cognitive value of a picture or elements in a picture in a short period, rather than a whole section of learning material that a learner must master over a longer period. Experimental conditions, however, constitute a learning environment where extraneous variables can be controlled. The model, therefore, makes use of ordinal values.

The model that is presented in Figure 5.13 (p. 393) is an abstract graphic figure that can be used for the explanation and prediction of pictorial learning facilitation in picture-text learning material. This model can also be used for the evaluation of current and intended picture-text learning material.

5.2.1 The theoretical proposition for the model

The relative effectiveness of pictures in picture-text learning material is, in part, a function of interrelating processes between text, pictures, learners, assessment tests, the learning objective and the learning environment.

5.2.2 The operational definitions of the terms used in the model

The concept of effectiveness in the context of the proposed model is limited to the recall and comprehension of the information presented in the picture-text material. Recall of information does not imply that a learner understands the information presented in the text and pictures. He or she might be able to name certain parts of a mechanical device, but at the same time might not understand the function of the device or the function of such a part. Comprehension of the information implies a wider meaning than just the recall of information. A learner must not only understand the concepts and processes presented in the learning material, but must also be able to deduce solutions for a problem that is associated with, or related to, the given learning material. The learner must have an understanding of the practical application of the knowledge gained from the learning material. The concept “relative” is a quantifiable, measurable and comparative concept with reference to the same text but without picture support. The word picture in the “picture-text”

context signifies a picture that has a specific picture function, for example to repeat the same information that is represented in the text, but which plays a secondary role to the text in the learning material. An illustration of a brake system would support the text that describes the working of the system. A cross-section of an internal combustion engine from a vehicle workshop manual is normally supported by text and labels, rather than the illustration supporting the text. A picture that supports text, and a picture that must be supported by text, are given as examples in Plate 5.1 and Plate 5.2. The remaining operational terms in the proposition are attended to in the discussion of the augmented constructs.

PLATE 5.1

An example of a picture that supplements text
(Automobile Association, 1986:203).

PLATE 5.2

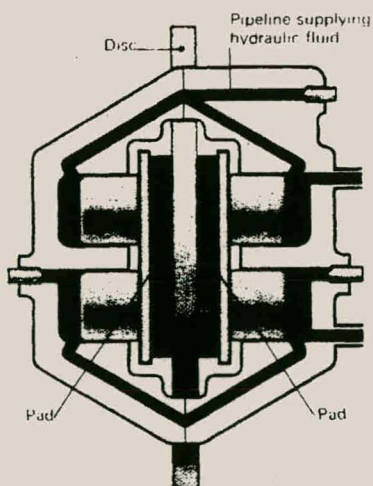
An example of a picture that needs the support of text to explain its parts.
The text appeared on a page facing the illustration.
(Morris Motors Limited, 1954:A4)

The four-piston caliper

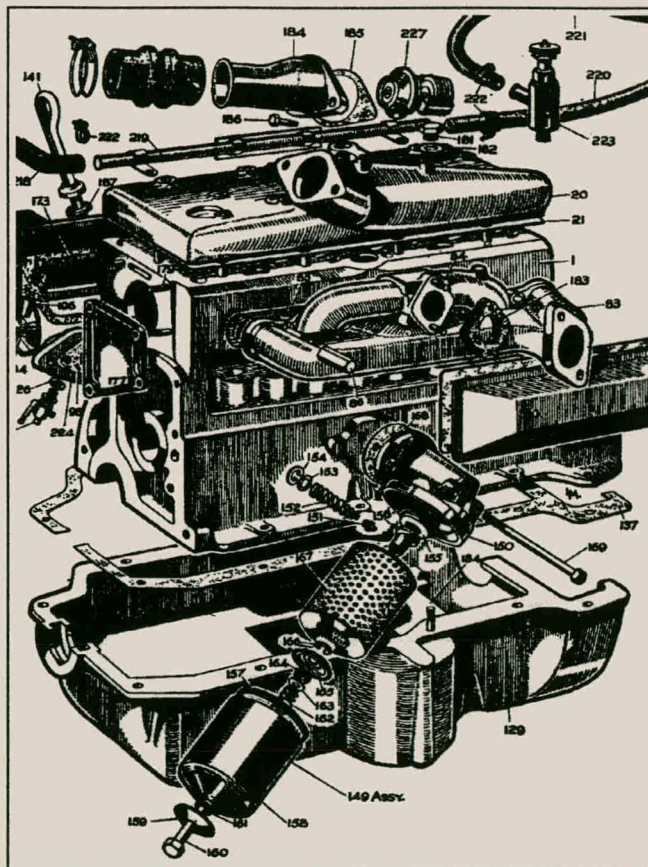
ONE FORM of disc brake uses two single-piston cylinders. The hydraulic fluid which operates them is fed directly to one cylinder and linked to the other by a bridge pipe. A variation of this has fluid fed to both cylinders through a passage in the caliper casting.

The pistons in a disc-brake caliper are made of steel and are plated on their outer cylindrical surface with a hard coating to resist wear and corrosion.

To limit the amount of heat transmitted from the disc through to the fluid the



The four-piston caliper Two pistons on each side of the disc exert greater braking pressure. The upper pistons work independently of the lower, providing a 'fail safe' system.



5.2.3 The constructs for the proposed model

The word “construct” was defined in the first chapter as a concept that has been intentionally adopted for this study and which has a wider meaning than the word “concept” (*Vide.* p.25). It is the construction or the ordering of an idea through the synthesis of several related elements, terms or factors. Several constructs form the basis for the construction of the proposed model in this chapter. The constructs in this section augment (support/increase) the concepts in the theoretical proposition as stated in Section 5.2.1 (*Vide.* p. 373).

Construct number 1

The basis for picture facilitation is a function of the relationship between text and pictures. The stronger the relationship, the larger the potential picture facilitating effect.

Construct number 2

The potential picture facilitating effect is actualised¹ by the learner. The measure of facilitation is, in part, a function of the learner characteristics².

Construct number 3

The level of achievement with picture-text material is not only regulated by the learner and by the strength of the picture and the text variables, but is also a function of the learner's relationship with the text-picture relationship.

Construct number 4

The observable extent of picture facilitation is a function of assessment tests and learning objectives.

Construct number 5

Picture facilitation is not only a function of assessment tests, learning objectives, text, pictures and a learner, but is also affected by the relationships between these elements.

Construct number 6

The picture facilitating effect operates within a specifically defined learning environment³.

¹ The potential effect is realised or experienced by the learner and then demonstrated or shown by the learner as an increase in learning.

² Individuals' reading, verbal and reasoning abilities affect how they would utilise pictures.

³ The subject's learning environment is a function of his/her past experience, socio-economic-cultural conditions, level of urbanisation, level of exposure to Western culture, level of verbal literacy and level of visual literacy.

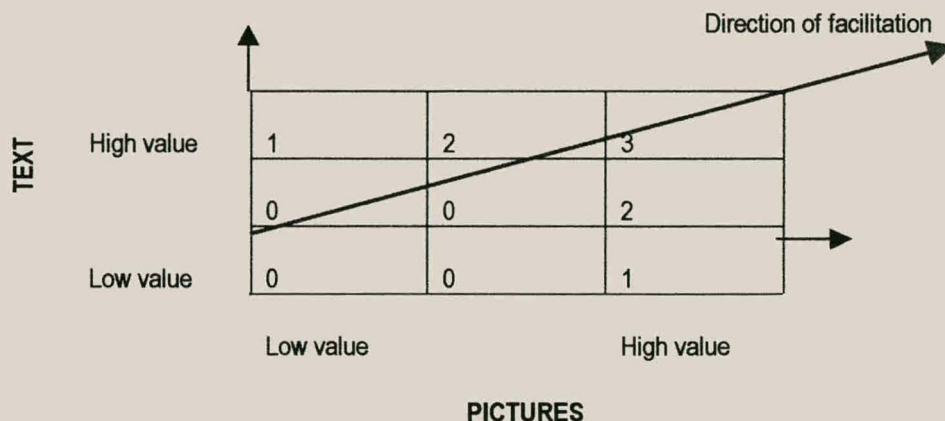
5.2.4 A utility rectangle for estimating and allocating ordinal values to a picture-text relationship

A proposed utility rectangle is given in Figure 5.1 and can be used to measure variables in picture-text learning conditions. This rectangle is based upon the concept of Pettersson (1993:161), who provided a utility/originality rectangle and a legibility/reading rectangle as two instruments to measure picture properties.

Five variables are present in picture-text learning conditions, namely the text, the pictures, the learner, the learning objective, assessment, and interfering and facilitating factors. These variables interact with each other and are capable of adding or deducting from the facilitating effect. A utility value rectangle for the interaction between pictures and text is as follows:

FIGURE 5.1

A utility rectangle for assigning values to interacting variables in picture-text learning conditions.



A value of 2 is obtained when, for example, a representative picture, which has a facilitating value between low and high, is combined with explanative text which has an inherently high value. A technical illustration of a mechanical device, with labels and cues that explain the working of the device, has high value when it supports explanative text on the device, resulting in a value of 3.

5.2.5 A matrix for appointing values to variables that are present in picture-text learning conditions

Reports on experimental hypothesis-testing research with picture-text material provide probability values and effect sizes as interval measurements to give an idea of the magnitude of the dependent variable under investigation. These values reflect experimental results and might not show the same magnitude or direction of effect in a real-life classroom situation. Extraneous variables and the interactive process between the text, the learners and their learning condition, to name but a few, could alter the expected outcome in a real-life classroom situation. Some form of measurement, indicating direction and size, at least on an ordinal scale, is necessary to construct a graphic model and to make the model practically useful. The matrix as given in Figure 5.2 enables the portrayal of interacting variables in picture-text material as ordinal values. It is proposed that a differential scale with values of 0 – 3, with the assistance of the utility rectangle in the previous section, should be used to allocate a value to each cell. The value of 0 would represent no interaction, the value of 3 a higher interaction.

FIGURE 5.2

A matrix for allocating values to interacting variables in picture-text learning conditions.

	Text	Pictures	Learner	Assessment
Pictures	1			
Learner	2	3		
Assessment	4	5	6	
Learning objective	7	8	9	10

- 1 = the interactive value between text and pictures obtained by the utility rectangle
- 2 = the interactive value between text and learner obtained by the utility rectangle
- 3 = the interactive value between learner and pictures obtained by the utility rectangle
- 4 = the interactive value between text and assessment obtained by the utility rectangle
- 5 = the interactive value between pictures and assessment obtained by the utility rectangle
- 6 = the interactive value between learner and assessment obtained by the utility rectangle
- 7 = the interactive value between text and learning objective obtained by the utility rectangle
- 8 = the interactive value between pictures and learning objective obtained by the utility rectangle
- 9 = the interactive value between learner and learning objective obtained by the utility rectangle
- 10 = the interactive value between assessment and learning objective obtained by the utility rectangle

5.2.6 A graphic representation and an explanation of the constructs

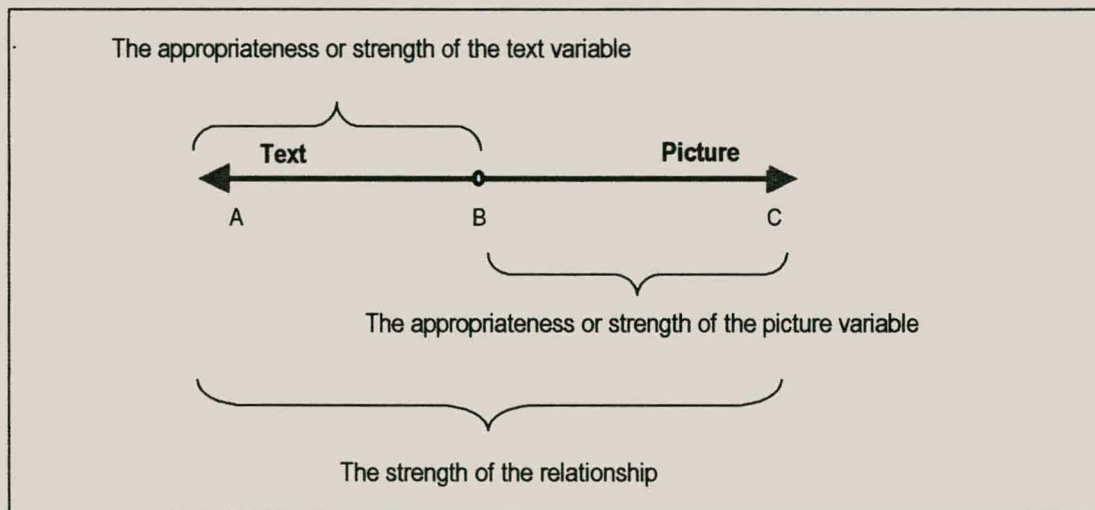
Construct number 1

The basis for picture facilitation is a function of the relationship between text and pictures. The stronger the relationship, the larger the potential picture facilitating effect.

The horizontal line ABC in Figure 5.3 represents the interaction between text and pictures, in terms of the model, with text variables represented at one terminal and picture variables at the other terminal. Both terminals originate from a mid-point, with the length of each half-axis determined by the appropriateness or strength of each variable. The total length of line AB represents the strength of their relationship.

FIGURE 5.3

A graphic representation of the relationship between text and pictures to form the basis for picture facilitation.



The relative length of line AB and line BC can be determined by the criteria presented in Table 2.5 (*Vide.* p 98) and in Addendum 2 (*Vide.* p. 122). Text that is explanative in nature, for example, (Mayer, 1993), and text that contains cause-and-effect information (Mayer and Gallini, 1990; Mayer, 1989 and 1993), will result in a longer AB line and will provide a stronger relationship value between pictures and text. Pictures that relate poorly to the text, for example, will result in a shorter BC line and will decrease the strength of the relationship between pictures and text.

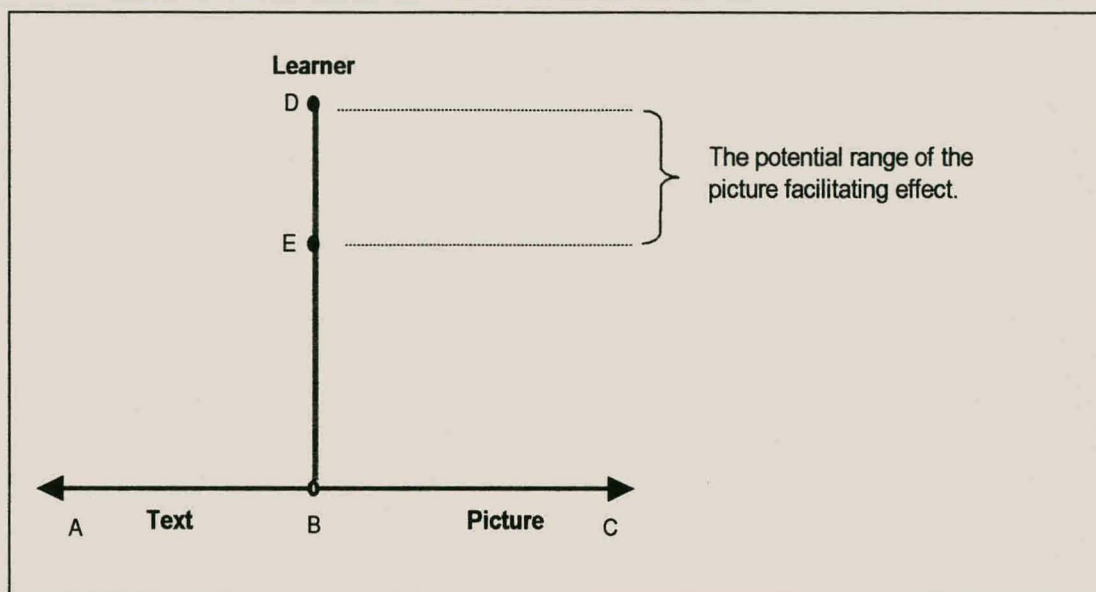
Construct number 2

The potential picture facilitating effect is actualised by the learner. The measure of facilitation is, in part, a function of the learner characteristics.

The vertical line ED in Figure 5.4 represents, in terms of the model, the direction and range of picture facilitation that is possible for a specific learner. Point D represents the maximum learning that can be achieved with text-only and with picture-text material. Point E represents a level where no learning has taken place.

FIGURE 5.4

A graphic representation, in terms of the model, of the relationship between text, pictures and the learner.



Learners who receive picture-text material can, under ideal conditions, achieve the maximum benefit from the pictures and obtain an achievement level equivalent to point D. It is also possible for a learner to accomplish no learning at all as depicted by point E. This can happen when a learner does not have adequate word-recognition and word-decoding skills (Levin *et al.*, 1987) or when the message depicted in the picture is not recognisable by the learner (Holmes, 1968; Van Aswegen and Steyn, 1987).

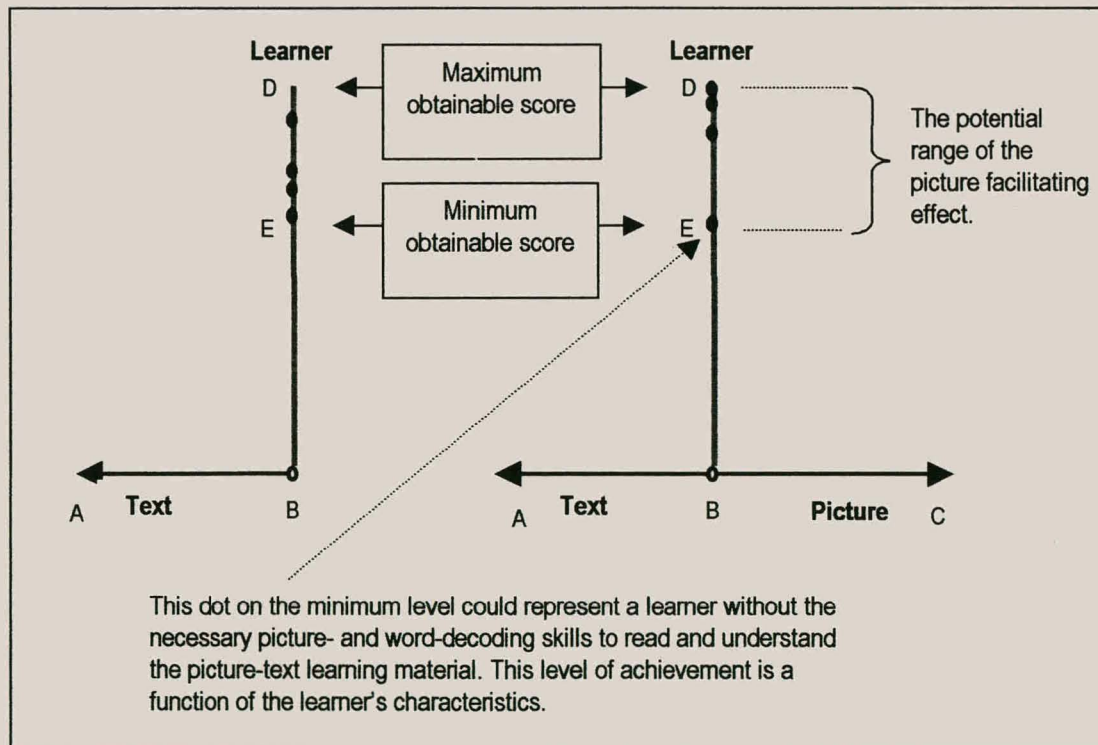
Individual learners who receive text-only material can also obtain an achievement level equivalent to D, as they can extract all the necessary information from the text. Text-only learners, however, are more likely to obtain a mean score that is below the maximum mean score of the picture-text group if the variables to promote picture facilitation create an environment conducive to this effect.

Points A, C, and D graphically portray the relationship between the text, the pictures, and the learner. The extent of the upper terminal of the triangle depicts the maximum level of picture facilitation or learning that can be achieved.

A hypothetical example of the achievement scores of four picture-text learners and four text-only learners under ideal experimental conditions is portrayed in Figure 5.5.

FIGURE 5.5

A hypothetical example of the achievement scores of text-only and picture-text learners depicted as dots on the learner axis.



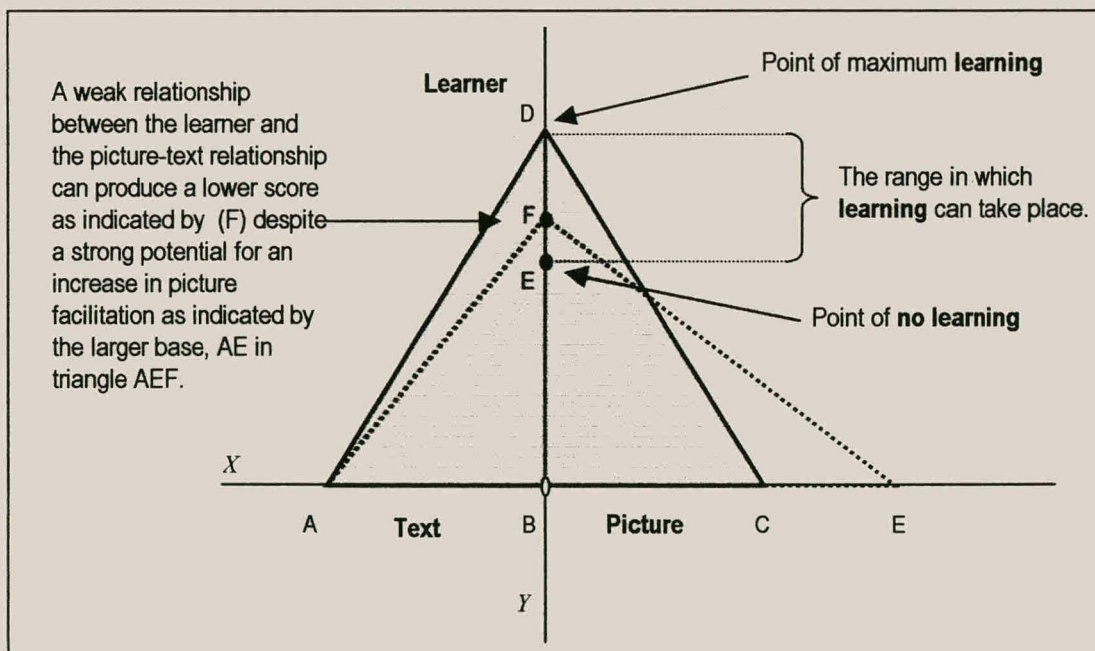
Construct number 3

The level of achievement with picture-text material is not only regulated by the learner and by the strength of the picture and the text variables, but is also a function of the learner's relationship with the text-picture relationship.

The relationship between the text, the pictures and the learner, in terms of the model, can be represented by a triangle. This triangle will be referred to as the *Facilitation Triangle* for future discussions. This triangle is a combination of the first two constructs. The shape and size of the *Facilitation Triangle* is determined, amongst other things, not only by the strength of the text and picture variables and by the learner's ability, but also by the strength of the relationship between the text-picture variable and the learner. Such a triangle can be placed on an X-Y axis for positional reference and is given in Figure 5.6.

FIGURE 5.6

A graphic representation, in terms of the model, of the relationship between text, pictures and the learner, and the relationship between these three variables.



The picture variables, indicated by line BE in *Facilitating Triangle AEF* are stronger than the picture variable BC in *Facilitating Triangle ACD*. *Facilitating Triangle AEF* therefore has a larger base and should theoretically be able to produce a score that is higher than the facilitating score of *Facilitating Triangle*

ACD. The learner's relationship with the picture-text variables in *Facilitating Triangle* AEF is, however, weaker than the learner's relationship with the text-picture relationship in ACD, resulting in a maximum obtainable score of F.

A typical example would be where the combination of a latent message in text and its corresponding picture is not understood, resulting in an achievement score that is lower than what a learner could have scored if he or she understood the text and picture. A learner must understand messages in pictures and in the text before pictures in picture-text material will show a facilitating effect (Holmes, 1968; Van Aswegen and Steyn, 1987).

An example of the combination of the first three constructs is given in Figure 5.7.

This example is a combination of the first three constructs. The example is hypothetical and for illustration purposes only. The two illustrations are used to portray the learning results of text-only material compared to the facilitating effect of pictures in picture-text material, as well as how the learner, text and picture variables can influence the outcome of the facilitating effect.

FIGURE 5.7 (Illustration 1)

An example to demonstrate the relationship between text and pictures.

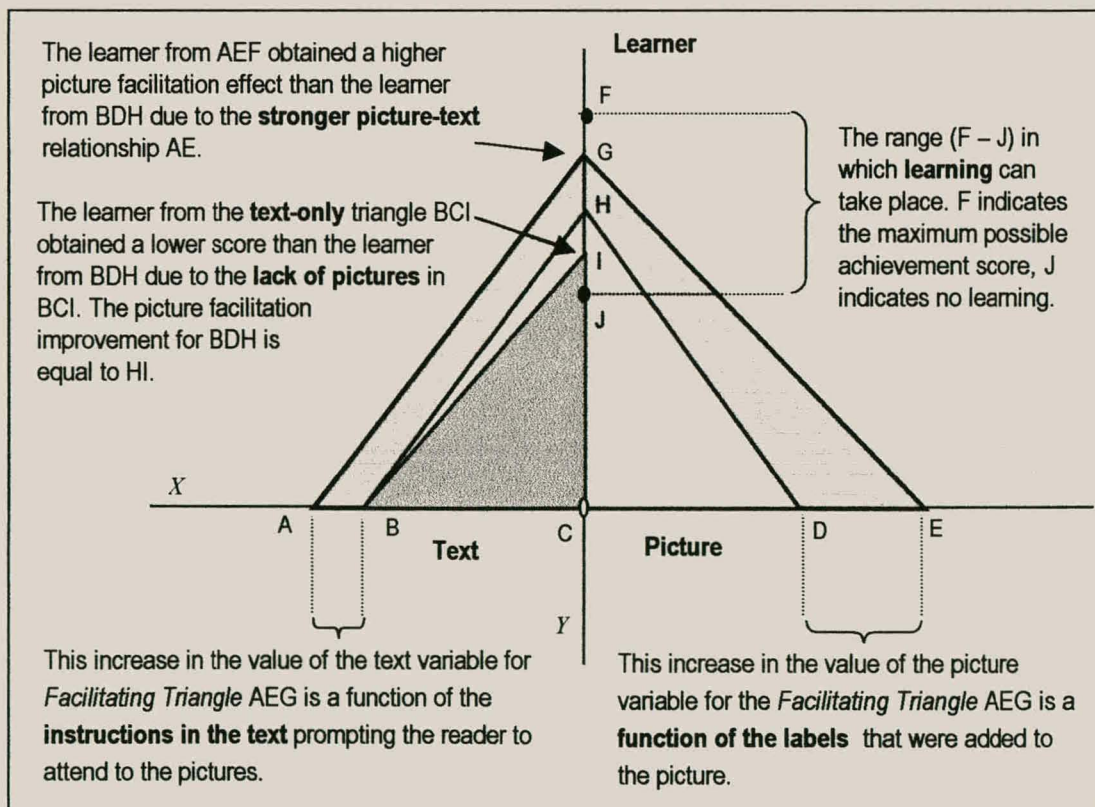
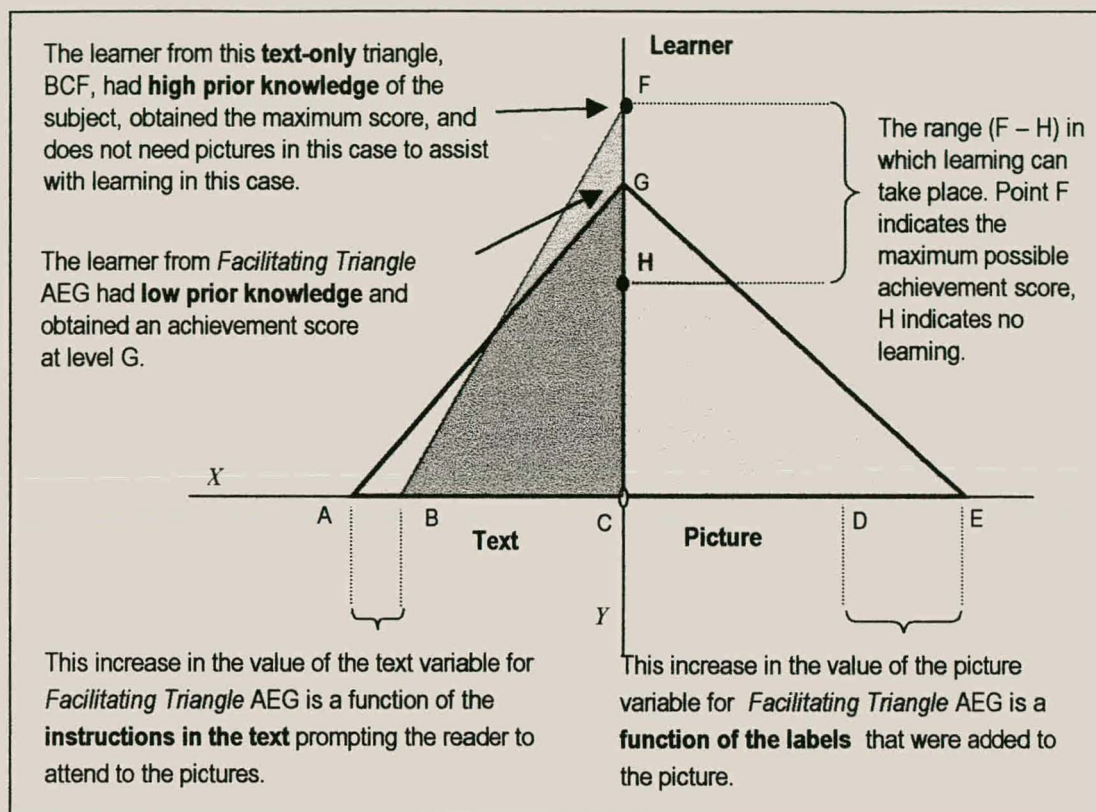


FIGURE 5.8 (Illustration 2)

An example to demonstrate the regulatory effect of the learner on the picture-text relationship.



Comments on Illustration 1

Illustration 1 is an example of where an increase in the picture-text relationship contributes to an increase in the facilitation effect.

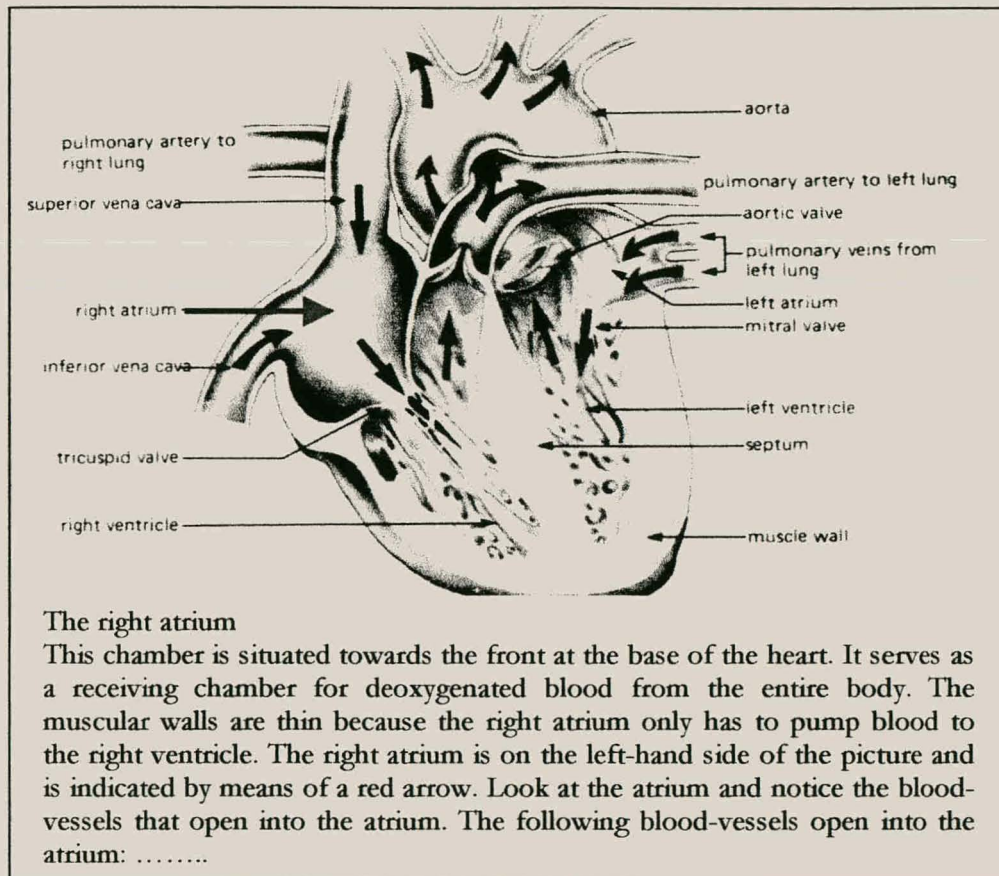
Comments on Illustration 2

Text about the human heart, illustrated with a cross-section of the heart, and with instructions in the text directing the reader to attend to the illustration, could result in the blue *Facilitating Triangle* AEG if, for example, a primary-school child is the subject. A strong relationship exists between the picture and the text (indicated by the length of AE) by virtue of the type of text and the type of illustration, resulting in a learning effect of GH. If the same text material, minus the instructions to attend to the picture, is given to a medical student, the result might be triangle BCF. The medical student will experience the text as easy and will have sufficient prior knowledge of the subject. An example of a picture of a heart, accompanying labels and an instruction to attend to a part of the picture is given in Plate 5.3 on the next page. Text that is difficult to comprehend or difficult to recall, but not

beyond the grasp of the learner, will benefit from the inclusion of pictures (Beck, 1983; Peeck, 1993). Medical students will clearly find text on the human heart easy to recall and comprehend and might not benefit as much from the picture as the primary school children.

PLATE 5.3

An example of a picture with accompanying labels and an instruction to attend to a part of the picture.



The above picture of the heart and the text has been adapted from Du P. Du Toit, Van Rensburg, Du Toit, Botha, Van der Merwe, Volschenk, Van der Westhuizen, De Kock and Niebuhr (1985:218).

The picture facilitating effect that can materialise is determined by the picture-text relationship and by the learner. The individual factors that affect picture facilitation, for example the addition of labels to pictures, the addition of instructions to attend to the picture, and low prior knowledge of the learners, to name but a few, are fully discussed in Chapter 2, Section 2.6 (*Vide.* p. 60 - 83).

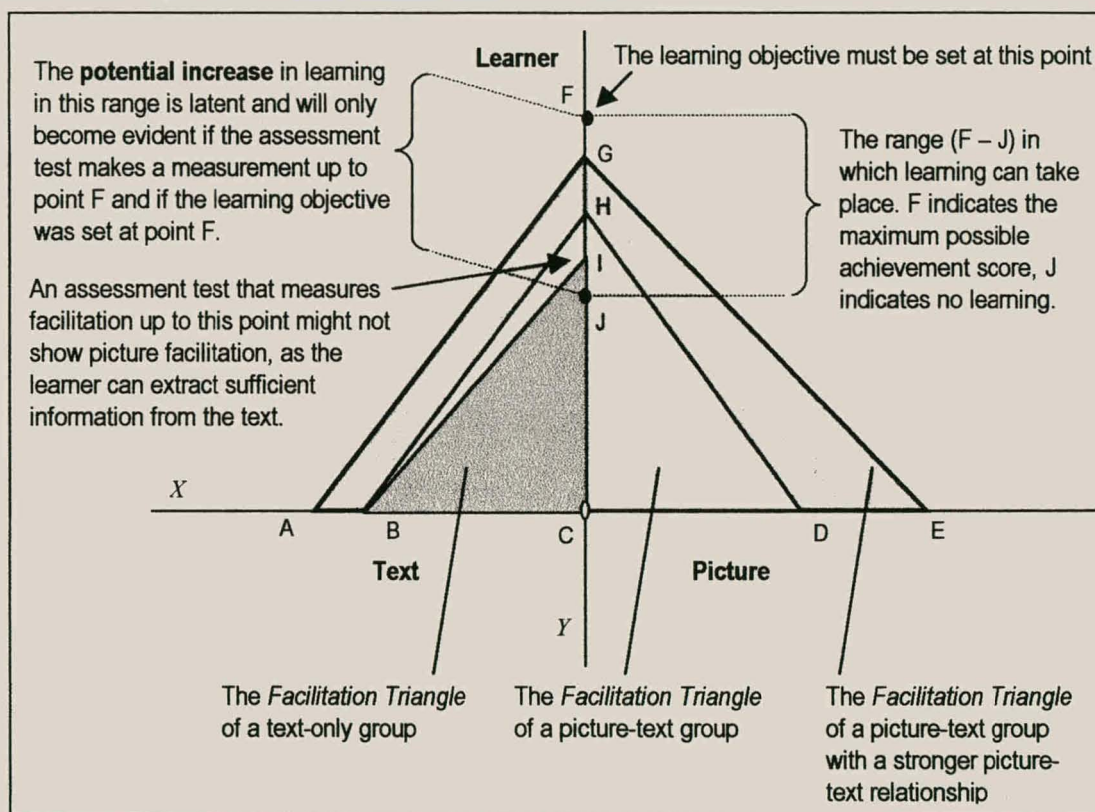
Construct number 4

The observable extent of picture facilitation is a function of assessment tests and learning objectives.

The term “observable” in terms of this construct refers to the increase in learning that can be measured in an assessment test. This construct is illustrated in Figure 5.9.

FIGURE 5.9

A graphic representation, in terms of the model, as to how the measurable extent of the picture facilitation is determined by the assessment test and learning objective.



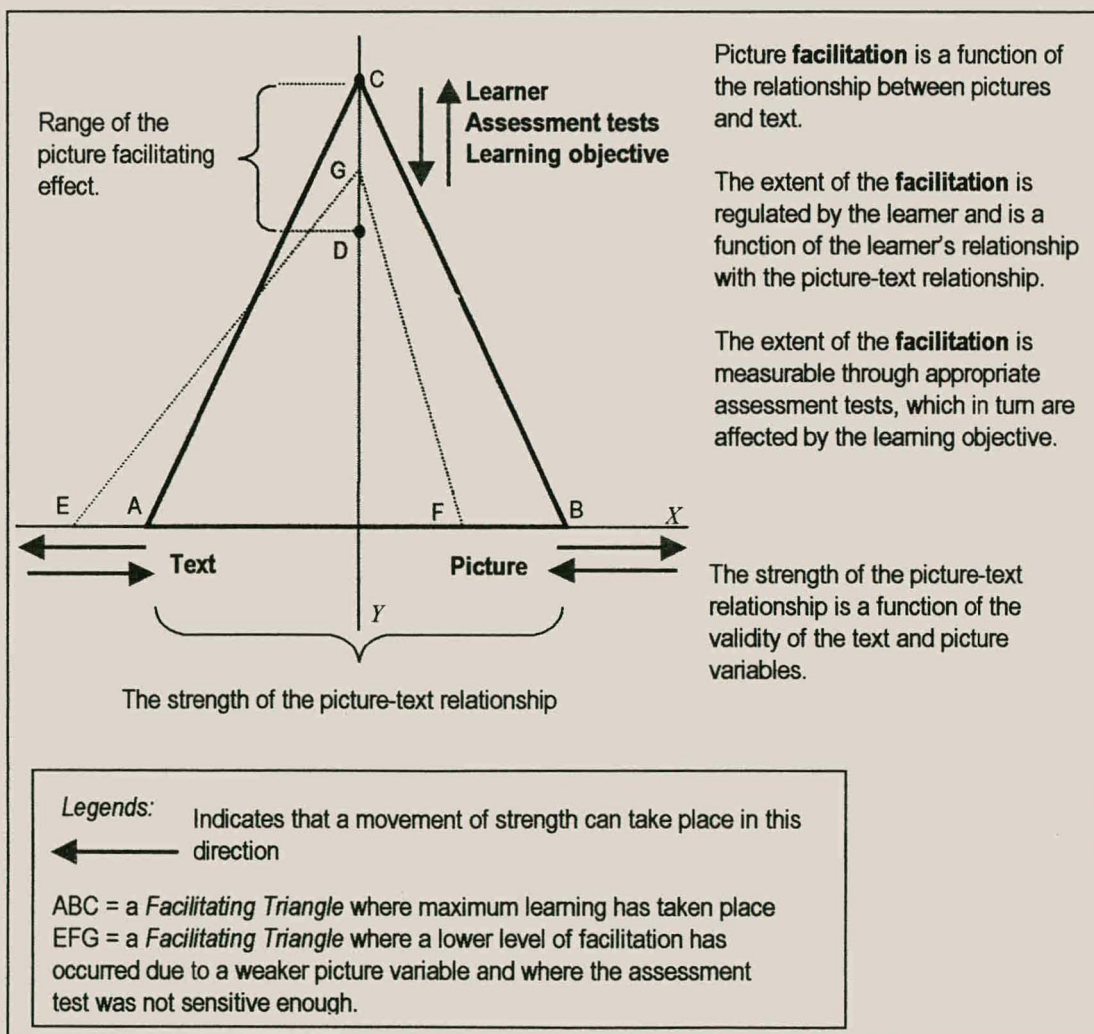
The word “latent” or “hidden” is used to indicate the picture facilitating effect in the above construct, as the effect can only become evident if it is revealed by a post-test, and only in a comparative test with the same text material but without the pictures.

Assessment tests or post-tests must be appropriate before the picture facilitating effect becomes observable. The post-test must test for items that were presented in the pictures and in the text, and must have internal validity (Mayer, 1993). Learners who memorise the different parts of the human heart with the aid of picture-text material, for example, and who are then tested on the working of the human heart, could show no benefit from the pictures in the learning material. Learners must be informed of the learning objective, while the assessment test must test the objective and must be sensitive enough to measure the facilitation effect before picture facilitation becomes observable.

A simplified example of the combination of the first four constructs is given in Figure 5.10.

FIGURE 5.10

A simplified illustration of the first four constructs.



The example on the previous page is a simplified combination of elements from the first four constructs. The example is hypothetical and for illustration purposes only. Picture facilitation is possible where there is an appropriate relationship between text and pictures. The extent of facilitation is not only regulated in part by the learner, but is also a function of the assessment tests and learning objectives.

The following illustration, with reference to the previous four constructs, is presented in a simplified form. The purpose of Figure 5.10 is to present a retrospective summation of the earlier proposed constructs and to act as an advance organiser for the ensuing model and constructs.

Construct number 5

Picture facilitation is not only a function of assessment tests, learning objectives, text, pictures and a learner, but is also affected by the relationships between these elements.

Interaction between the learner and pictures in one event, and interaction between the learner and text in the second event can affect picture facilitation. The inward or outward movement of two planes of the *Facilitating Triangle* adjoining the Y-axis depicts these changes in picture facilitation. This is illustrated in Figure 5.11 on the next page.

Some learners require more time to recognise and interpret pictures when elements in the pictures are unfamiliar (Holmes, 1968). A learning situation where limited time is available to master the material will in effect reduce the strength of the picture variable, thereby reducing the strength of the picture-text relationship in the *Facilitating Triangle*. However, the reduction in the strength of the picture variable is in this instance, a function of the learner and not of the picture. The right-hand plane of the *Facilitating Triangle* therefore moves from CB to DE. The original point of achievement on the Y-axis moves from C to D. Another example is where individuals experience difficulty in interpreting pictures that have different cultural conventions than those to which they are accustomed (Hudson, 1960; Deregowski and Bentley, 1986). Movement, sequence in pictures and perspective are some Western conventions that could create a restricting interaction between the learner and the pictures. This could move the plane of the *Facilitating Triangle* to a new position.

Construct number 6

The picture facilitating effect operates within a specific learning environment.

The previous constructs showed that pictures, text and learners, as well as the interaction between these elements, influence the shape, size, and lateral movement of the *Facilitation Triangle*. The observable facilitation effect is a function of the learning objective and the assessment test. Achievement scores for a group would fall in a cluster around and on the Y-axis, below and including the maximum possible facilitation effect. The region where facilitation takes place and where it can be measured is situated in the upper section of the *Facilitating Triangle*. This construct will show how the learning environment could cause a movement of the *Facilitation Triangle*, thereby affecting the picture facilitating effect.

The macro-environment of the model contains social, economic, cultural and didactical elements. These elements in the learner's environment can assist or distract the learner and can thus affect any of the elements or combination of elements that play a role in the picture facilitation process.

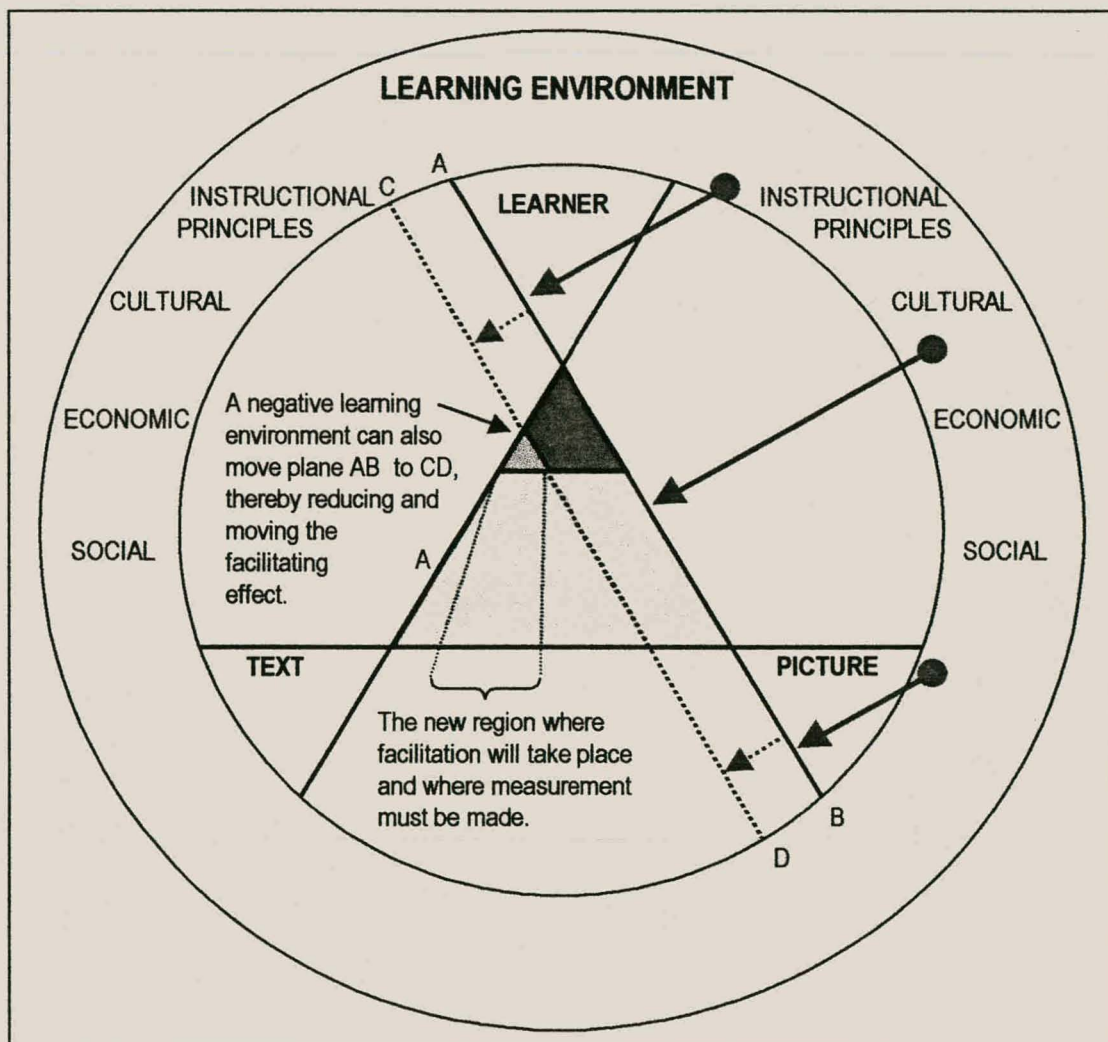
A poor socio-economic and culturally unfamiliar environment, for example, might contribute to learners having difficulty in correctly interpreting elements in a picture (Ajayi-Dopemu, 1982; Van Aswegen and Steyn, 1987; Tzeng and Trung, 1990) and could also contribute to the learner's difficulty in reading and understanding the text. The result could translate into low achievement scores even for those individual learners who could have obtained higher achievement scores if they were in a better environment. No facilitation can take place despite the potential of picture facilitation by nature of the text-picture material and appropriate assessment tests. A subject's interpretation of picture messages is influenced by his/her past experience, his/her social, economic and cultural environment, his/her level of urban influence, his/her level of exposure to Western culture, and his/her level of visual and verbal literacy (Spaulding, 1956; Winter, 1963; Duncan *et al.*, 1973; Cook, 1980b; Ajayi-Dopemu, 1982; Ausburn and Ausburn, 1983; Goldsmith, 1986; Van Aswegen and Steyn, 1987; Cripwell, 1989; Tzeng and Trung, 1990; Hugo and Skibbe, 1991 and 1994; Peeck, 1993).

A positive learning environment, for example, where the learner is exposed to visual and other learning stimuli, where there is sufficient time to study a given task, and where learners have been taught to provide a description for themselves during learning (Kunen and Duncan, 1983), could cause an improvement in achievement scores regardless of the presence or absence of pictures. This improvement will not only be for the learners who are exposed to the picture-text

material, but also for those learners exposed to text-only material. Such a condition could cause an effect where there will be no significant difference between the achievement scores of groups that receive either picture-text material or text-only material. An upward or downward movement of one or both of the planes that connect the picture and learner terminal, and the text and learner terminals that are adjacent to the Y-axis, can graphically illustrate this assistance or distraction process. A shift of one or more of these line or planes will change the position of the *Facilitation Triangle*, which affects its maximum achievement point and which will reduce the potential size or range of the facilitation effect. This is demonstrated in Figure 5.12.

FIGURE 5.12

A graphic representation of how elements in the learning environment could affect the size and range of the Facilitating Triangle.



5.3 THE MODEL FOR THE EXPLANATION AND PREDICTION OF PICTORIAL LEARNING FACILITATION IN PICTURE-TEXT LEARNING MATERIAL

This section provides the model for the explanation and prediction of pictorial learning facilitation in picture-text learning material.

The introductory section of Chapter 5 stated that several components are required before a theoretical model with a graphic structure can be created. These components were presented in the previous section and consisted of:

- A theoretical proposition of the model.
- The operational definitions of the terms used in the model.
- Six constructs for the proposed model.
- A utility rectangle for estimating and allocating ordinal values to a picture-text relationship.
- A matrix to assign these ordinal values.
- An explanation and a graphic illustration of the six constructs.

The graphic illustrations clarified concepts in the constructs and showed how these constructs combine towards the final model.

This section assembled the model from the above components. The proposed model for the explanation and prediction of picture-text learning material is given later in this section in Figure 5.13.

The previous ten figures and six constructs provided explanations and graphic examples for the picture facilitating phenomena that could occur in picture-text learning material. These constructs are combined to form a graphic model that endeavours to explain and predict the picture facilitating effect in learning material. This graphic model is a visualised construct or idea of the factors that influence picture facilitation, the theories for the efficacy of picture-text material, and observations and hypothetical conjectures derived from this study.

Hugo (1997:276) proposed a model for message appropriateness in health education within a multicultural developing community. The three central cornerstones in Hugo's model are health education, appropriate media usage, and sociocultural sensitivity. These three elements give rise to three secondary elements, namely communication, media-acculturation, and contextualisation. The community, the family and the individual are placed in the centre of Hugo's model and become the primary focus of health education messages.

The model presented in Figure 5.13 uses a triangular shape as its principal and central graphic modelling component, similar to the design concept of Hugo's

model (Hugo, 1997). This shape enables the portrayal of movement at each of the three terminals and the three sides. Models in educational technology traditionally appear to make use of flow charts and models constructed on an X-Y axis (Pettersson, 1993:161-163) or cells in different arrays (Goldsmith, 1984:126).

The upper section in the *Facilitation Triangle* (presented as a red triangle in Figures 5.11 and 5.12) was arbitrarily chosen as the central component in the model. It represents and replaces the *Facilitation Triangle* region and allows a better graphic display of the concepts explained in the final model. The *Facilitation Triangle* in the final model is thus replaced with “FACILITATING EFFECT” as the focus of the model. This facilitating effect represents the picture learning facilitation.

The concepts “Learning objective” and “Assessment tests” are included beneath the segment “LEARNER” to indicate that these two elements can influence the facilitating effect. An assessment test that measures comprehension when the learning objective was to memorise factual elements in educational text will not show facilitation and will place pressure on the upper terminal of the red FACILITATING TRIANGLE, forcing it downwards and predicting low or no picture learning facilitation.

The instructional principles and the economic, cultural and social elements indicated in the LEARNING ENVIRONMENT of the model influence the LEARNER, the LEARNER-PICTURE INTERACTION and the LEARNER-TEXT INTERACTION segments of the model, whilst it is just the “instructional principles and economic elements” in the LEARNING ENVIRONMENT that influence the TEXT, the TEXT-PICTURE RELATIONSHIP and the PICTURE segments of the model. Lack of funds, for example, might prevent the production of picture-text material in colour, thereby removing the potential benefit of colour cueing practices in the text and the pictures. The cultural element in the learning environment is that area where the learner’s culture could act as a screen and affect his/her interpretation of the message or the picture when inappropriate cultural elements are present in the picture. It is here where it is appropriate to culturally modify a picture or, as stated by Schiffman (1996:67), to visually translate the material for a specific population.

The model operates within the field of instructional communication. All the segments of the model are exposed to the influence of communication and instructional principles.

The model is presented in Figure 5.13 on the next page.

A graphic variation of the model for the explanation and prediction of pictorial learning facilitation in picture-text learning material is presented in Figure 5.14 on the next page.

The graphic structure of the model consists of circles and ovals that contain the same segments that appear in the original graphic structure of the model. The solid arrows indicate the direction of influence from one segment to another segment. The broken arrows denote an interaction between two segments of the model, forming a third segment. The broken line around the red FACILITATING EFFECT globule in the center of the model indicates that the facilitating effect can increase or decrease. This dimensional change is a function of any of the segments, in unison or as individual elements.

The purpose of presenting the model in a different graphic array is to present the explanation for pictorial learning facilitation from a more familiar graphic perspective. The first graphic structure of the model as presented in Figure 5.13 is, however, more appropriate for predicting pictorial learning facilitation. A triangular shape has six defined points (three planes and three terminals) that can be manipulated on an ordinal level. In this way the effect of one segment on the facilitating effect can be more accurately predicted.

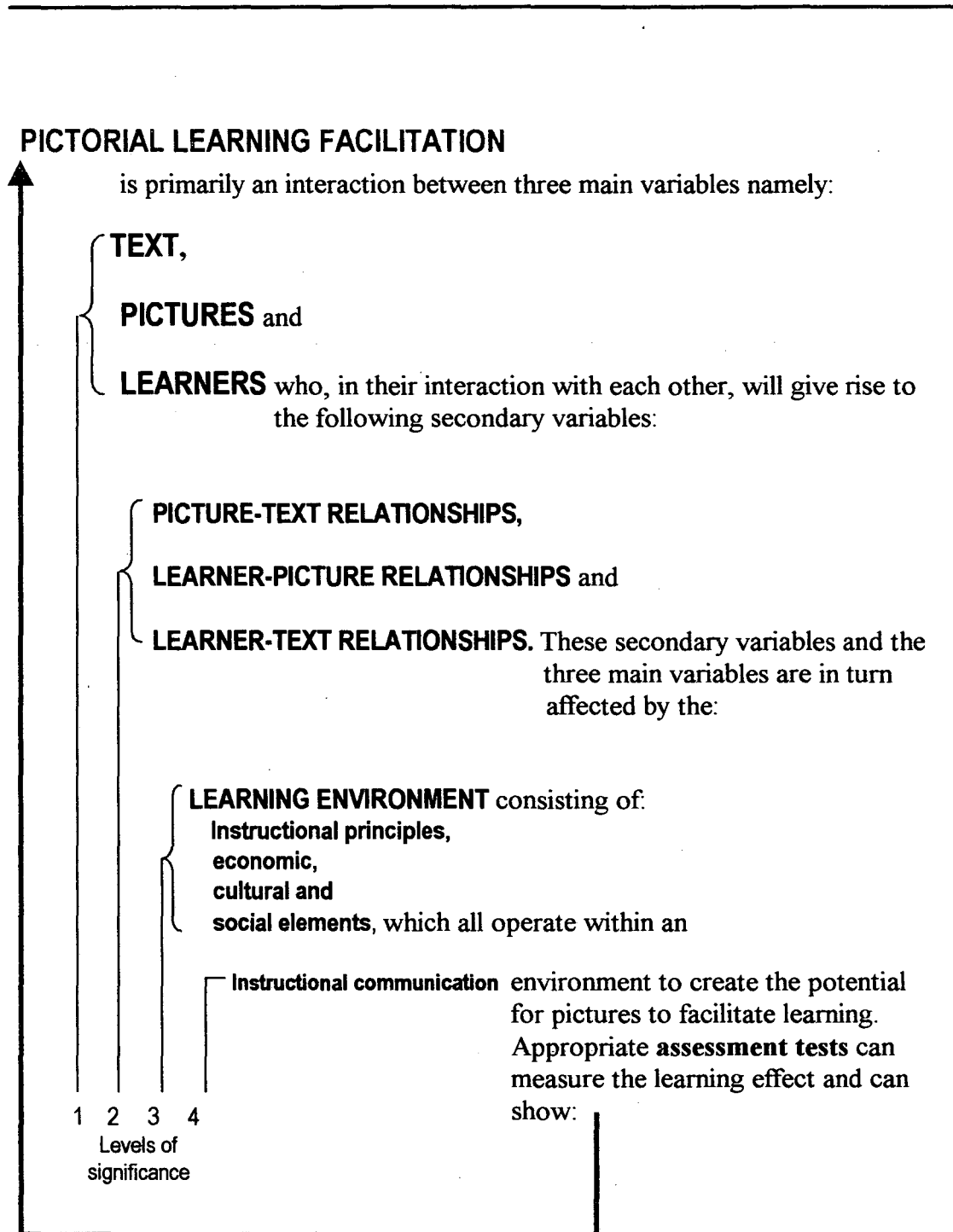
A third variation of the model in the form of a textual discourse is presented as a flow chart in Figure 5.15 (p. 396). This model is limited in that it cannot explain the magnitude of pictorial learning facilitation, nor can it portray the effect of different elements on the facilitating effect.

The value of this model is that it presents the different elements (text, pictures, learners, learning environment, etc.) in the levels in which they affect pictorial learning facilitation, as well as the process that takes place to produce the learning effect from pictures.

Figure 5.14 is presented on the next page and Figure 5.15 on the page thereafter.

FIGURE 5.15

A variation of the model for the explanation and prediction of pictorial learning facilitation in picture-text learning material in the form of a textual flowchart discourse.



5.4 THE APPLICATION OF THE MODEL

The purpose of the model that was presented in the previous section is to predict and explain pictorial learning facilitation. A triangular shape was used as the main graphic component of the model, as there are six areas that can be manipulated to show the influence of different elements on the facilitating effect in the model.

One of the experimental results will be explained with the aid of the model:

The Grade 9 peri-urban subjects of Experiment 6a (*Vide.* p. 174 - 203) who received one picture with their text scored significantly better in the delayed test than the text-only or control group. The equivalent Grade 11 group, however, did not score better than their control group. This “one picture” was a cross-section illustration of a fire extinguisher with corresponding labels. The delayed post-test provided the pupils with the same drawing and requested the pupils to select the correct answer (multiple choice) for all the parts of the fire extinguisher. The subjects’ learning environment was similar, and the conditions at the school, the learning material, the procedures and the evaluation procedures were kept constant under experimental conditions. The text, the pictures, and the text-picture relationship were also unchanged.

One possible explanation for the results of the Grade 9 subjects is the “stimulus generalisation theory”, which states that learning is improved when the test situation is similar to the learning situation. The main stimulus in the test and in the learning situation that was the same, was the picture. Different labels indicated the different parts of the fire extinguisher during the learning period. These same names were repeated (in multiple-choice form) in the assessment test seven days later. The text, but to a lesser degree, was also a stimulus in the test and learning situation that remained the same.

Projecting the results of the Grade 9 and Grade 11 subjects (relative to their respective control groups) into the model could show the following:

- * The horizontal length of the text-picture relationship for both groups will remain constant, as the text and picture were the same for both groups. (the basis of the red *Facilitating Effect Triangle* stays the same).
- * The upper terminal of the red *Facilitating Effect Triangle* will be relatively higher for the Grade 9 subjects than the Grade 11 subjects (the Grade 9 text and

one-picture group scored significantly better than their control group, while the Grade 11 subjects did not).

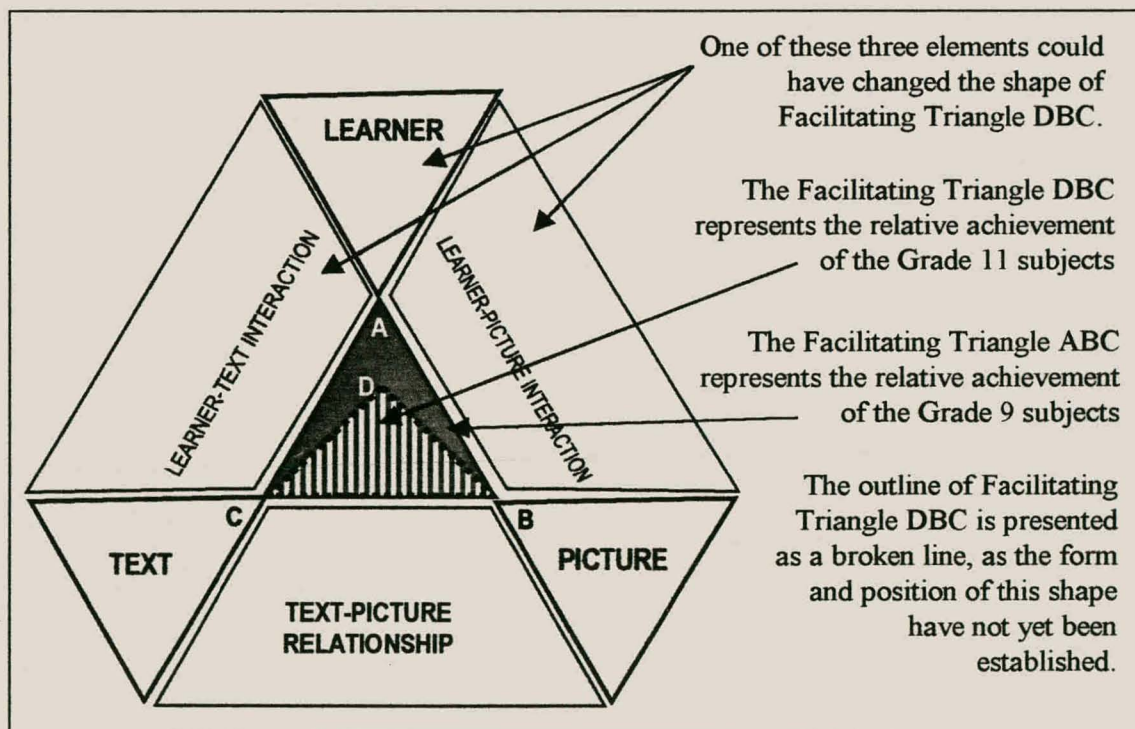
* The “*Learning Environment*” was the same for both groups. The effect or lack of effect of the elements in the environment (social, cultural, economic, learning principles) was the same for all the subjects. This element can thus be removed as a possible explanation for the results of the Grade 11 subjects when viewed against their Grade 9 counterparts.

* It is therefore only the “*Learner*”, “*Learner-text Relationship*” and “*Learner-picture Relationship*” elements in the model that could have changed the shape of the “*Facilitating Triangle*” that represents the results of the Grade 11 subjects. The shape of the triangle is such that the assessment test could not measure a facilitation effect for the Grade 11 subjects.

The position of the above arguments and deductions, as well as the Grade 9 and Grade 11 results, are presented as a part-model in Figure 5.16 to illustrate and visualise the explanation of the working of the model up to this stage.

FIGURE 5.16

A part of the model providing a partial explanation for some of the results of Experiment 6a.



It must be pointed out that both the modified and the unmodified picture groups of the Grade 9 and the Grade 11 subjects did not score significantly better than their respective control groups. A possible explanation for this is that the subjects focussed more on the text to extract information during the learning session, pointing to a weak relationship between these learners and the picture used in the experiment. The “*Learner-picture Relationship*” element is therefore possibly responsible for changing the shape of the “*Facilitating Triangle*” for these groups to such an extent that an assessment test was not able to measure pictorial learning facilitation.

The Grade 11 subjects from the “one-picture-and-text group” who were older and who had completed more years at school did not seem to have derived benefit from the picture in the delayed post-test. These “age” and “years of schooling” are elements that fall in the “*Learner*” element of the model. The reason that was stated in the preceding paragraph and the reason presented at the beginning of this paragraph lead one to deduce that a combination of the “*Learner*” element and the “*Learner-picture Relationship*” element in the model changed the shape of the “*Facilitating Effect Triangle*” of the Grade 11 subjects. It is now possible to project a more accurate shape of the *Facilitating Triangle* representing the Grade 11 subjects than what was projected in the previous figure. This is given in Figure 5.17 on the next page.

The “*stimulus generalisation theory*” will not be realised if there is no relationship between the test and learning situation by means of the same stimuli. A weak relationship between the learner and the picture (ineffective picture processing) will create a break in the relationship between the test and learning situation and will weaken the potential benefit of pictures in a learning situation. The preceding arguments therefore pose a possible explanation as to why the Grade 11 subjects did not show pictorial learning facilitation despite the prediction that it should have occurred.

The explanation, in terms of the model, is that the Grade 11 learners (one-picture-and-text group) did not establish a relationship with the picture that they received with their text and were therefore not able to benefit from the picture in the delayed post-test. Characteristics unique to the Grade 11 subjects affected their

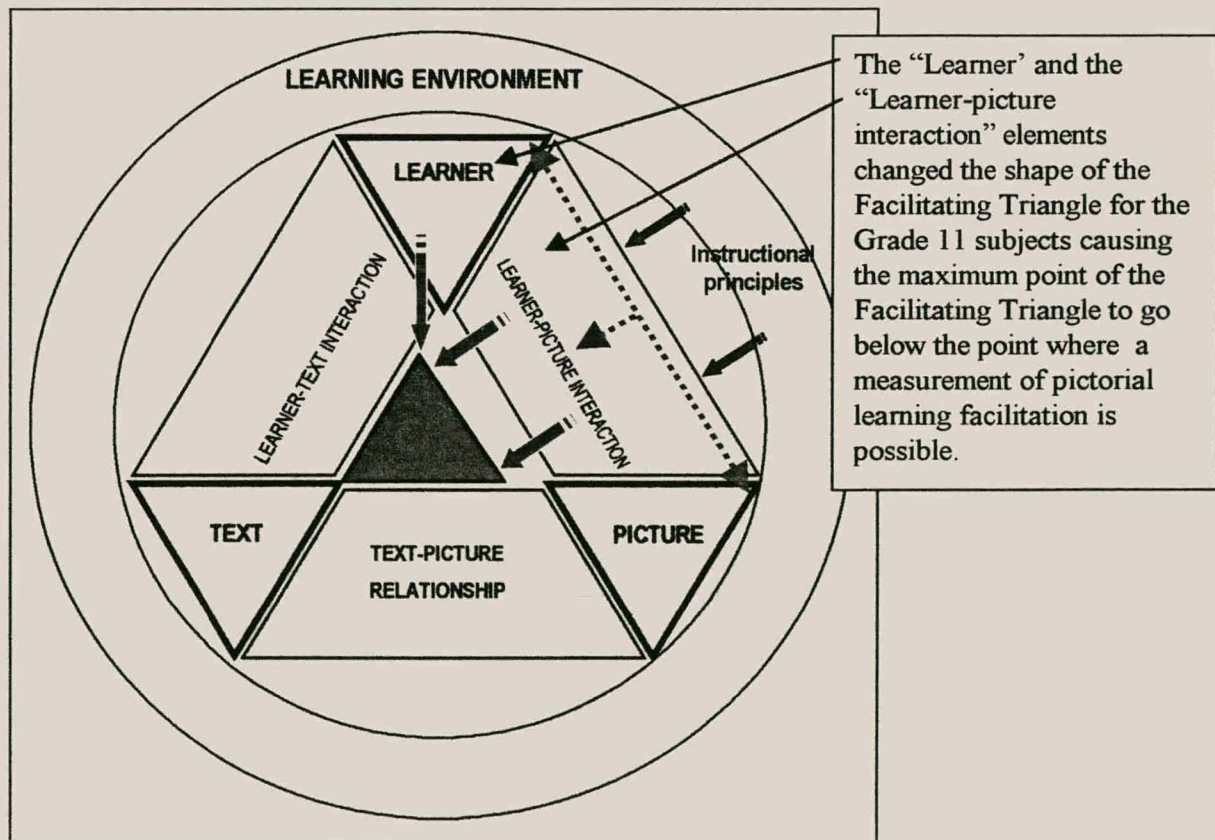
learning objective, which in turn neutralised the potential benefit of the picture in their learning material.

The solution, in terms of the model, would be to develop an instructional strategy whereby the “*Learner-picture Relationship*” can be strengthened by specifically instructing the learners to attend to the pictures and by demonstrating how to make use of the picture for learning purposes.

A possible explanation, in terms of the model, for the result of the Grade 11 (one-picture-and-text group) subjects is illustrated in Figure 5.17.

FIGURE 5.17

A possible explanation for the results of the peri-urban Grade 11 subjects in Experiment 6a.



5.5 A SUMMARY OF CHAPTER 5

This chapter provided a model for the explanation and prediction of pictorial learning facilitation in picture-text learning material. The development of this model followed an inductive process whereby observations during the empirical work, and the conclusions that were developed from these observations, provided six theoretical constructs which, as the main elements in a composite arrangement, provided the model.

The first section of the chapter presented the components that were required for the construction of a model, namely: a theoretical proposition of the model; the operational definitions of the terms used in the model; the constructs for the proposed model; a utility rectangle for estimating and allocating ordinal values to a picture-text relationship; a matrix to assign these ordinal values; and a graphic representation and explanation of the constructs. Each construct was illustrated with annotated diagrams.

The second section presented the model and two variations of the model. This graphic model is a visualised idea of the factors that influence picture facilitation, the theories for the efficacy of picture-text material, and observations and hypothetical conjectures derived from this study. The second variant of the model presented the explanation for pictorial learning facilitation from a more familiar graphic perspective. The third variant of the model presented the different elements (text, pictures, learners, learning environment, etc.) in a hierarchical format, in the levels in which they affect pictorial learning facilitation and in the process that takes place to produce picture learning facilitation.

The third section used the model to explain part of the results obtained in one experiment that was conducted for the empirical work.

CHAPTER 6

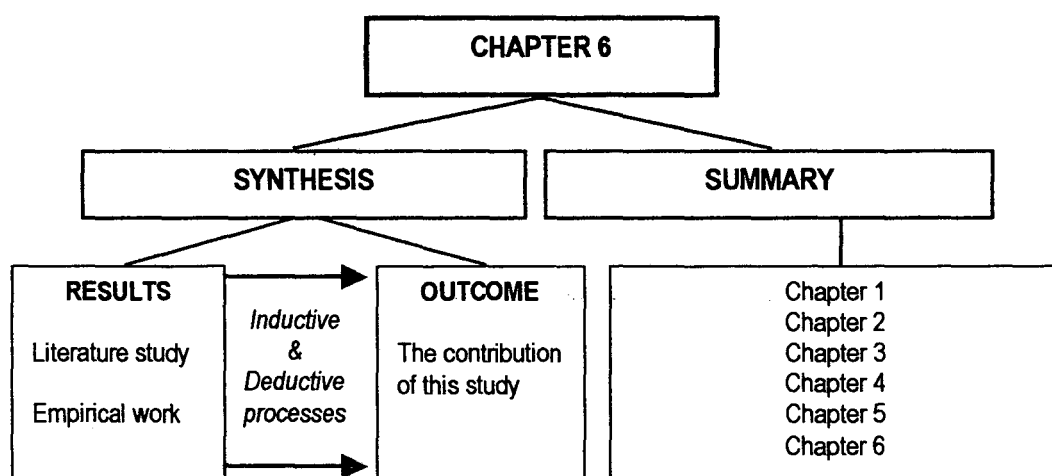
A SYNTHESIS AND A SUMMARY OF THE STUDY

This chapter is a synthesis and a summary of the thesis that was presented in the preceding five chapters. Synthesis in the context of this chapter denotes a brief outline of the **results** and **outcome** of the study, whilst the summary is a brief outline of the work that was presented in the first five chapters. The concepts “results” and “outcome” refer to two different and distinct events. Results are those issues that come about from the empirical work and the literature review. Outcomes are those issues that are presented as a contribution to the science of picture-text learning. The outcome of this study is a function of inductive and deductive processes based on the results of the literature study, and the results and conclusions from the empirical work.

There are two sections in this chapter: The first section is a synthesis of the results and outcome of the study, whilst the second section provides the summary. The relationship between the concepts “*synthesis*” and “*summary*” is graphically portrayed in Figure 6.1.

FIGURE 6.1

The relationship between “*synthesis*” and “*summary*”.



6.1 A SYNTHESIS OF THE STUDY

This section provides a brief account of the results and the outcomes of the research project. The aim of this section is to communicate the research project in a clear and concise manner, both verbally and graphically.

This study investigated whether culturally modifying pictures would increase the facilitating effect that pictures have when they are combined with instructional text. The research looked at the receivers' response to culturally modified pictures and comprised empirical work within a theoretical framework. This study took place within the field of educational technology and focused in particular on the facilitating effect that pictures have in instructional text within a developing community.

6.1.1 The results of the study

6.1.1.(a) *The results of the literature study*

The results of the literature study proposed a **four-tier functional-oriented taxonomy of pictures in educational text**, namely representative pictures, explanative pictures, organisational pictures and decorative pictures (Section 2.3, *Vide.* p. 45).

The literature study further identified **twenty-two factors that facilitate the educational effect of picture-text material** (Section 2.6, *Vide.* p. 76 - 78). These general factors can be grouped under four interrelating major categories, namely picture characteristics, instructional material and text content, learner characteristics, and evaluation methods.

In addition to the twenty-two facilitating factors, the study separated a further **ten factors that mainly influence the facilitating effect of pictures in instructional text aimed at developing communities** (Section 2.7, *Vide.* p. 89). These factors have wide generalisation possibilities.

The section on cross-cultural research, within the delimitation of this study, determined **nineteen variables that instructional designers must consider when designing picture-text material aimed at developing communities** (Section 2.9, *Vide.* p. 115 - 116).

The literature study also highlighted **nine theories that explain the picture facilitating effect** (Section 2.8, *Vide.* p. 100).

6.1.1.(b) The results of the empirical work

The results of the empirical work have indicated that **culturally modified pictures do not necessarily increase recall, comprehension or problem-solving abilities** more than instructional pictures that are not culturally sensitised or modified to their audience.

However, **subjects have shown that they prefer pictures that are modified to their own culture** (Sections 3.5.6; 3.6.5.(a); 3.7.5.(d); 3.8.5.(c)). Culturally appropriate and relevant graphic elements and conventions might not necessarily reveal measurable cognitive value, but are important elements in instructional picture-text learning materials that are specifically aimed at developing communities.

6.1.2 The outcomes of the study

The outcomes of the study are a function of inductive and deductive processes based on the results of the literature study and the results of the empirical work. These outcomes are regarded as the study's contribution to the science of picture-text learning.

6.1.2.(a) The outcomes as a model

The outcome of this study, as a contribution to the science of picture-text learning, is a model for the explanation and prediction of pictorial learning facilitation in picture-text learning material (Section 5.3). This model is also presented in two alternative graphic formats. The purpose of the one alternative model is to present the model in a more familiar graphic perspective. The purpose of the second alternative is to present the different elements (text, pictures, learners, learning environment, etc.) in a hierarchical format, in the levels in which they affect pictorial learning facilitation, and the process that takes place to produce the learning effect from pictures. It was indicated that the cultural element in the learning environment is an area where the learner's culture could act as a screen and affect his/her interpretation of the message or the picture when inappropriate cultural elements are present in the picture. A cultural modification process, or a visual translation process of pictures (Schiffman, 1996), is necessary in such a situation to rectify or counteract misinterpretation or the rejection of a picture in picture-text learning material.

Supporting this model are:

A utility rectangle for estimating and allocating ordinal values to a picture-text relationship (Section 5.2.4). This instrument can be used to allocate a value to a picture-text message within the context of picture-text learning material. This rectangle consists of a 3 x 3-cell array on an x - y axis. Pictures and text can be individually plotted on this rectangle according to their value to provide an estimated indication of the utility value of a picture-text message.

A matrix for appointing values to variables that are present in picture-text learning conditions (Section 5.2.5). This matrix enables the portrayal of interacting variables in picture-text material as ordinal values. The interacting variables, namely text, pictures, learners, learning objectives and assessment, are given in an opposing array of x - y cells. It is proposed that a differential scale with values of 0 – 3, with the assistance of the utility rectangle in the previous section, can be used to allocate a value to each cell. The value of 0 would represent no interaction, the value of 3 a higher interaction.

6.1.2.(b) *The outcome as a theory*

A learner-centred theory for the picture facilitating effect (Section 4.5.3). This theory is in addition to the model and proposes that the learner is the dominant factor in the picture facilitating effect and not picture factors, as is normally portrayed.

Supporting this model is:

A model for the learner-centred theory process of the picture facilitating effect (Figure 4.13). This model graphically represents the learner in a central position during the picture facilitating effect. The aim of the model is to present a model for the picture-text learning process where the learner or receiver is the focus of the model. The central position that the learner occupied in the experiments during the empirical work motivated the proposal of this theory and the subsequent model.

6.1.2. (c) The outcome as guidelines

The study also proposes, as an outcome, **guidelines for the design and development of picture-text learning material, recommended as seven consecutive steps** (Section 4.6.4, *Vide.* p. 358). These guidelines are presented as seven consecutive and practical steps.

These guidelines are supported by:

A **flowchart model**, which instructional designers can follow when they need to develop picture-text learning material (Figure 4.14, *Vide.* p. 360). This flowchart is aimed at developers of picture-text learning material, who aim their messages at learners both from developing and developed or urban communities. The steps in the flowchart model provide consecutive steps in a graphic format.

6.1.2. (d) The outcome as an analytical instrument

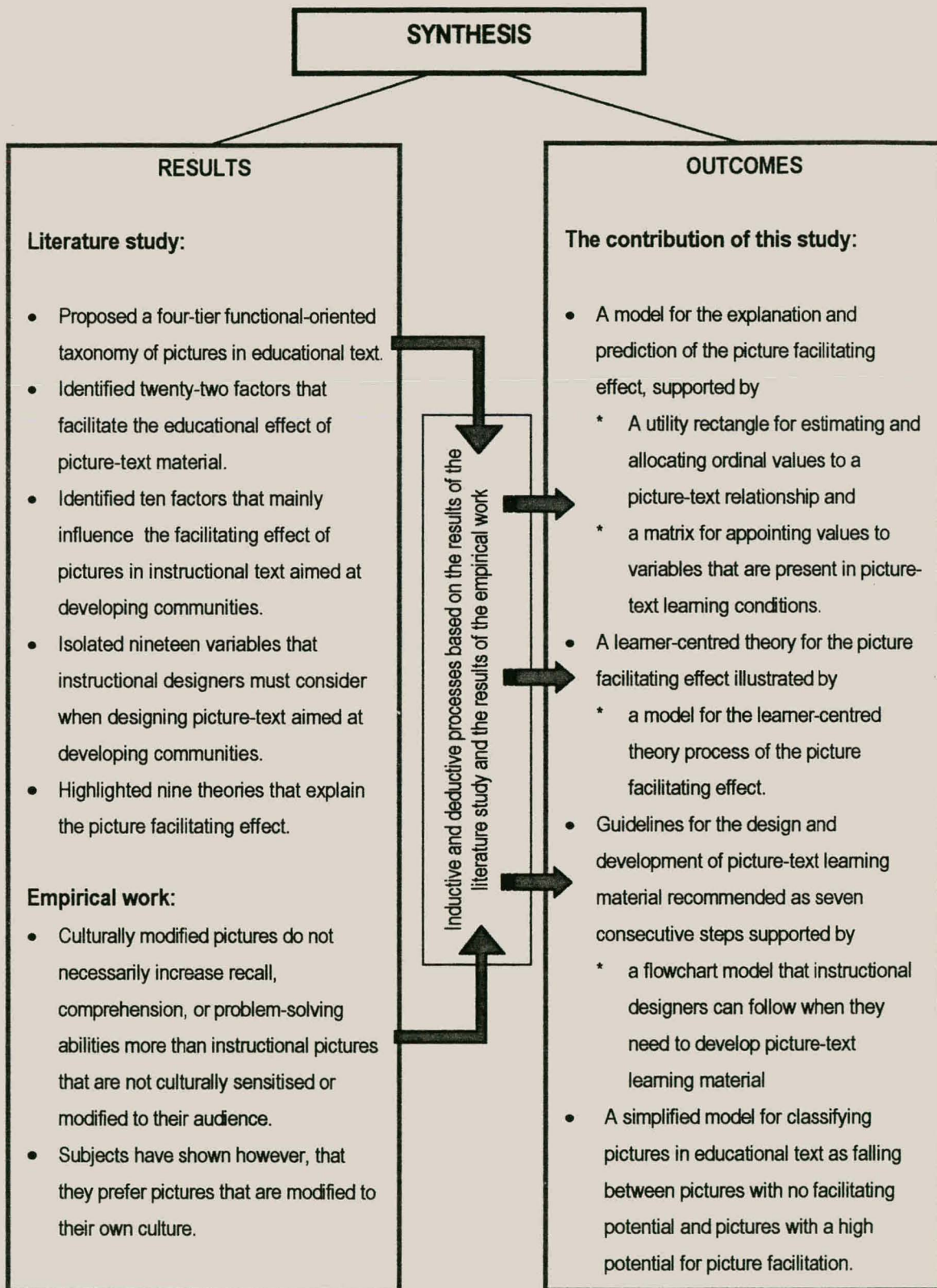
Also proposed as a practical instrument is a **simplified instrument for classifying pictures in educational text as falling between pictures with no facilitating potential and pictures with a high potential for facilitation** (Section 4.7, *Vide.* p. 361 - 367). The flowchart model is an instrument that instructional designers can use during a formative and evaluative research process of pictures in picture-text instructional material.

The synthesis of the study as a graphic representation and summary of the results and outcomes of the study is graphically portrayed in Figure 6.2 (p. 407). This figure shows how “Results” and “Outcomes” are related and how the results of the literature study and the results of the empirical work contributed towards the outcomes. There are five main results of the literature, two of the empirical work and four main outcomes of the study. This figure also acts as a graphic summary of the “Synthesis” section of Chapter 6.

Figure 6.2 is presented on the next page.

FIGURE 6.2

The synthesis of the study as a graphic representation and summary of the results and outcomes of the study.



6.2 A SUMMARY OF THE STUDY

The purpose of this section is to provide an overview of the work that was presented in this thesis. Particular details are supplied in the summaries at the end of each chapter and are therefore not given in this section. The thesis was divided into six chapters. Addenda, applicable to a particular chapter, were included at the end of each chapter. This section will repeat summaries or parts of summaries that were presented previously in the thesis.

6.2.1 A summary of Chapter 1

The first or introductory chapter provided a background to the study, the statement of the problem, the general research hypotheses, the purpose and value of the study, the limitations and delimitations, a description of the technical terms used in the thesis and a general description of the methodology.

The first chapter stated that it appears as if researchers are confident that culturally modified pictures in picture-text material can aid the acceptance, congeniality and appeal of the material and message, and that culturally insensitive visuals will be a hindrance. It was, however not evident from the empirical literature whether such visuals can produce a measurable increase in recall, comprehension and problem-solving skills when these pictures are used in conjunction with educational text aimed at developing communities. The study was directed to investigate the use of pictures in picture-text learning material and in particular the value of culturally modifying pictures in such material to increase the facilitating effect of the pictures in the text. The researcher used a *post-test control group* experimental design for the experiments. Pictures in the context of this study were defined as images that support and repeat the text and which are used in combination with the text. Pictures with an attentive and mood-creating function, for example in political, marketing and propaganda material, were excluded. Text in the context of this study was defined as information presented in printed form, which a learner can master without the assistance of pictures. The facilitating effect signified a relative improvement of the learners' problem-solving skills and their recall and comprehension of the information represented in the picture-text learning material. Learners in the context of this study are persons who have the verbal skill to read and understand instructional text material that is written for their level. The focus was on learners from developing communities.

The aim of the study was formulated as a fourfold mission, namely to develop a theoretical foundation and framework for the study through a literature study; to investigate the effect of culturally modified pictures when they are combined with printed educational text through a series of experiments; to make a theoretical contribution with a model that would explain and predict the picture facilitating effect; and to make practical and applicable recommendations for the design and development of picture-text learning material.

6.2.2 A summary of Chapter 2

Chapter 2 was a review of the literature relevant to this study. This review provided an orientation to the research and established a theoretical foundation and framework for the rest of the study. It gave direction for the empirical work and theory development in Chapter 4 and in Chapter 5.

Reported research in the field of study appeared in diverse academic journals, of which educational technology, education, and educational psychology journals were the most prominent. The review looked at picture classification systems, it proposed a taxonomy of pictures in instructional text, and it highlighted the fact that decorative pictures appear not to have the potential to assist learning, whilst organisational and explanative pictures have the highest potential for assisting the learning task. The review showed that there is sufficient empirical evidence that pictures can facilitate learning. This facilitation effect applies to the recall of information, the comprehension of information, and the answering of inferential questions. It is also durable over time, and it applies to young and older learners. The effect can be small to large whilst the text in the learning material, the experimental conditions, the pictures and the learners themselves affect the magnitude of the picture facilitating effect. The fourth section in Chapter 2 found that pictures could impede beginner readers when they learn how to read and that decorative pictures do not have a cognitive value when they are used with instructional text. The fifth section isolated those factors that influence the facilitating effect that pictures have in instructional text. These factors can be grouped under picture characteristics, type of instructional media and text content, learner characteristics, and evaluation methods. It provided a synopsis of twenty-two factors that influence the facilitating effect of pictures in instructional text. The section concluded by providing a utility checklist, which can be used as an analytical instrument to evaluate picture-text learning material. The sixth section was focused on those factors

that are applicable to learners from developing communities. The main categories that influence the picture facilitating effect are picture characteristics, the learning material and content thereof, and the learners' characteristics. The section concluded with a summary of ten factors that instructional designers must consider when developing picture-text material aimed at subjects from developing communities. The seventh section examined cross-cultural research in pictures and picture-text instructional material. This section reported on the influence of culture on pictorial perception, preference, the use of pictures by developing communities, and the relative effectiveness of different picture styles. Nineteen principles were identified and listed which instructional designers can use to develop and improve pictorial material that is used in educational material, health education and development programmes aimed at developing communities. This chapter reviewed communication models relevant to the focus of the study and looked at cultural aspects in picture communication materials. It showed that culture and communication are inseparably linked and that culture is a lens or a filter through which people receive, interpret and transmit messages. Communication is an open system and takes place within a cultural environment. The section concluded by presenting a simplified model that projected the picture-text-communication process as an open system which takes place within a cultural environment. The last two sections provided an overview of different theories that explained the beneficial effect that pictures can have on learning when they are combined with text, and made critical observations on some of the methods that are used in picture-text research.

6.2.3 A summary of Chapter 3

Chapter 3 is the empirical section of the study and reported on eight completed experiments.

The aim of the empirical work was to determine whether pictures in picture-text learning material, which are modified to visual aspects of the learners' culture and environment, namely food, clothing, symbols, physical features, environment and other items of the learners, could increase the subjects' recall and comprehension of such learning material. The experiments also determined the subjects' preference for modified or unmodified pictures in learning material.

It was hypothesised that the picture groups would perform better than the text-only groups; that the subjects who received the modified pictures with their text would

perform better than the subjects who received unmodified pictures with their text; that the subjects would prefer the pictures that were modified for them; and that the picture groups would forget relatively less in a delayed test than the text-only group. Comparisons were made between the mean scores of the groups, and the subjects' preference for modified or unmodified pictures was determined. ANOVA, Tukey's HSD and the Z-test for proportions were used to analyse the data. The procedures were similar for all the experiments. More than seven hundred subjects participated in the experiments. The results have shown that subjects prefer culturally modified pictures, but that modified pictures do not assist learning more than unmodified pictures. The results have also shown that a picture can benefit learners if the same picture that was used in the learning situation is used in the assessment situation. The research hypothesis was rejected in terms of the learning effect of modified versus unmodified pictures, and was not rejected in terms of the subjects' preference.

6.2.4 A summary of Chapter 4

Chapter 4 contained the recommendations and conclusion of the study and consisted of eight sections. The first section drew conclusions from the literature study whilst the second and third sections drew conclusions from the experiments. These conclusions were given in the form of generalisations that have application value to a wider audience.

The fourth section in Chapter 4 proposed a learner-centred theory for the picture facilitating effect. The purpose of this proposed theory and its model is to accentuate the central position of the learner in the learning process when the learning material consists of picture and text components. The fifth section recommended guidelines for the design and development of picture-text learning material for subjects from developed and developing communities. The sixth section recommended an instrument as a model that instructional designers could use for the analysis of pictures in picture-text instructional material. This instrument, in the form of a flowchart, can be used for classifying pictures in educational text as pictures that have no potential to facilitate learning, through to pictures that have a high potential to facilitate learning.

6.2.5 A summary of Chapter 5

Chapter 5 provided a model for the explanation and prediction of pictorial learning facilitation in picture-text learning material. The development of this model followed an inductive process whereby observations during the empirical work and the conclusions that were developed from these observations provided six theoretical constructs which, as the main elements in a composite arrangement, provided the model. The first section of the chapter presented the components that were required for the construction of a model. Explanative diagrams accompanied the constructs and components that were discussed in the first section. The second section presented the model and two variations of the model. This graphic model is a visualised idea of the factors that influence picture facilitation, the theories for the efficacy of picture-text material, and observations and hypothetical conjectures derived from this study. The second variant of the model presented the explanation for pictorial learning facilitation from a more familiar graphic perspective. The third variant of the model presented the different elements (text, pictures, learners, learning, environment etc.) in a hierarchical format, in the levels in which they affect pictorial learning facilitation and in the process that takes place to produce picture learning facilitation. The third section used the model to explain part of the results that were obtained in one experiment that was conducted for the empirical work.

6.2.6 A summary of Chapter 6

The last chapter provided a synthesis and a summary of the study. The synthesis is a brief outline of the results and outcomes of the study, whilst the summary is a brief outline of the thesis. The results are those issues that came about from the empirical work and the literature review, while the outcomes are those issues that are presented as a contribution to the science of learning from picture-text material. The outcomes of this study were presented as a function of inductive and deductive processes based on the results of the literature study, and the results and conclusions from the empirical work.

The results and the outcomes of this study have implications for scientists and practitioners who must solve problems primarily in the field of visual communication, educational technology and graphic design. Graphic designers and educators can use the regularities established in the theoretical study for extrapolation and prediction when developing educational materials of a visual nature. The outcomes of the study will assist designers of picture-text information material to decrease trial-and-error design practices when they aim their messages at target groups in developing communities.

6.3 CONCLUSIONS AND RECOMMENDATIONS

6.3.1 Conclusion of the study

Subjects prefer culturally modified pictures, but modified pictures do not assist learning more than unmodified pictures. The results have shown that a picture can benefit learners if the same picture that was used in the learning situation is used in the assessment situation. The research hypothesis is rejected in terms of the learning effect of modified versus unmodified pictures, and is not rejected in terms of the subjects' preference. Socio-cultural variables in text and in pictures play an important role in picture-text learning material when such material is aimed at learners from developing communities. These variables become less important when the subjects move towards an urbanised, developed and heterogeneous community. Cultural appropriateness in pictures can affect the congeniality of picture-text learning material but does not contribute on a cognitive level to the value of picture-text learning material. Inappropriate cultural conventions in text and pictures, however, can create a barrier to communication and thereby affect the cognitive value of such learning material.

The picture facilitating effect is a function of interacting text, picture, learner, environmental and assessment variables. A model incorporating these variables can predict and explain the picture facilitating effect. The picture facilitating effect is robust and at the same time sensitive to identifiable and sometimes unknown variables that diminish or nullify the picture facilitating effect. The extent of the picture facilitating effect can be augmented through the addition of known picture, text, and learning variables that facilitate learning. A learner-centred theory for the picture facilitation process accounts for the factors that play a role in this process.

6.3.2 Recommendations for future research

The first chapter demarcated the area of this study as falling under the field of research on visual learning, which is a subdivision of visual literacy. Related to and next to the field of learning from visuals are research on reading of pictures and research on the design of instructional materials.

These three areas: design of materials, research on learning (from picture-text, or verbo-visual material), and the reading of pictures, particularly within developing communities, offer wide areas of research possibilities.

This study looked at the use of pictures, in support of educational text, as a means to assist learning, and in particular the effect of culturally modifying pictures in picture-text learning material. The focus was on subjects from developing communities. This study, however, excluded emotive factors associated with visuals, and emotive factors associated with the text content and message. The study used printed matter as the medium of presenting the educational material and excluded other mediums that can be used to communicate an educational message. This study also excluded differing proportions of text and pictures as a variable in educational messages. Quantitative methods were used for the empirical part of this study as this is the preferred method, rather than qualitative methods, used by researched that publish in this field.

Several questions arose as a result of this study.

These questions, together with those areas that were excluded from the focus of the study, provide possible areas of research are:

- The use of culturally modified pictures with an emotive content (ambiguous/suggestive pictures) in support of educational text, as a means to assist learning.
- The use of qualitative methods whereby small focus groups can be employed to determine the subjects' ideas and reaction to cultural modifications of instructional pictures.
- The use of culturally modified pictures with an emotive content as a means to assist learning, but where the pictures play a dominant role and the educational text supports the picture.
- Factors that inhibit the effective use of pictures in picture-text learning material within the context of developing communities in South Africa. The focus of the identification of these factors must be for specific groups and for specific educational messages, and should not be general in nature.

- The effect of culturally modified pictures in picture-text learning material when the learners can pace their own learning time and when a different medium is used, for example a poster in a classroom.
- The use and effect of active pictures, movement and sequence of pictures, and how these conventions can support learning.

It could be, as stated by Peeck (1987), that because researchers consider the emotional benefits of some pictures as being too obvious for serious consideration, there is limited reported research in this field. Hugo (1995:14), however, reported that an experiment with a picture card game not only increased children's knowledge about accident prevention, but also had a "stimulating effect" on their learning skills. The area of learning from pictures, with an emotive content, holds promise of future research particularly as attitudes and various motivational factors in media use influence learning outcomes.

Current research in the field of educational technology, and in learning from picture-text research, focuses more on electronic means of delivering a message than an analog or paper-based mediums of delivery. The poor physical infrastructure and lack of electricity, as well as the relatively high cost of sophisticated delivery mediums, such as personal computers, in developing communities, will ensure that paper remains one of the dominant carrier mediums of educational messages aimed at developing communities.

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FREE STATE PROVINCIAL GOVERNMENT
PROVINSIALE REGERING VAN DIE VRYSTAAT
MMUSO WA POROFENSI YA FOREISETATA

DEPARTMENT OF EDUCATION
CR Swart Building, 55 Elizabeth Street, Private Bag X20565, BLOEMFONTEIN, 9300
DEPARTEMENT VAN ONDERWYS
CR Swartgebou, Elizabethstraat 55, Privaatsak X20565, BLOEMFONTEIN, 9300
LEFAPHA LA THUTO
Moaho wa CR Swart, 55 Elizabeth Street, Private Bag X20565, BLOEMFONTEIN 9300

Enquires/Navrae/Botsa ho : MR W B VAN ROOYEN
Ref./Verw./Tshupo : 0.1/11/3/3

Fax (051) 4033421
Tel: (051) 4055777

1997 03 05

Mr R W de Lange
Faculty of Human Sciences
Technikon Free State
Private Bag X20539
BLOEMFONTEIN
9301

Dear Mr de Lange

REQUEST TO CIRCULATE QUESTIONNAIRE TO PUPILS AT A BLOEMFONTEIN SCHOOL

- 1 Your request dated 21 February 1997 refers.
- 2 Permission is granted for your request under the following conditions:
 - 2.1 The names of pupils must be provided by the principals.
 - 2.2 Pupils and Teachers participate voluntarily in the project.
 - 2.3 The names of the schools and teachers/pupils involved remain confidential in all respects.
 - 2.4 This letter must be shown to all participating persons.
 - 2.5 A report on this study must be donated to the Free State Department of Education after completion of the project.
 - 2.6 You must address a letter to the Head: Education accepting the conditions as laid down.
- 3 We wish you every success with your studies.

Yours sincerely

HEAD: EDUCATION.

O. 1/11/3/3

**VRYSTAAT DEPARTEMENT VAN ONDERWYS
ONDERWYSINSTITUUT
SUBDIREKTORAAT: Onderwysbeplanning**

**INLIGTINGSTUK RAKENDE VERSOEKE OM NAVORSING IN DIE
VRYSTAAT DEPARTMENT VAN ONDERWYS TE ONDERNEEM**

1. INLEIDEND

Voornemende navorsers en nagraadse studente sal begrip daarvoor hê dat die belange van alle Vrystaatse ouers, leerlinge, onderwysers en departementele amptenare binne sy jurisdiksiegebied deur die Vrystaat Departement van Onderwys beskerm moet word. Dit bring mee dat alle aansoeke om navorsing in die Departement te doen, noukeuring oorweeg moet word. Om te voorkom dat sodanige versoeke onvolledig ingedien word en oorweging van die aansoeke dus onnodig vertraag word, word die inligting hieronder tot beskikking van voornemende navorsers gestel.

2. AAN WIE NAVORSINGSVERSOEKE GERIG WORD

Die aansoeker moet uitdruklik meld of die aansoek by slegs een provinsiale onderwysdepartement of by meer as een ingedien is. Indien die navorsing op die Vrystaat Departement van Onderwys van toepassing is, moet alle versoeke skriftelik gerig word aan:

Die Hoof
Vrystaat Departement van Onderwys
Privaatsak x 20565
BLOEMFONTEIN
9300
Vir aandag: W.B. van Rooyen
Kamer 1211

3. WAT BY 'N AANSOEK INGESLUIT MOET WORD

Vier afsonderlike stukke moet ingesluit word:

- * 'n aanbevelingsbrief deur die studieleier;
- * 'n volledige uiteensetting van die navorsingprojek;
- * die vraelys of beplanning van die onderhoud;
- * 'n konsepbrief aan die skoolhoof.

- 3.1 In die aanbevelingsbrief bevestig die navorser se studieleier dat die aansoeker 'n ingeskrewe student aan die bepaalde tersiêre inrigting is. Die graad of diploma waarvoor die navorsing onderneem word, moet genoem word, asook enige ander ondersteunende inligting rakende die student en/of die navorsing.

- 3.2 In 'n volledige uiteensetting van die navorsingsprojek verstrek die aansoeker minstens die volgende gegewens:-
- 3.2.1. Titel (Mnr./Mev./Mej.), voorletters en van;
 - 3.2.2 adres;
 - 3.2.3 telefoonnommer gedurende kantoorure;
 - 3.2.4 naam van tersiêre inrigting /navorsingsinstansie;
 - 3.2.5 graadkursus/diplomakursus;
 - 3.2.6 naam van studieleier/promotor;
 - 3.2.7 titel van skripsie/verhandeling/proefskrift/verslag/projek;
 - 3.2.8 bondige uiteensetting van die navorsingsonderwerp;
 - 3.2.9 doel met navorsing;
 - 3.2.10. Toepassingswaarde wat navorsing vir die Vrystaat Departement van Onderwys kan he;
 - 3.2.11. volle besonderhede van die persone/groep by wie die navorsing onderneem word, byvoorbeeld geslag, graad, ouderdomsgroep, taal, woongebied, getal wat by navorsing betrek sal word;
 - 3.3.12. 'n presiese aanduiding van die inligting wat verlang word;
 - 3.3.13. in watter skoolkwartaal die navorsing onderneem en afgehandel sal word;
 - 3.3.14. op watter wyse inligting verkry sal word, byvoorbeeld vraelys, onderhoud, gestandaardiseerde toetse;
 - 3.3.15. of die ondersoek na skoolure uitgevoer sal word;
 - 3.3.16. hoeveel tyd deur individuele leerkragte en/of leerlinge as respondente aan die navorsing bestee sal word.
- 3.3 Die volledige vraelys, indien van toepassing ,of struktuur van die onderhoud soos goedgekeur deur die studieleier en presies soos dit deur die leerkrag ingevul moet word, moet ook die aansoek vergesel, asook
- 3.4 'n konsepbrief aan die skoolhoof waarin die aansoeker die skoolhoof se toestemming vra om in sy skool navorsing te onderneem.

4. VOORNEMENDE NAVORSERS WORD VRIENDELIK OP DIE VOLGENDE GEWYS:

- 4.1 Normaalweg sal navorsing gedurende die vierde kwartaal nie goedgekeur word nie.
- 4.2 Kwalifikasies van leerkragte en dosente word normaalweg nie aan navorsers verstrekk nie.
- 4.3 Vrae aan respondente oor kontensieuse aangeleenthede, soos onder andere die ouers, ouerhuise, kerkverband en sedes, word normaalweg nie toegelaat nie.
- 4.4 Navorsing moet verkieslik na skoolure gedoen word.
- 4.5 Vraelyste moet verkieslik in die relevante landstale wees as persone van verskillende landstale vir die projek genader word.
- 4.6 Departementele goedkeuring moet eers verkry word voordat hoofde van skole en ander inrigtings gevra word of hulle met navorsing behulpsaam sal wees.
- 4.7 Hoofde van skole en ander inrigtings mag nie sonder die Departement se toestemming magtiging gee dat vertroulike inligting soos leerlinge se kumulatiewe verslagkaarte, IK's of ander persoonlike inligting vir navorsingsdoeleindes gebruik word nie. Alle toetse en prosedures wat die navorser wil toepas, moet in die aansoek genoem word.
- 4.8 Dit sal soms, veral by sensitiewe navorsing, nodig wees om ouers se skriftelike toestemming te verskry voordat navorsing by hulle kinders onderneem word. Die navorser moet self die toestemming van die betrokke ouers/voogde bekom.
- 4.9 Vraelyste moet verkieslik anoniem ingevul word en moet so opgestel word dat dit nie die Departement, ouers, leerlinge of personeellede in enige opsig deur selfs net een vraag aanstoot gee of in die verleentheid stel nie. Sulke vraelyste is onaanvaarbaar vir die Departement.
- 1.10 Slegs vraelyste wat reeds deur die studieleier goedgekeur is, moet aan die Departement voorgeleword.
- 4.11 Die Departement verskaf op versoek adresse van bepaalde skole, maar nie adres-etikette nie.
- 4.12 Die taalkundige versorging en tipografiese uiteensetting van vraelyste bly die navorser se verantwoordelikheid en moet aan die Departement se vereistes voldoen.
- 4.13 Aansoekers moet die Departement 'n redelike tyd gun om die aansoek te oorweeg en aansoeke moet eerder te vroeg as te laat ingedien word. (ten minste drie maande voordat die aksie by skole moet plaasvind)

-4-

- 4.14 Aansoeke sal soms met spesifieke bykomende voorwaardes goedgekeur word.
- 4.15 Navorsers moet so min tyd moontlik by onderwysinrigtings in beslag neem, aangesien die Departement moet toesien dat daar nie onredelike eise aan skool-en werksure gestel word nie.
- 4.16 Daar moet noukeurig op die implikasies van alle gebruiklike voorwaardes gelet word.

5. GEBRUIKLIKE VOORWAARDES WAT BY GOEDKEURING VAN ALLE NAVORSINGSVERSOEKE GELD:

- 5.1 Die navorser moet self alle reelings met die skole, onderwysers en/of leerlinge tref.
- 5.2 Geen skoolhoof, onderwyser en/of leerling is verplig om aan die navorsing deel te neem nie.
- 5.3 Geen inligting of kommentaar oor die navorsing mag sonder toestemming van die Departement aan die media bekend gemaak word nie.
- 5.4 Alle inligting moet streng vertroulik gehanteer word. Skole en respondente se name mag nie in die verslag, proefskrif, verhandeling of skripsie wat op die navorsing volg, genoem word nie en deelnemers aan die navorsingsprojek moenie geïdentifiseer kan word nie.
- 5.5 Geen inbreuk mag op skoolbedrywighede gemaak word nie.
- 5.6 Na voltooiing van die navorsing moet 'n afskrif van die bevindinge aan die Departement geskenk word. Indien 'n opsomming nie reeds hierby ingesluit is nie, moet 'n afsonderlike opsomming (nie langer nie as 2-3 bladsye) van die belangrikste bevindinge en aanbevelings saam met die volledige bevindinge gestuur word.
- 5.7 'n Afskrif van die brief waarin toestemming tot navorsing verleen word, moet getoon word aan skoolhoofde van skole waar navorsing gedoen word.
- 5.8 Voordat met die navorsing begin word, moet die navorser skriftelik aan die Departement bevestig dat al die voorwaardes aanvaar word.

6. BYKOMENDE SPESIALE VOORWAARDES VAN TOEPASSING BY NAVORSINGSVERSOEKE VIR PRE-MAGISTER KWALIFIKASIES

Navorsing vir pre-magister kwalifikasies is aan die volgende bykomende beperkings onderworpe:

- 6.1 'n Vraelys mag nie langer as tien minute neem om te voltooi nie.
- 6.2 Slegs onderwysers mag by ondersoek betrek word en nie leerlinge nie.