The application of a whole brain approach to learning activity design in a Bachelor of Commerce degree

by

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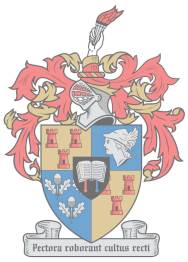

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DECLARATION

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ABSTRACT

In South Africa, student achievement is paramount in maintaining standards set by institutions for higher education qualifications within higher education. Moreover, student achievement is emphasised. Higher education institutions thus launch initiatives that may positively influence learning and achievement. Students' potential for achievement could potentially be negatively influenced due to a lack of mental dexterity. A whole-brain teaching and learning approach is one way of developing mental dexterity. Therefore, this study set out to determine how, if at all, the whole-brain teaching and learning approach was applied to the design of learning activities within the main discipline of Business Administration and Management (General) within the Bachelor of Commerce (BCom) degree offered by a private higher education institution (PHEI) in South Africa.

Within the interpretivist paradigm, this study provided an insider perspective on the approach to learning-activity design through a case-study methodology, by means of document analysis of selected modules within the Business Administration and Management (General) discipline associated with the Bachelor of Commerce degree, and the interpretation of purposively chosen participants' interviews and class observations. The data sets included the online learning material of the selected modules, digitally voice-recorded semi-structured interviews, and observations of class lectures, transcribed and interpreted by means of a conceptual framework. The conceptual framework, based on the delineated related literature illuminated the themes that allowed for the categorisation thereof using the Herrmann Whole Brain Teaching and Learning Model and the Herrmann Brain Dominance Instrument as organising tools. The data demonstrated that teaching and learning elements within the online learning material and learning activities, and the theories of learning participants subscribe to, could be linked to the Herrmann Whole Brain Teaching and Learning Model.

The results showed progress towards an application of whole-brain teaching and learning; however, these were not conclusive. The small sample size and disciplinary delimitations in this study precludes any claim that the conclusions refer to all learning activities

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designed for all modules offered at the PHEI. Regarding the broader significance of this case study, there is still a great deal to be done to ensure the application of a whole-brain teaching and learning approach to learning activity design in the Bachelor of Commerce degree. This study therefore only serves as a point of departure in addressing the learning activity design of modules within the Bachelor of Commerce degree providing the PHEI with information that could inform future interventions that aim to address concerns around student achievement.

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OPSOMMING

Studenteprestasie in Suid-Afrika is uiters belangrik in die handhawing van standaarde daar gestel deur instellings vir hoër onderwys kwalifikasies binne hoër onderwys. Boonop, word student prestasie beklemtoon en dus loods hoër onderwys instansies verskeie inisiatiewe wat positiewe leer en prestasie kan beïnvloed. ‘n Gebrek aan verstandelike behendigheid kan moontlik studente se potensiaal vir prestasie negatief beïnvloed. ‘n Heel brein onderrig en leer benadering is een manier om verstandelike behendigheid te bevorder. Vandaar, is hierdie studie uiteengesit om te bepaal hoe, indien enigsins, die heel brein onderrig en leer benadering toegepas is tot die ontwerp van leer aktiwiteite binne die hoof vakgebied van Besigheid Administrasie en Bestuur (Algemeen) van die BCom Besigheidsbestuur-studie program aangebied deur ‘n privaat hoër onderwys instelling.

Binne die interpretatiewe paradigma, voorsien hierdie studie 'n binnekringperspektief op die benadering wat gevolg is tot leer aktiwiteit ontwerp. Deur middel van 'n gevallestudie metodologie, word die dokumentasie van geselekteerde vakke binne die Besigheids Administrasie en Bestuur (Algemeen) vakgebied wat verband hou met die BCom Besigheidsbestuur-studie program en die onderhoude van doelgerig-verkose deelnemers aan die studie en klas waarnemings geïnterpreteer. Die data stelle het ingesluit die aanlyn leer materiaal van die geselekteerde vakke, digitale stemopnames van die semi gestruktureerde onderhoude en waarnemings van klas lesings, woordeliks getranskribeer en geïnterpreteer met die hulp van 'n konseptuele raamwerk. Die konseptuele raamwerk, gebaseer op afgebakende verwante literatuur het die lig gewerp op die temas binne die data stelle. Hierdie temas is met behulp van die Herrmann Whole Brain Model en die Herrmann Brain Dominance Instrument daarna gekategoriseer. Die data het elemente van onderrig en leer gedemonstreer, binne die aanlyn leer material en leer aktiwiteite sowel as gevolg van die teorieë waaraan deelnemers hulleself toeskryf wat met die Whole Brain Teaching and Learning Model geassosieer kon word. Die resultate het vordering getoon teenoor 'n toepassing van die heel brein onderrig en leer benadering, dit was egter nie deurslaggewend nie. As gevolg van die klein steekproef grootte en gedelimiteerde

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vakgebied in hierdie studie is enige aanspraak wat aanleiding mag gee dat dit na alle leer aktiwiteit ontwerp van alle vakke wat deur die privaat hoër onderwys instelling aangebied word, uitgesluit. Met betrekking tot die breër betekenisvolheid van hierdie gevallestudie, is daar nog heelwat wat gedoen moet word om die toepassing van 'n heel brein onderrig en leer benadering tot leer aktiwiteit ontwerp in die BCom Besigheidsbestuur-studie program te verseker. Hierdie studie dien dus slegs as ‘n vertrekpunt vir die aanspreek van die leer aktiwiteit ontwerp van vakke binne die BCom Besigheidsbestuur-studie program wat aangebied word deur die privaat hoër onderwys instelling en die voorsiening van inligting om sodoende toekomstige ingrypings oor die kommer rondom student prestasie te adresseer.

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LIST OF ACRONYMS AND INITIALISMS

ASSIST:	Approaches and Study Skills Inventory for Students
CAT:	Central Academic Team
CD(s):	Content Developer(s)
CHE:	Council on Higher Education
CSI:	Cognitive Style Index
EEG:	Electroencephalographic
FLP:	Facilitating Learning Programme
GE:	General Electric Company
HBDI:	Herrmann Brain Dominance Instrument
HE:	Higher Education
HEI(s):	Higher Education Institution(s)
HEQC:	Higher Education Quality Committee
HEQF:	Higher Education Qualifications Framework
HoP(s):	Heads of Programme(s)
Hz:	Hertz (Hz)
ID(s):	Instructional Designer(s)
ILS:	Inventory of Learning Styles
LMS:	Learning Management System
LSP:	Learning Style Profiler
MSP:	Motivational Styles Profiler
PHEI:	Private Higher Education Institution
QEP:	Quality Enhancement Project
REC:	Research Ethics Committee
SID:	Senior Instructional Designer
SME:	Subject Matter Expert
WBTL:	Whole Brain Teaching and Learning

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LIST OF ADDENDA

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CHAPTER ONE

ORIENTATION TO THE STUDY

1.1 Introduction

The Greek philosopher and scientist, Aristotle, wrote “which have several parts and in which the totality is not, as it were, a mere heap, but the whole is something besides the parts” (Cohen, 2016). To recast these words more simply, one can say that ‘the whole is greater than the sum of its parts.’ This rendering is often used as a saying, a dictum, which summarises the gist of what this study aims to support – i.e. the application of a whole-brain approach to the design of learning activities. It is believed that learning activities designed to develop the entire brain, instead of only parts thereof, will result in greater mental dexterity and therefore improved student achievement. This study, however, does not set out to prove the latter; it aims to determine if a whole-brain approach to learning activity design has been applied and, if so, how it has been done.

This chapter provides an overview of a study focused on the application of a “Whole Brain Teaching and Learning” (WBTL) approach to learning activity design using Ned Herrmann’s whole-brain model (Herrmann, 1995). The study was aimed at determining how a Private Higher Education Institution (PHEI) applied a WBTL approach to the design of the learning activities of the Business Management modules in the Bachelor of Commerce degree offered by the PHEI.

The study includes an analysis of the learning-styles field, and the critiques of learning-style models such as Ned Herrmann’s whole-brain model (Herrmann, 1995). In order to motivate the selection of Herrmann’s whole-brain model for this study, various other learning-style theories and models are considered against the research questions posed. These theories and models are described in order to demonstrate why they were not suitable for this study. Moreover, the considerations for choosing Herrmann’s whole-brain model for this study are provided to further motivate the selection thereof. The study concludes with suggestions for enhancing the application of the WBTL approach to the

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learning activity design of the Business Management modules in the Bachelor of Commerce degree.

In the next section, some theoretical information and background about the unique context of the PHEI and its relation to the study is provided. This section furthermore addresses the relevance of and motivation for this particular study.

1.2 Motivation for the study

1.2.1 Background of the study

The human brain is divided into two hemispheres: the left and the right. Each hemisphere is associated with different, specialised functions and cognitive processes, which control different aspects of thought and action (Gazzaniga, 1998:42). In each individual, a single hemisphere tends to be more dominant, depending predominantly on genetic factors, and, to a lesser extent, to environmental and childhood development factors (Sperry, 1975:32). Research conducted on the human brain led to the conclusion that each individual has a thinking preference (Deshpande & Baxi, 2011:228). The thinking preference is associated with the dominant brain hemisphere and its functioning and cognitive processing. The thinking preference affects the way the individual receives and processes information (Deshpande & Baxi, 2011:228), thus affecting the way in which an individual learns. The way in which individuals learn is also referred to as a 'learning preference' or a 'learning style' (Snowman & McCown, 2012:121). Individuals have the ability to act outside of their thinking and learning preference and can thus adopt a different learning style depending on the learning activity (Snowman *et al.*, 2012:121). Learning activities vary from reading, writing and questioning through to drawing or creating, to name but a few. However, some individuals switch learning styles more easily than others and would possibly be quite comfortable with learning activities that fall outside of their preferred learning style or styles (Snowman *et al.*, 2012:121).

Nevertheless, in order to enhance learning it is important for higher education institutions (HEIs) to design learning activities that require students to use both their preferred as well as their less preferred learning style or styles, thus involving the whole brain in the

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learning process (Buzan, 1991:33-34; Jensen, 2008:22). Based on research by MacLean (1990) and Sperry (1990), Herrmann (1995:39) developed a “whole brain” model that represents the four thinking structures of the brain linked to different thinking and learning styles or thinking and learning preferences (De Boer, Steyn & Du Toit, 2010:186; Herrmann, 1995:39). This approach to designing and developing learning activities – which requires various learning styles associated with the four thinking structures of the brain – is referred to as a “whole brain teaching and learning” (WBTL) approach (Herrmann, 1996:151). According to De Boer, Steyn and Du Toit (2001:188–189) and Felder (1996:18), not applying a whole-brain approach to teaching and learning within higher education (HE) could negatively influence the development of the mental dexterity of students, and thus also their potential for achievement. Consequently, the application of a WBTL approach should be considered when designing and developing learning activities for HE students.

The measurement of student achievement is paramount in maintaining standards set by each institution for HE qualifications within HE in South Africa, both in private and public institutions (CHE, 2013:7). Student achievement – in terms of assessment, throughput and completion rates in relation to teaching and learning at HEIs in South Africa – is a targeted area for improvement by the Council on Higher Education (CHE) (CHE, 2014:i-ii). The focus of the Higher Education Quality Committee (HEQC), a permanent committee of the CHE, is to enhance teaching and learning in HE in order to improve student achievement. This is operationalised through the Quality Enhancement Project (QEP) that requires South African HEIs to align “institutional goals, strategies and planning, together with coordination of people and activities across different institutional structures” (CHE, 2014:2–3; 14). In addition, HEIs that offer the same qualification at various sites of delivery (commonly referred to as campuses) have to demonstrate to the HEQC that the delivery of the same qualifications at various sites of delivery are equitable. Student achievement is often used as a measure to determine equity of delivery. Thus, student achievement is a core focus area for HEIs in South Africa, resulting in various initiatives by HEIs to improve quality, to add additional support services, and to adapt teaching and learning approaches that may positively influence student learning and

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achievement. According to the Improving Teaching and Learning (ITL) Resources (CHE, 2004: 48; 113), learning material plays a supportive role in the delivery of the programmes offered by HEIs, and this learning material should be responsive to student diversity and inclusive of different learning styles. It is therefore important that the academics as educators within HEIs in South Africa, as well as the custodians of learning programmes, consider different learning styles when planning, designing, developing or moderating learning material and associated learning activities.

Furthermore, academics as educators all subscribe, whether consciously or unconsciously, to theories of learning that influence their design of learning activities (Jordan, Carlile & Stack, 2008:1). The theory of learning subscribed to by an educator may form a coherent whole or might hold bits of different theories that are incompatible (Jordan *et al*., 2008:1). According to Jordan *et al.* (2008:1), bringing the incompatible principles of learning held by an educator to light is important to ensure shared educational discourse. 'Educational discourse' refers to conversations amongst educators that ensure a common understanding and the sharing of ideas. Within a PHEI in South Africa that offers more than 90 accredited higher education qualifications through six brands and more than 20 sites of delivery across the country, ensuring shared educational discourse is paramount to the achievement of equity of delivery. This would ensure that students on a site of delivery in one city are receiving an educational experience guaranteed to match the educational experience in any other city. This includes the same access to key learning materials and facilities. Due to the nature and scope of the PHEI, a strong central academic and quality assurance team – referred to as the Central Academic Team (CAT) – is employed. This team is responsible for the registration and accreditation of all qualifications; curriculum development (which includes the design of learning programmes that consist of sequential learning activities organised into modules, and provided to lecturers and students through learning material); the quality of delivery; assessment development; and certification (graduation). Central to the CAT are the Heads of Programme (HoPs). In observation and discussion with the HoPs on ways to address student achievement and to overcome possible learning barriers, interest grew on how learning and learning styles in particular were conceptualised by

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themselves as educators. Each of the HoPs as educators holds his or her own theory of learning. Therefore, each HoP at the PHEI has different ideas of learning and learning styles (Jordan *et al*., 2008:1). As a result, in collaboration with the Academic Development Manager at the PHEI, the researcher conducted a workshop with the HoPs: the Facilitating Learning Programme (FLP). The aim of the FLP was to ensure shared educational discourse on learning styles and learning-style flexibility, particularly focusing on the concept and principles of whole-brain teaching and learning. WBTL was selected for the FLP workshop by the researcher and the Academic Development Manager since scholars such as Buzan (1991:33-34) and Jensen (2008:22) recognise that effective learning only takes place if the entire brain is involved in learning. There are many learning-style models to choose from, such as:

- David Kolb's model (Kolb, 1984) that places emphasis on learning as a process in which knowledge is created through the transformation of experience;
- Howard Gardner's theory of Multiple Intelligences (Gardner, 1983) in which Gardner identifies a list of seven intelligences that do not operate independently, but work concurrently, complementing each other as individuals learn;
- Dunn and Dunn's model (Dunn, 1990) that divides learning styles into five major stimulus strands that influence how individuals learn; and
- Ned Herrmann's whole brain model (Herrmann, 1995) in which Herrmann identifies four preferences (represented as 'quadrants') and advocates the incorporation of all four when learning in order to develop the whole brain.

The Herrmann Whole Brain Model (1995) was selected as it is based on the physiology of the brain and involves the whole brain in the learning process. Moreover, authors such as Coffield, Moseley, Hall and Ecclestone (2004a:84) suggest that learning style literature lacks underpinning theory. However, in their critical review of learning styles, Coffield, *et al*. (2004a:84) identified that one of the strengths of Herrmann's whole brain model is that the design of the model is based on theory related not only to the brain, but also to growth and development, especially in the development of creativity. In addition, it must also be noted that learning-style models and their associated assumptions are under some scrutiny by neuroscientists. "All individuals learn better when they receive information in

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their preferred learning style" is an example of such a scrutinised assumption, which is also referred to as a 'neuromyth' (Howard-Jones, 2014:1-2). Authors on neuromyths such as Howard-Jones (2014:2) state that the brain's interconnectivity makes assumptions made by learning-style models, like the assumption above, unsound. In contrast, the assumption of the Hermann Whole Brain Model (1995) is that individuals learn better when they receive information that incorporates all the different learning-style preferences associated with each quadrant of the brain; thus using and developing the whole brain.

For the purpose of the FLP, Herrmann's Whole Brain Teaching and Learning Model (1995) was selected to demonstrate, firstly, the application thereof in the design of learning activities of modules within learning programmes and, secondly, the application's possible influence on student achievement.

The HoPs attending the FLP were encouraged to not only consider, but to also apply, a WBTL approach when designing and developing learning material that sets out the learning activities for each module within a learning programme. The learning materials include module manuals, module guides, online learning material (currently only in selected modules), as well as formative and summative assessments. The learning materials are centrally planned, designed, developed, and moderated (that is, quality assured) within the CAT by the HoPs. The learning material is then disseminated to the various sites of delivery across the country where the lecturers, as implementers, deliver the content of modules to the students. Learning material is the tool the CAT provides to the lecturers and students. This tool's purpose is to support the lecturers' teaching and the students' learning, and to ensure equity of delivery. Student achievement is then used as a means to measure and determine the level of equity achieved as students across the country are assessed simultaneously using the same assessment instruments.

Student achievement, particularly in the Bachelor of Commerce degree offered by the PHEI, is of interest. The Bachelor of Commerce, with the core discipline of Business Administration and Management (General), is not only one of the first degrees that was accredited and approved by the HEQC to be offered by the PHEI, but it is also one of the

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qualifications with the highest number of student enrolments. Student achievement in the Bachelor of Commerce degree is, therefore, of paramount importance to all stakeholders. Not only is student achievement of reputational importance to the institution, but also a necessary measure for evaluation and reaccreditation purposes required by the HEQC. Student achievement is also important for students wanting to embark on further studies in the field of Business Management.

1.2.2 Problem statement

The mental dexterity of HE students could be negatively influenced if a whole-brain teaching and learning approach is not applied to the design of learning activities of modules within a learning programme. This could, in turn, negatively influence students' potential for achievement (De Boer, Steyn & Du Toit, 2001:188-189). Student achievement is an important factor to consider within HE in South Africa. It is therefore imperative for the PHEI to determine how, if at all, a WBTL approach is applied in the design of learning activities. Bearing in mind the importance of student achievement to stakeholders as indicated above, it is particularly important to determine if a WBTL approach is applied to learning-activity design within the main discipline of Business Administration and Management (General) within the Bachelor of Commerce degree. Information gathered through an enquiry to determine the application of a WBTL approach could potentially provide information required to make informed decisions on possible future interventions, if relevant, to address concerns around student achievement.

1.3 Research questions

In order to determine how, if at all, a WBTL approach to learning activity design is applied in the main discipline of Business Administration and Management within the Bachelor of Commerce degree offered by the PHEI, the following primary research question was addressed in this study:

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How, if at all, does one private higher education institution apply a whole brain teaching and learning approach in the design of learning activities within selected modules in a Bachelor of Commerce degree?

The primary research question was answered by responding to the following subsidiary questions:

i. *What is Whole Brain Teaching and Learning (WBTL)?*
ii. *What is the relevance of WBTL in learning activity design in the context of student achievement?*
iii. *How, if at all, is WBTL applied in the design of learning activities within the Business Management modules in the Bachelor of Commerce degree?*
iv. *What interventions, based on the findings of this study, could enhance the application of WBTL in learning activity design for the Business Management modules within the Bachelor of Commerce degree?*

The primary and subsidiary research questions guides the research design of the study as described in the next section.

1.4 Research methodology

1.4.1 Research design

The study is set within an interpretive paradigm using a case-study design. According to Babbie (2001:42), a 'paradigm' is the frame of reference used to organise observations and reasoning. A paradigm is informed by philosophical assumptions about the nature of reality (ontology); the ways of knowing reality (epistemology); and the ethics and value systems (axiology) (Patton, 2002:266). Interpretivist research aims to gain an in-depth understanding of the phenomenon under investigation (Du Plooy-Cilliers, Davis & Bezuidenhout, 2014:28). According to Merriam (1998:19), a case-study design enables the researcher to gain in-depth understanding of a situation, as well as to derive its meaning for those involved. The aim of this study is to gain an in-depth understanding of how, if at all, a WBTL approach was applied in the design of learning activities within the Business Management modules in the Bachelor of Commerce degree offered by the

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PHEI. In addition, this study also considered the meaning of the application of WBTL to learning activity design for those involved such as the HoPs, the Instructional Designers (IDs), and the module lecturers. In Chapter 4, the interpretive paradigm in which this study was set, the research design and research methodology employed, as well as the population, sampling and methods of data collection and analysis are elaborated upon. This section (Section 1.4.1) and Sections 1.4.2 to 1.4.5 that follow only provide a brief methodological overview.

1.4.2 Research approach

When a study focusses on contemporary events with no real control on behavioural events, and the aim is to gain an in-depth understanding of a situation and the meaning of that understanding for those involved, using a case-study methodology is the most appropriate approach (Merriam, 1998:19; Yin, 2003:13). Researchers further opt to use the case-study methodology in order to fully understand a particular bounded unit (Stake, 2000:436) that must be explained, described, illustrated or explored (Yin, 2003:42-46). Using a case-study methodology for this study allowed the researcher to fully understand the application of WBTL in the design of the learning activities, as well as to describe how WBTL is applied in the design of learning activities within the Business Management modules in the Bachelor of Commerce degree offered at the PHEI.

1.4.3 Population and sampling

Gaining access to the entire multi-sited PHEI population would not have been feasible within the parameters and scope of this study. The PHEI population is spread across South Africa and includes more than 90 accredited qualifications, more than a 1000 modules of which the design and moderation (quality assurance) is done by more than 20 Heads of Programme (HoPs) and over 800 lecturers as implementers of those modules. According to Du Plooy-Cilliers *et al*. (2014:137), it is appropriate to use non-probability sampling when gaining access to the entire population is problematic. Therefore, non-probability sampling is considered appropriate for this study. This method of sampling is also used in “special situations where the sampling is done with a specific purpose in mind” (Maree, 2016:198). The purpose of this study is specifically to analyse

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the design of learning activities. Furthermore, Du Plooy-Cilliers *et al.* (2014:142) postulate that should the researcher be able to choose the elements to include in the sample, based on a list of characteristics or criteria, non-probability purposive sampling could be used. Considering the population and the purpose of the research, certain criteria from the population were identified as important for the study. The criteria identified by the researcher related to the selection of the qualification, its modules and the participants. Based on these criteria, the Bachelor of Commerce degree and its Business Management modules were selected. The identified criteria are discussed in more detail in Section 4.4.3 in Chapter 4.

In addition, a case-study methodology also offers a multi-perspective analysis by using multiple units of analysis in which the researcher considers, not just the voice and perspective of one or two participants, but also the views of other relevant groups of 'actors' (Maree, 2007:75). Using a case-study methodology, therefore, allowed the researcher to consider the voice and perspective of the HoPs, the module lecturers, the IDs, and the interaction between them. The various perspectives of all role players offer in-depth insight into the dynamics of the situation and its associated interaction. The criteria included in the sampling as indicated above had a direct influence on the selection of the three levels of 'actors' in this study. The inclusion of the three levels of 'actors' gave an interesting cross-sectional perspective on the application of a WBTL approach in the design of learning activities within the Business Management modules in the Bachelor of Commerce degree. At the first level of 'actors', the HoP as the designer, developer and/or moderator (quality assurer) of the learning activities within the Business Management modules in the Bachelor of Commerce degree was included in this study. At the second level of 'actors', the ID, who reworked existing or designed new learning activities for the online learning platform in collaboration with the HoP, were included. Finally, at the third level of 'actors', a sample of the Business Management module lecturers, at site or campus level, responsible for the delivery of the learning material and thus the learning activities of the modules within the Bachelor of Commerce degree was included.

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The PHEI offers a wide variety of fully accredited undergraduate- and postgraduate-degree, diploma and higher-certificate qualifications at various brands nationally. The bulk (eight) of brand sites of delivery is located within the Gauteng province (The Independent Institute of Education, 2017). Brands in the context of the PHEI refer to six different trading divisions managed as business entities by their own divisional management teams. The Bachelor of Commerce degree is only offered at one of these brands, which has three sites located within the Gauteng province. Consequently, lecturers from these three sites of delivery were approached to partake in the study. The number of module lecturers depended on the number of students enrolled for this particular qualification – and its modules – at a particular site of delivery. Those module lecturers selected to participate in the study were required to have lectured the module for at least one offering and had to have demonstrated some activity on the online platform in which the online learning material is presented. The reasons for the criteria relating to the selection of the module lecturers are elaborated on in Chapter 4. According to Du Plooy-Cilliers *et al.* (2014:143), elements that fall outside of the required criteria of the non-probability purposive sampling should be disregarded. For this reason, module lecturers who did not fall into the classification of lecturing the module for at least one offering with demonstrated activity on the online learning platform as per the required criteria were disregarded from the sample of module lecturers. The data gathered from these three levels of 'actors' allowed for the crystallisation of the data as discussed in Chapter 4 and 5.

1.4.4 Data collection techniques

The nature of the primary research question lends itself to a qualitative data collection strategy as it was a small-scale study aimed at gathering focused rich data, rather than a broader range of data generated through quantitative data collection. Qualitative data collection allowed the researcher to focus on each participant to attain quality information in order to understand the phenomena through the eyes of the individuals (Maree, 2007:51). The instrumentation and data-collection methods used in collecting focused rich data included:

- document analysis (also referred to as content analysis) of the online learning material and learning activities of the Business Management modules in the

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Bachelor of Commerce degree to determine how, if at all, WBTL has been applied in the design of the learning activities;

- semi-structured interviews with the HoP and the IDs from the CAT at the PHEI to ascertain their perspective of WBTL and its relevance to learning-activity design; opinion on the relationship between learning-activity design and student achievement; how he/she designed the learning activities of the Business Management modules in accordance with a WBTL approach; suggestions to enhance the application of a WBTL approach to learning-activity design; and
- scheduled non-participant observation of classes presented by the selected module lecturers to observe the conversion of the learning activities into the delivery of the Business Management modules in class.

These sources of information allowed for the crystallisation of the data to ensure a range of perspectives on how WBTL has been applied within the design of the learning activities within the Business Management modules offered in the Bachelor of Commerce degree are provided and to determine if the application of a WBTL approach is evident.

1.4.5 Data analysis and interpretation

The Herrmann WBTL Model (Herrmann, 1995:220) together with the Herrmann Brain Dominance Instrument (HBDI) (Herrmann, 1995) are used as organising tools for data analysis. As organising tools, the WBTL model and HBDI assisted in organising the learning activities within each module into the four thinking structures of the brain – thus linking the learning activities to different thinking and learning styles or thinking and learning preferences. It is a model for understanding the complex task of realising whole-brain teaching and learning. The model and instrument allowed for the analysis of the documents related to the actual ‘official’ learning activities of the modules and the associated or ‘unofficial’ learning activities of the modules. Moreover, the model and instrument allowed for the identification of how, if at all, a WBTL approach has been applied in the design of the learning activities within the selected modules. The model and instrument further provided categories that allowed for the use of qualitative thematic data analysis. According to Maxwell (2008:236–238), qualitative thematic data analysis

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involves breaking down data into categories that enable the data to be analysed, compared and contrasted, in order to interpret and make sense of it. Maree (2007:100) posits that the aim of qualitative data is "to interpret and make sense of what is in the data". In order to achieve this, the researcher was required to be creative and disciplined, and the researcher had to follow a systematic approach (Maree, 2007:100). Document analysis that formed the central data source of this study is in itself a systematic procedure for reviewing and evaluating documents (Bowen, 2009:27). The document analysis in combination with data sources that included the semi-structured interviews and observations were used to facilitate crystallisation (Maree, 2007:41).

1.5 Credibility and trustworthiness

Lincoln and Guba (1985:219, 247; also see Veal, 2011:47) have introduced the concept of trustworthiness, particularly in qualitative research. To increase trustworthiness in a qualitative study, authors such as Lincoln and Guba (1985:219, 247) as well as Denzin and Lincoln (2011:646), suggest that researchers pay attention to the following four dimensions: credibility (alternative to internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity). Tracy (2010:839) adds more dimensions to consider and posits that quality qualitative methodological research is marked by a worthy topic, rich rigour, sincerity, credibility, resonance, significant contribution, ethics and meaningful coherence. Therefore, the researcher should conduct research on a worthy topic that is relevant, timely, significant and interesting (Tracy, 2010:840).

The topic selected for this study is relevant, addressing contextual priorities of the PHEI and is therefore deemed a worthy topic. Moreover, to achieve rich rigour, the researcher should consider whether the study is based on suitable theoretical constructs; there are enough data to support significant claims; enough time has been spent on gathering data; the sample used is appropriate; and the methods used to gather the data are appropriate (based on the guidelines provided by Tracy, 2010:841). This study is based on suitable theoretical constructs as discussed in Chapter 2 and Chapter 3. In addition, sufficient data was gathered to support findings. Furthermore, the researcher spent enough time on

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gathering the data using an appropriate sample and appropriate methods as detailed in Chapter 4. In order to achieve qualitative credibility, research practices should also include enough detail and explanation (thick description) to show the complexity of the data (Tracy, 2010:843). Providing rich descriptions of the participants and the context, for example, can also facilitate generalisability (external validity) (Maree, 2007:37-38). Researchers should also use multiple types of data and numerous theoretical frameworks in order to provide a more complex, in-depth understanding of the issue (triangulation and crystallisation) (Lincoln & Guba, 1985:305; Tracy, 2010:843). More importantly, the researcher should include different perspectives (multivocality) and employ various methods to draw a conclusion. By engaging multiple methods of data collection, the research will also be considered trustworthy (Lincoln & Guba, 1985:305; Maree, 2007:80). Credibility (internal validity) is also achieved by demonstrating that the conducted inquiry accurately identifies and describes these theoretical frameworks (De Vos, Strydom, Fouché, & Delport, 2011:420). Credibility in this study is achieved by providing detailed descriptions (where appropriate) as well as the multiple methods of data collection that were used. Theoretical frameworks are accurately described with a particular focus on Herrmann's Whole Brain Model (1995).

To ensure dependability (reliability), a researcher should provide evidence generated through the triangulation and crystallisation of the data collected (Eisner, 1991:110; Lincoln & Guba, 1985:317; Maree, 2007:38). The document analysis in combination with data sources that included the semi-structured interviews and observations were used to facilitate crystallisation in this study . To make a significant contribution on a range of levels, such as theoretical, practical, ethical and methodological, it is imperative that the study does what it claims to do, uses suitable methods, and makes meaningful connections between the literature, findings and interpretations (meaningfully coherent) (Tracy, 2010:844; 846; 848). In addition, the researcher should be honest and transparent about any biases, goals and weaknesses, and how these influenced the research (sincerity) (Tracy, 2010:841). By disclosing researcher bias, internal validity is also enhanced (Yazan, 2015:150). This study achieves what it set out to achieve, uses appropriate methods and makes meaningful connections based on the literature used.

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The researcher is honest and transparent clearly indicating any biases and weaknesses within the study. The researcher especially considered the positionality of the researcher as an employee of the PHEI where the study was conducted. The way in which the research report is written and the research transferability leads to resonance. Transferability, according to Lincoln and Guba (1985:316), relates to whether the findings of the research can be transferred from one case to another. Resonance refers to the ability of the research to have a meaningful widespread influence and effect an audience (Tracy, 2010:845). It is believed that the findings of this study can be transferred from this study to another and that it can affect an audience. From an ethical perspective, the researcher should take a holistic approach to research ethics (Tracy, 2010:847) as described further in Section 1.6.

1.6 Ethical considerations

A number of ethical issues and concerns should be considered when conducting a qualitative study (Henning, Van Rensburg, & Smit, 2004:73). The ethical issues and concerns include, for example, informed consent, anonymity, confidentiality, the right to withdraw, and ethical approval. In addition, the Principles of Professional Responsibility described by the American Anthropological Association (2012) address other ethical concerns that should also be considered. These ethical concerns include, for example to:

- do no harm;
- be open and honest regarding the research;
- obtain informed consent as well as other necessary permission;
- carefully weigh competing ethical obligations to research participants, students, professional colleagues and employers, among others;
- make the results of the research accessible (if appropriate); and
- protect and preserve research records/data; and to maintain respectful and ethical professional relationships with others.

The ethical considerations for this particular study include submitting an application for approval to conduct this study to the Research Ethics Committee (REC) of the University of Stellenbosch following the Standard Operating Procedure. In line with policies and procedures for research related to the PHEI, the researcher was required to apply for

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ethical clearance from the PHEI itself in order to obtain written consent from the PHEI prior to making contact with the identified participants. Consequently, an application for both ethical clearance and permission to conduct the study was submitted to the PHEI. Ethical clearance and approval was received from both the University of Stellenbosch and the PHEI (refer to Addendum A & B). The PHEI also provided written consent to conduct the study at the sites of delivery indicated (refer to Addendum C). This study also required the identified participants, which included the HoP, the IDs and the module lecturers within the PHEI, to provide written consent to taking part in the study, as well as to conduct and record the scheduled interviews and observations (refer to Addendum D). The PHEI, as well as the identified participants, were informed about the reason for the study, what their participation would entail, and what their rights as participants are. Information related to the PHEI and the personal details of the participants was treated as confidential. Participants were kept anonymous. Research results are available to the PHEI and, by discretion of the PHEI, to the participants. All research records and data are password protected and stored either in a lockup cupboard or on a central server, the files of which are only accessible by the researcher. Throughout the study, the researcher maintained a respectful and ethical professional relationship with representatives of the PHEI as well as the research participants. Furthermore, the researcher carefully weighed competing ethical obligations to research participants, professional colleagues and employers.

1.7 Limitations and delimitations of the study

This study is limited to one PHEI in South Africa. It is further limited to the application of a WBTL approach to learning-activity design for the Business Management modules in the Bachelor of Commerce degree offered by the PHEI. Therefore, it is not representative of all learning activities in all modules on all levels offered by the PHEI. The Business Management modules are, however, representative in that they are high-impact modules that are not only offered in the Bachelor of Commerce degree, but also in various other qualifications. Only the HoP who is the custodian and learning-activity designer, developer and/or moderator (quality assurer) of the Business Management modules was included in the study. Even though it is representative of HoPs within the discipline of

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Business Administration and Management in one faculty, it is not representative of all HoPs within all disciplines in the four faculties within the PHEI. Similarly, only the IDs who reworked and designed learning activities for deployment on the online learning platform of the selected modules are included. The study is further limited in terms of the brand sites selected to form part of the study, and the number of participants from or associated with the PHEI – i.e. the module lecturers at brand and site level. Only the three brand sites offering the Bachelor of Commerce degree and the associated Business Management modules within the Gauteng province were considered for inclusion in this study. In addition, only a sample of module lecturers meeting the criteria set by the researcher was included in this study.

1.8 Chapter outline

This thesis is presented in six parts, namely:

- Orientating relative to the research that was conducted (Chapter 1);
- Defining and discussing learning styles; examining the complexity of the learning-styles field; investigating the critique of learning styles; discussing different types of learning-style models and providing reasons for choosing Ned Herrmann's whole-brain model in the study (Chapter 2);
- Discussing Herrmann's Whole Brain Model (1995) in greater detail (Chapter 3);
- Explaining in detail the research design and methodology used in the study (Chapter 4);
- Discussing the empirical part of the study that examined how the principles of a WBTL approach was applied to the design of learning activities of the Business Management modules offered in the Bachelor of Commerce degree (Chapter 5); and
- Discussing possible implications of the findings in this study for the application of the WBTL approach to the learning-activity design of the Business Management modules within the Bachelor of Commerce degree (Chapter 6).

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1.9 Summary

This chapter provided an overview of the study comprising an introduction, the background of the problem and the problem statement. It further introduced the aim of the study and the research purpose as well as a brief overview of the research design and research methodology that will be expanded on in Chapter 4. In addition, Chapter 1 briefly described the ethical considerations as well as limitations of the study. In the following chapter, Chapter 2, learning styles will be defined and discussed in greater detail – not only examining the complexity of the learning-styles field, but also investigating the critique of learning styles. Chapter 2 also discusses six different learning-style theories and models with the aim of demonstrating why Ned Herrrman's whole-brain model is the most suitable for the study. In addition, Chapter 2 provides the researcher's considerations in choosing Ned Herrmann's whole-brain model, which is discussed in detail in Chapter 3.

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CHAPTER TWO

OVERVIEW OF RELEVANT LEARNING STYLES LITERATURE

2.1 Introduction

Chapter 2 focuses on the complex nature of learning styles. An exploration of the definition of learning styles will be crucial in order to contextualise the complexity of this field, and the critique against it. The chapter further provides an overview of six learning-style models and theories with demonstrably greater reliability and validity. In particular, the focus is on the application of the learning-style theories and models as tools to investigate phenomena beyond the theory itself – thus not trying to prove or test any of the theories. This chapter concludes with the considerations of the researcher as motivation for choosing Ned Herrmann's whole-brain model (1995) for this study.

2.2 Learning styles

2.2.1 Learning styles defined

Over the past 30 years, the theory and practice of learning styles has generated great interest and controversy. According to Scott (2010:6), learning styles as a field of study is characterised by considerable conceptual confusion, as well as a lack of a generally accepted definition. However, Keefe's widely used definition is provided here. According to Keefe (1979:1), a learning style represents "the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment." In order to understand this definition, the three factors included need to be described further. Cognitive factors relate to the individual student's way of processing information – i.e. the typical way that an individual student perceives, thinks about, organises, and remembers information, as well as how that student solves problems (Keefe, 1979:8). The affective factors include personality characteristics that are concerned with attention, emotion, and valuing. These factors are the product of motivational processes – i.e. the characteristic way of arousing, directing and sustaining behaviour. The cultural environment, external pressures, and personality factors in which values play a significant role often influence

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motivational processes (Keefe, 1979:8). The physiological factors relate to the biological influences of an individual student on the learning process. These factors include responses to the learning process based on sexual differences, nutrition and health, and characteristic responses to the environment (Keefe, 1979:8). The cognitive, affective, and physiological factors that affect learning are numerous, interconnected, and influenced by several uncontrollable variables. It is therefore difficult to isolate the effect of any given factor (Popescu, 2009:1). In addition to the already complex nature of learning styles deduced from this definition, the literature contains a variety of theories and models on learning styles that add to the criticism against the field.

2.2.2 Learning style criticism

The most frequently raised criticisms regarding learning styles include the complex nature of learning styles boosted by a proliferation of terms and concepts (which sometimes overlap), as well as the large number of learning-style theories and models of which none are unanimously accepted (Cassidy, 2004:420; Coffield *et al*., 2004a:2; Curry, 1990:50; Popescu, 2009:4). Inventories used in the field are psychometrically weak, neither demonstrating internal consistency and test-retest reliability, nor construct and predictive validity (Coffield *et al*., 2004a:2; Curry, 1990:50; Popescu, 2009:4; Reid, 2005:53). Some learning-style instruments or models have also been sharply criticised as the developer of these instruments and models conducted research into the instruments they sell, therefore leading to bias resulting from the possibility of vested interest (Coffield *et al*., 2004a:46). In addition, psychometric instruments can usually only be applied once per student. Moreover, the accuracy of self-perceptions is questionable as it can be misleading, and answers can be fake, giving a distorted impression (Honey & Mumford, 2000:20; Popescu, 2009:4). Assumptions made by some learning-style models that disregard the brain's interconnectivity are also scrutinised by neuroscientists claiming that these assumptions are unsound (Howard-Jones, 2014:2). From a teaching-methodological perspective, Reid (2005:83) posits that it is practically impossible to accommodate each individual student's learning style in a classroom set-up but suggests that the activities and materials used should, however, cover a wide range of styles.

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Despite these criticisms, researchers persist in the field. A survey of 94 learning- and cognitive-style researchers indicated that 70% believe that the field had value and over 80% thought it is moderately to very important for teachers, lecturers and students to be aware of learning-style issues (Peterson, Rayner & Armstrong, 2009:518-519). However, these researchers are aware and concerned about similar issues to their critics. The consensus is that researchers should actively address these concerns by working towards clarifying key definitions and seeking a consensual, coherent and shared theory (Peterson *et al*., 2009:522). In addition to these researchers' input, a strong intuitive appeal to the notion of individual preferences and styles of learning remain. Evidence for the idea that we have individual learning styles appear to be offered when noticing the differences in the speed and manner that students 'learn' (Coffield, Mosely, Hall & Eccleston, 2004b:1). Therefore, it appears that, despite the critique offered, learning-style theories and models are still used in practice. The advice from Coffield *et al*. (2004b:36-37) is for these practitioners to be highly selective as it matters which learning-style theory and model is used. Coffield *et al*. (2004b:51) recommend the use of "those models which have proved to be the most psychometrically sound and ecologically valid", as discussed below in Section 2.2.3.

2.2.3 Learning-style theories and models

A survey by Coffield *et al*. (2004a) reports no less than 71 different models and theories on learning styles. The report further presents these learning-style theories and models as well as their related instruments on a continuum in order to organise the different theories and models according to some overarching ideas behind them (Coffield *et al.*, 2004a:10). Furthermore, these learning-style theories and models were grouped into five categories onto the continuum as illustrated in Figure 2.1. On the left-hand side of the continuum, the report places theorists that consider learning styles to be fixed, even determined by genetics. On the right-hand side of the continuum, the report places theorists with a strong belief that learning styles are variable and that students have the option to move between them (Coffield *et al.*, 2004a:10).

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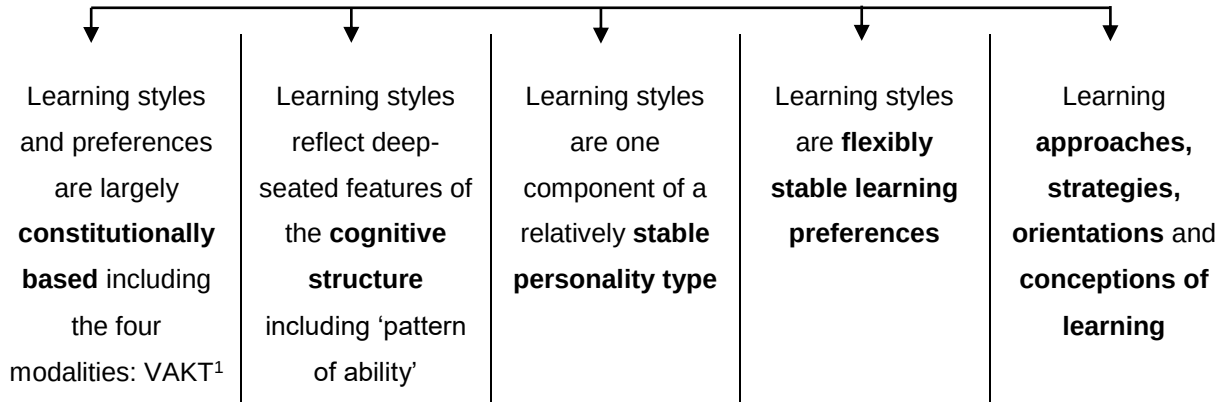

Figure 2.1 Family of learning styles (Coffield *et al.*, 2004a:10)

Of the 71 models, 13 of the most influential or potentially influential learning-style theories and models, as well as their related instruments, were identified and selected to be studied in more depth. Coffield and his team investigated the validity and reliability of each of these 13 learning-style theories and models and found seven that demonstrably had greater reliability and validity than the rest. Of these, they (Coffield *et al*., 2004a:139) recommend the use and further research of the following six theories and models:

- Allinson and Hayes' Cognitive Style Index (1996);
- Apter's Reversal Theory and Motivational Styles Profiler (1998);
- Entwistle's Approaches and Study Skills Inventory for Students (2000);
- Jackson's Learning Style Profiler (2002);
- Vermunt's Inventory of Learning Styles (2005); and
- Herrmann's Whole Brain Model (1995).

The following sections (Sections 2.2.3.1 to 2.2.3.6) provide an overview of these six theories and models.

[1] VAKT = visual, auditory, kinaesthetic, tactile

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2.2.3.1 Allinson and Hayes' Cognitive Style Index

Christopher Allinson and John Hayes developed the Cognitive Style Index (CSI) as a result of their research into Honey and Mumford's Learning Styles Questionnaire (LSQ). Allinson and Hayes identified two factors – namely, "action" and "analysis" – in the Honey and Mumford's LSQ. In addition, they also found problems with existing ways of measuring cognitive style and therefore decided to develop an easy-to-use instrument with a three-point rating scale. The single dimension measured with this instrument is intuition at the one extreme and analysis on the other (Coffield *et al.*, 2004a:85). According to Allinson and Hayes (1996:122), intuition versus analysis is the most basic dimension of cognitive style. The 38 items identified and used in the CSI echo their belief that:

> "Intuition, characteristic of right-brain orientation, refers to immediate judgement based on feeling and the adoption of a global perspective. Analysis, characteristic of left-brain orientation, refers to judgement based on mental reasoning and a focus on detail" (Allinson & Hayes, 1996:122).

Allinson and Hayes (2000:161) further posit that a right-brain dominant individual is an individualist. A right-brain dominant individual prefers to solve problems using a holistic approach and does not like tasks that are restrictive in nature. Conversely, a left-brain dominant individual is more likely to be more accommodating, preferring to solve problems that require a step-by-step approach. These individuals are also more likely to like structured tasks. Studies found a relationship between the CSI scores and entrepreneurial behaviour; leader-member relationships; mentor-protégé relationships; relationships between supervisors and research students; relationships between lecturers and undergraduate students; group behaviour and performance-management education (Hayes, Allinson, Hudson & Keasey, 2003:276). Furthermore, Allinson and Hayes (2012:34) suggest the use of the CSI scores of students to match their cognitive- or learning-style orientation to the learning activity in order to improve cognitive performance and the effectiveness of training. Attention is drawn to the benefits "of developing a range of activities, each designed to offer the same content in a way that matches different cognitive styles, or the design of a single activity that accommodates a

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range of cognitive styles" (Allinson & Hayes, 2012:34). This approach results in learning activities designed to accommodate the whole brain. Therefore, using the CSI for this study was considered. However, according to Coffield *et al*. (2004a:139), the CSI was designed to be used by managers, in the field of business, and teachers, in the field of educational management, focusing on decision making and other procedures at work (Coffield *et al*., 2004a:139). It therefore appears not to be appropriate for use as a tool in learning-activity design for students. In addition, Petty (2006:34) states that the "Allinson and Hayes' system is like a simplification of Herrmann's, but research evidence and factor analysis show that Herrmann's model is the strongest." Accordingly, the decision was made not to use the Allinson and Hayes' CSI for this particular study.

2.2.3.2 Apter's Reversal Theory and Motivational Styles Profiler

The Motivational Styles Profiler (MSP), based on the Reversal Theory by Michael Apter, measures personality in terms of the different ways in which an individual orientates themselves in the world in relation to certain fundamental psychological needs (Apter, Mallows & Williams, 1998:7). The MSP is used to gain a clear picture of an individual's personality, as well as to obtain information about motivational characteristics, which interact with dominances within the individual profile (Apter *et al*., 1998:17). Apter's theory provides a deeper understanding into human behaviour and experience – it features the dynamic interplay that occurs when motivational states are reversed (Apter, 2001:317). The individual profile is viewed in terms of changes within and between four domains: means-end, rules, transactions, and relationships. The application of the reversal theory and use of the MSP appear to be more successful when used in practice in such areas as management consultancy, athletic coaching, marital counselling, and addiction therapy. Other topics that have been addressed by, and into the theory, include topics related to stress, anxiety, depression, gambling, corporate culture, and military combat, to name but a few (Apter, 2013:1). Reversal theory is not a theory of learning style (Coffield *et al*., 2004a:52). However, it was included in the evaluation done by Coffield and team as learning cannot be understood in isolation from motivation. Furthermore, reversal theory is intended to have wide application. Some key concepts in reversal theory that are relevant to learning and instruction and of great interest to educators

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include achievement, motivation, boredom, frustration, satiation, arousal seeking, arousal avoidance, and cognitive synergy (Coffield *et al*., 2004a:56).

Even though Apter's reversal theory of motivational styles and the MSP have major implications for how we think about learning styles, the implications of reversal theory for learning have not been fully elaborated on or widely researched. There are merits for further research and development in the educational contexts in using this theory and model (Coffield *et al*., 2004a:55). However, for this particular study, the application of this theory and model using the MSP would not have answered the primary and secondary research questions posed in Chapter 1. The primary and secondary research questions pertain to the application of a whole-brain teaching and learning approach to learning-activity design. The MSP, however, provides information pertaining to the motivational states of an individual and how it affects his/her behaviour in a given scenario. It does not provide information relevant to whole-brain teaching and learning. The MSP could provide information on how learning activities or events affect the motivational states of an individual or vice versa. However, this is not the aim of this study. Consequently, this learning style theory and model was not used.

2.2.3.3 Entwistle's Approaches and Study Skills Inventory for Students

Research conducted by Entwistle and colleagues on student learning that began with interviews led to the construction of inventories assessing the predominant approach students use to learn. This research led to the construction of the Approaches and Study Skills Inventory for Students (ASSIST) (Tait, Entwistle & McCune, 1998). The components of the ASSIST inventory include "deep", "strategic" and "surface" approaches to learning (Entwistle, 2000:4). In the "deep" approach to learning, the student's intention is to extract meaning. This produces active learning processes that involve the relating of ideas, the search for patterns and principles as well as using evidence and examining the logic of an argument. Moreover, this approach involves monitoring the development of one's own understanding. In contrast, the intention of students using the "surface" approach is to simply cope with the task with a view that the course constitutes unrelated

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bits of information. This results in restrictive learning processes such as routine memorisation. In the “strategic” approach to learning, the student’s intention is to achieve the highest possible marks. Students using the “strategic” approach are cognisant of the assessment procedures and processes, and they use organised study methods, good time-management and monitor their own study effectiveness (Entwistle, 2000:3).

According to Coffield *et al*. (2004a:99), the ASSIST inventory and its model can be used as:

- a diagnostic tool used by lecturers and students to discuss approaches to learning and the development thereof;
- a diagnostic tool used by course teams when talking about curriculum design as well as implementation and assessments, including different forms of student support; and
- a theoretical rationale on which to base discussions in terms of students’ learning and ways of improving their approaches to learning.

Even though the curriculum design and implementation, particularly assessment strategies, have an influence on some students’ approach to learning, and the study approach students use has an influence on student achievement (Coffield *et al*., 2004a:93; Entwistle, 2000:7-8), the application of this theory and its model was not used for this study. Similar to the previous learning-style theory and model, discussed in Section 2.2.3.2, the application of this theory and model would not have answered the primary and secondary research questions posed in Chapter 1. The ASSIST inventory provides information that relates to the approach and study methods a student adopts when learning. It does not provide information related to whole-brain teaching and learning or its application to learning-activity design.

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2.2.3.4 Jackson's Learning Style Profiler

To explain relationships between learning and personality, Jackson (2002, 2005, 2008) designed a hybrid model: the Learning Style Profiler (LSP). This learning-style theory and model is concerned with the construction of an instrument which embeds learning styles within an understanding of the personality traits that influence the way an individual interacts with the world (Coffield *et al*., 2004a:46). Learning styles are seen as a subset of personality. The LSP model measures learning preferences on four scales: impulsivity (initiator), emotional independence (reasoner), responsibility (analyst) and practicality (implementer) (O'Connor & Jackson, 2007:118; Coffield *et al*., 2004a:57). Moreover, the LSP model may also provide an understanding of functional and dysfunctional behaviour within organisational, educational, and clinical domains (Jackson, Hobman, Jimmieson & Martin, 2009:284). According to this learning-style theory and model, high scores on emotional independence and responsibility are indicative of an individual that is more likely to engage in functional behaviour, based on effective learning. Conversely, a high score on impulsivity is indicative of an individual who is less likely to engage in functional behaviours and is likely to become easily distracted despite initiating more learning opportunities. Practicality does not necessarily affect learning effectiveness, but does have an influence on preferred learning interest – i.e. practical vs. reflective. However, no studies have been published that assess the validity of the LSP (O'Conner *et al*., 2007:118; Coffield *et al*., 2004a:59). In addition, Coffield and his team could also not find sufficient evidence to support internal consistency or test-retest reliability (Coffield *et al*., 2004a:139). As a result, this model was not considered for this study. In addition, the LSP was designed to explain relationships between learning and personality. As a result, information from the LSP would not have provided relevant information related to whole-brain teaching and learning or in terms of learning-activity design in order to answer the research questions posed in Chapter 1.

2.2.3.5 Vermunt's Inventory of Learning Styles

The four learning styles identified by Vermunt display characteristic patterns across four components of learning: cognitive-processing strategies, metacognitive regulation strategies, conceptions of learning, and learning orientations (Boyle, Duffy & Dunleavy,

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2003:267; Coffield e*t al*., 2004a:103; Vermunt, 2005:212). These four components of learning are integrated into the Inventory of Learning Styles (ILS) (Boyle *et al*., 2003:267; Vermunt, 2005:212). Cognitive-processing strategies refer to the types of learning activities a student engages with to process the study material. The metacognitive-regulation strategies relate to the process of linking learning to emotional or cognitive processes (introspection, orientation). The goals set by a student, or the motivation that drives the pursuit of studies, are seen as the learning orientation; whereas the conceptions of learning constitute the student's thoughts regarding his/her own learning processes (Alves de Lima, Ines Bettati, Baratta, Falconi, Sokn, Galli, Barrero, Cagide & Iglesias, 2006:290). Depending on the student's position on the four components of learning, four learning styles can be identified (Boyle *et al*., 2003:267; Vermunt, 2005:212). These styles are: meaning-directed learning, reproduction-directed learning, application-directed learning, and undirected learning (Boyle *et al*., 2003:267; Vermunt, 2005:206). Alves de Lima *et al*. (2006:290) summarise the four learning styles demonstrating a student's approach to learning as follows:

- Construction-directed Learning Style (meaning-directed): in order for the student to best understand the learning material, the student attempts to find links within the learning material in order to develop a critical view, and an integral comprehension;
- Application-directed Learning Style: the student tries to find physical ways to apply the information he or she is studying;
- Reproduction-directed Learning Style: the learning material is studied in detail and the student attempts to memorise the content in order to reproduce it for an exam; and
- Undirected Learning Style: the student uses secondary/high-school study habits as he/she has not yet developed a clear strategy that is suitable for university-level studies.

The ILS assesses approaches to learning and can therefore be used to reflect on students' current approaches in order to develop more productive approaches to learning. Moreover, the approach to learning may also affect the teaching practices of lecturers. Therefore, the ILS can be utilised as a basis for developing more objective, contextually

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appropriate teaching methods, particularly in relation to student and teacher regulation of learning (Coffield *et al*., 2004a:108-109). Similar to the other learning-style theories and models described in Section 2.2.3.2 to 2.2.3.4, the application of this learning-style theory and model using the ILS would not have provided relevant data to answer the research questions posed in Chapter 1. As a learning-style theory categorised under the learning approaches, strategies, orientations and conceptions of learning, the ILS provides information that also relates to the approach and study methods a student adopts when learning. As a result, it does not provide information related to whole-brain teaching and learning or its application to learning-activity design.

2.2.3.6 Herrmann's Whole Brain Model

Herrmann (1995) developed the Herrmann Brain Dominance Instrument (HBDI) as a result of research into electroencephalographic (EEG) assessment of the human brain (Herrmann & Herrmann-Nedhi, 2015:16). The HBDI is a self-administered test consisting of 120 items. The individuals' learning style profile is mapped on a circular grid and is expressed in a four-digit code – that is, a number for each quadrant. The number indicates the strength of preference for the specific quadrant linked to the four-part model developed by Herrmann (Herrmann, 1995:70). Herrmann's experimentation and analysis of MacLean's (1952, 1990) triune brain theory and Sperry's (1990) left-brain/right-brain theory led him to combine elements of these two theories into a four-part model (Herrmann, 1995:39). This four-part model serves as a metaphoric four-quadrant model of the brain that represents the interconnected yet specialised 'whole thinking' brain (Herrmann *et al*., 2015:20). Herrmann *et al*. (2015:20) posits that there are four thinking preferences. However, these four thinking preferences function together as a whole. According to Herrmann (1995:127), learning requires a balance of the four quadrants. In other words, students should have equal access to each quadrant.

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Quadrant A students learn by: • obtaining and considering facts • analysing and using logic • building cases • formulating theories **These students respond well to:** • formal lectures • factually based content • discussion about financial or technical situations • textbooks and bibliographies • behaviour modification program learning	**Quadrant D students learn by:** • taking initiative • delving into hidden alternatives • relying on intuition • self-discover • forming concepts • integrating the content **These students respond well to:** • spontaneity • experiential opportunities • experimentation • playfulness • individuality • discussions that are focused on the future • visual demonstrations • aesthetics • being involved • free flow
Quadrant B students learn by: • organising and structuring the content of material • placing the content in sequence • evaluating and testing theories • developing skills through practice • putting content into practice **These students respond well to:** • thorough planning • sequential order • discussions of organisational and administrative situations • textbooks • structure • lectures • behaviour modification program learning	**Quadrant C students learn by:** • listening and sharing ideas • integrating experiences with the self • moving and feeling • harmonising with the content • becoming emotionally involved **These students respond well to:** • music • discussions of people-centred situations • sensory movement • group interaction experiential opportunities

Figure 2.2 HBDI characteristics of learning styles (Herrmann, 1995:419)

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Quadrant A represents factual, rational, logical, analytical, and critical thinking; Quadrant B represents organised, planned, and controlled thinking; Quadrant C represents intuitive, symbolic, and a people-orientated approach to thinking; Quadrant D represents creativity and innovation, holistic, imaginative, and strategic thinking (Hughes, Hughes, & Hodgkins, 2016:3). Within each quadrant, as depicted in the HBDI model, characteristics of the learning styles can be identified as indicated in Figure 2.2. By considering the characteristics of learning styles presented in Figure 2.2, it can, for example, be extrapolated that students from Quadrant A tend to approach problems with factual, rational, logical, analytical, and critical thinking, while decisions and actions are based on logical reasoning. The approach of a Quadrant A student to solve problems implies a mind-set consistent with facts, evidence, and problem-based learning techniques (Hughes *et al*., 2016:5). Therefore, a lecture about key principles and theory of a set of facts or constructs should be preferred by Quadrant A students (Hughes *et al*., 2016:6). Herrmann (1996:151) further hypothesised that teaching methods – i.e. learning activities – can target and develop specific learning styles, keeping in mind that within a class a complete spectrum of learning-style preferences is more than likely to be present (Hughes *et al*., 2016:7). Therefore, Herrmann recommends whole-brain teaching and learning (Herrmann, 1996:151).

Based on this brief description of Ned Herrmann's whole-brain model and the HBDI, it appears that various learning activities can be linked to a particular quadrant. Thus, it appears that using this model, its associated models (as described in Chapter 3) and the HBDI as organising tools in organising the learning activities of the Business Management modules into the four quadrants of the metaphoric whole brain would provide relevant data in order to answer the questions posed for this study.

In addition to considering the possibility of gathering relevant data in order to answer the research questions posed, considering the critique against the learning-styles field, following the advice and recommendations by Coffield *et al*. (2004b:36-37, 51) seemed appropriate in selecting a learning-style theory and model. Consequently, the first consideration in deciding on a particular learning style theory and model to use for this

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study was to review the psychometric recommendations. Of the six-learning style theories and models described in this chapter, the Cognitive Style Index (CSI) by Allinson and Hayes received the best psychometric reference. The CSI met all four minimal criteria, namely: internal consistency, test-retest reliability, construct validity and predictive validity (Coffield *et al*., 2004a:141). However, as indicated in Section 2.2.3.1, the CSI appears not to be appropriate for use as a tool in learning-activity design for students. It also appears to be a simplification of Herrmann's model which is deemed a stronger model. The Herrmann Whole Brain Model (1995), on the other hand, met two of the four minimum criteria, namely, test-retest reliability and construct validity, with inefficient evidence to either support or deny the other two criteria (Coffield *et al.,* 2004a:140).

The second consideration in deciding on a particular learning-style theory and model to use for this study relates to the belief that effective learning only takes place if the whole brain is involved in learning (Buzan, 1991:33–34; Jensen, 2008:22). Closely related to this belief is the interconnectivity of the brain which, according to Howard-Jones (2014:2), is not necessarily supported by learning-style theories and models. Herrmann *et al*., (2015:20-21), however, realised the interconnectedness of the brain and that understanding of our preferred patterns of thinking was more important. Therefore, Herrmann (1989, 1995, 1996) developed a metaphoric model of brain function demonstrating the four interconnected clusters of specialised mental-processing modes functioning together situationally and iteratively. These four clusters of specialised mental-processing modes make up the whole brain in which one or more parts naturally become more dominant (Herrmann *et al*., 2015:21). Based on his research, Herrmann recommends "whole brain teaching and learning" (Herrmann, 1996:151). In addition, the Herrmann Whole Brain Model (1995), more than any of the other learning-style theories and models reviewed by Coffield *et al*. (2004a), "encourages flexibility, adaptation and change, rather than an avoidance of less preferred activities", thus encouraging the involvement of the entire brain in learning (Coffield *et al*., 2004a:139).

The third consideration relates to the fit for purpose. Considering the six-learning style theories and models described in this chapter and the application of their instruments, the

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Herrmann Whole Brain Model (1995) was the only one, besides the Cognitive Style Index (CSI) by Allinson and Hayes, that could provide relevant data to answer the research questions posed for this study. The above mentioned considerations are the primary reasons for the researcher choosing Herrmann's whole-brain model for this study. In Chapter 3, Ned Herrmann's whole brain model, its application and relevance in learning-activity design is discussed in greater detail.

2.3 Summary

This chapter provided a definition of learning styles as well as investigated the complex nature and some critiques against the learning-styles field. Despite the complex nature and critique against the learning-styles field, researchers persist due to the general belief that the field has value. However, researchers are cautioned to be selective when choosing a learning-style theory and model, and to use models that have proved to be the most psychometrically sound. As a result, this chapter provided an overview of the six learning-style models and theories with demonstrably greater reliability and validity. It also provided the researcher's considerations in choosing a particular learning-style theory and model for this study – i.e. Ned Herrmann's whole-brain model, which is described in more detail in Chapter 3.

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CHAPTER THREE
OVERVIEW OF NED HERRMANN'S WHOLE BRAIN MODEL

3.1 Introduction

Chapter 3 elaborates on Ned Herrmann's whole-brain model. This chapter includes some biographical information on Ned Herrmann that relates to his interest and further research on the human brain. Furthermore, this chapter provides detailed information about the theoretical components that led Herrmann to the development of the Herrmann Whole Brain Model (1995). The Herrmann Whole Brain Model (1995) and its associated models are discussed with a particular focus on the Whole Brain Teaching and Learning Model (1995). This chapter further provides information that addresses two of the subsidiary research questions posed in Chapter 1, namely: *What is Whole Brain Teaching and Learning (WBTL)*; and *What is the relevance of WBTL in learning activity design in the context of student achievement?*

3.2 Ned Herrmann – the originator of the whole brain model

After completing his bachelor's degree, majoring in both physics and music, Ned Herrmann joined the General Electric Company (GE) in America. Herrmann worked his way through various positions in the organisation, finally finding his calling as corporate manager of management education (Herrmann, 1995:3, 5). Balancing his personal duality – i.e. his professional career and his interest in music and drama – within his professional life at GE was impossible. Consequently, he pursued his love for music and, in particular, singing after hours (Herrmann, 1995:5). However, in 1963 his singing was ended due to a debilitating condition frequently resulting in blackouts, mainly brought on by the act of singing. Herrmann thought that this was the end of his artistic life until he turned his creativity towards painting and sculpting (Herrmann, 1995:5). He created more than 600 paintings and 100 sculptures of which three quarters were sold. This creative outburst awakened his interest in the subject of artistic creativity which led him to research the human brain (Herrmann, 1995:6, 7).

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Among others, the insights gained from his research findings led Herrmann to a new understanding of the learning process, which was his primary professional concern as the corporate manager of management education at GE (Herrmann, 1995:25). Aspects of brain-research breakthroughs related to the functional specialisation, interconnectedness, iterative functioning and situational functioning of the brain contributed to Herrmann's understanding of brain functioning in general. Considering and adding concepts related to the brain hypothesis, the neuron hypothesis, the triune brain theory, the left-brain/right-brain theory and the certainty of brain dominance provided Herrmann with the essential elements of an organising principle upon which a workable model could be based (Herrmann, 1995:39). As a result, Herrmann developed the whole-brain model. Herrmann's whole-brain model consists of two theoretical components, namely: functional specialisation, and dominance (Benziger & Sohn, 1993:245; Herrmann, 1995:39). In order to understand Herrmann's whole-brain model, it is therefore necessary to discuss these two theoretical components.

3.3 Theoretical components of Herrmann's whole brain model

According to Laxman and Chin (2010:1), it is important for educators to understand the brain as the organ of learning in order to make the classroom a place of meaningful learning. Knowledge of the modalities of the brain could assist educators to leverage specific teaching and learning approaches effectively (Fathima, Sasikumar & Roja, 2012:9; Laxman & Chin, 2010:1). Therefore, it is important for educators to have an understanding of the functional specialisation of the brain. In Section 3.3.1, the functional specialisation of the brain is described in relation to MacLean's (1990) triune brain theory and Sperry's (1990) left-brain/right-brain theory.

3.3.1 Functional specialisation

Functional specialisation[2] means that certain areas of the brain are specialised to

[2] There is a common misconception that human beings only use a small percentage of the brain. It is further proposed that human beings would be more intelligent and creative should a larger percentage of the brain be used and that the loss of a part of the brain would not have an effect. This is not true as areas within the human brain are highly specialised and any loss (even a small part) would result in loss of that areas function (Gazzaniga & Heatherton, 2003:101).

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perform a specific task or function (Benziger *et al*., 1993:245; Gazzaniga & Heatherton, 2003:100; Herrmann, 1995:11). The two brain theories that were combined to develop Herrmann's whole-brain model and that support the idea of functional specialisation – namely, MacLean's (1990) triune brain theory and Sperry's (1990) left brain/ right brain theory (Herrmann, 1995:39) – are elaborated on in Section 3.3.1.1 and Section 3.3.1.2 respectively.

3.3.1.1 MacLean's triune brain theory

The leading brain researcher of the 20th century and previous head of the Laboratory for Brain Evolution and Behaviour at the National Institute for Mental Health in Washington, DC, Dr Paul MacLean, theorised that the human brain consists of three smaller 'brains': the reptilian brain, the mammalian (paleomammalian) brain, and the neo-mammalian brain (neocortex) as illustrated in Figure 3.1 (Hart, 1975:54; Herrmann, 1995:31; MacLean, 1990:9). According to this theory, the three brains are defined biologically, electrically and chemically based on patterns of development and evolved functioning (Hannaford, 1995:31). However, MacLean (1990:9) clearly indicates the interconnectedness of these three brains – i.e.: "Our brain as a whole is not harmonious, but works through a precarious, constantly changing balance of these three 'partners'." Each of the three 'partners' (that is, brains) as identified by MacLean will now be discussed separately in terms of location, function and pedagogical implication.

3.3.1.1.1 The reptilian brain

The reptilian brain, similar in appearance and function to that found in lizards, crocodiles and birds, is the first part of the brain to develop in human beings (Hanneford, 1995:32; Hart, 1975:55; Herrmann, 1995:31; MacLean, 1990:15, 16). The development of the reptilian brain occurs between conception and the first fifteen months after birth (Hannaford, 1995:32). It consists of the medulla oblongata, pons and midbrain, which all form the brain stem and the cerebellum (see Figure 3.2) (Benziger *et al*., 1993:249; Hannaford, 1995:32; Herrmann, 1995:31).

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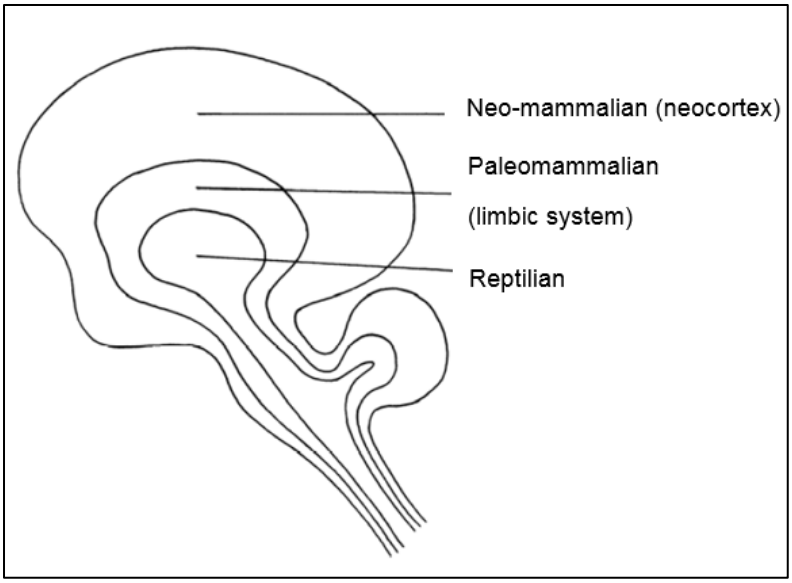

Figure 3.1 The triune brain (Herrmann, 1995:30; MacLean, 1990:9)

The medulla oblongata, pons and midbrain are also referred to as the 'reticular system'. This system plays an important role in a person's ability to adjust to constantly repeated stimuli. According to Landsberg, Krüger and Swart (2011:283), this adjustment "is necessary because we cannot possibly attend to all the stimuli impinging upon us". Therefore, the reticular system reduces distracting noises, sounds, visuals, etc. that could adversely affect us and, for example, create a barrier to learning (Landsberg *et al*., 2011:283).

The medulla oblongata develops from the myelencephalon and is a continuation of the upper portion of the spinal cord. It extends upward to the inferior part of the pons. Within regions of the medulla oblongata, several vital body functions are regulated: such as heartbeat, blood pressure, and breathing. Other regions within the medulla oblongata also coordinate swallowing, vomiting, coughing, sneezing and hiccupping (Tortora & Grabowski, 1993:412, 414). The pons is situated directly above the medulla oblongata and connects the spinal cord with the brain and parts of the brain with each other. The pons relays nerve impulses for chewing and sensations of the head and face, regulates certain eyeball movements, conducts impulses related to taste, salivation and facial expression, and is concerned with equilibrium, as well as with respiration (Tortora *et al*.,

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1993:414). Correctly interpreting facial expressions, for example, could assist educators to determine which students are experiencing performance difficulties when learning. A recent study indicated that adults, i.e. teachers, could correctly interpret nonverbal cues from facial expressions from children experiencing performance difficulties when learning (Van Amelsvoort, Joosten, Krahmer & Postma, 2013:654).

The midbrain extends from the pons and contains motor and sensory fibres, which connect the upper parts of the brain with the lower parts, as well as with the spinal cord. The midbrain serves as the reflex centres for movement of the eyes, head and neck in response to visual and other stimuli. In addition, the midbrain serves as the reflex centres for movement of the head and trunk in response to auditory stimuli, and it controls subconscious muscle activity (Tortora *et al*., 1993:414, 415).

A large portion of the reticular system consists of small areas of grey matter with additional sensory and motor functions. This portion receives input from higher brain regions that control skeletal muscles, it regulates muscle tone, and it maintains consciousness and regulates awakening from sleep (Tortora *et al*., 1993:414). The reticular system, therefore, plays an important role in the activation of attention (Landsberg *et al*., 2011:283). Attention is, for example, related to a person's ability to recall information. "If someone is not paying attention to something, they might find it harder to recall." (Lum, Greatbatch, Waldfogle, Benedict & Nembhard, 2016:1477). Thus, attention affects learning as well as the working memory of an individual.

By relaying messages to the body, the reptilian brain (reticular system) enables the body to respond to the outside world in such a way that it will ensure the body's survival. Consequently, this 'brain's' network will cause a shutdown of higher-level thinking if the body is threatened or faced by danger (Hannaford, 1995:32). The reptilian brain's task is therefore linked to self-preservation bringing about instinctive behaviours such as looking for food, grooming and the formation of social groups (Hart, 1975:56). Within social groups, according to the social-cognitive learning theory, human learning – whereby people acquire knowledge, rules, skills, strategies, beliefs, and attitudes – occurs through

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observing others (Merriam, Caffarella & Baumgartner, 2007:287-288). Therefore, it appears that the reptilian brain influences learning on various levels. The second brain identified by MacLean is the mammalian brain.

3.3.1.1.2 The mammalian brain

The mammalian brain is draped around the reptilian brain and consists primarily of the thalamus and the hypothalamus which, in turn, forms an important part of the limbic system (see Figure 3.2) (Grové, 1995:17; Hart, 1975:56; Herrmann, 1995:31; MacLean, 1990:53; Tortora *et al*., 1993:415). The thalamus is an oval-shaped structure above the midbrain. It is the principal relay station for sensory impulses that reach the cerebral cortex including hearing, vision, taste, and somatic sensations such as touch, pressure, vibration, heat, cold, and pain. The thalamus also contains centres of synapses in the somatic motor system that are related to voluntary motor actions, arousal (attention) as well as certain emotions and memory (Tortora *et al*., 1993:417). Sensory stimuli are relayed through the thalamus to the sensory association area of the neocortex where these sensory stimuli are put together into objects recognisable to us. This information is then sent to the amygdala for emotional evaluation, and to the frontal cortex for content evaluation. Based on this evaluation and analysis, the brain begins to construct meaning and, depending on its relevance, this new information is either retained or discarded. Knowledge of this process of memory could, for example, assist an educator to organise subject matter “in such a way that students could understand, restore, and retrieve the information easily and quickly” (Fathima *et al*., 2012:9).

The hypothalamus is a small portion of the mammalian brain that is located below the thalamus. It controls many body activities and is the main regulator of homeostasis in the body (Ornstein & Thompson, 1983:27; Tortora *et al*., 1993:418). Enclosing the brain stem is a circle of structures on the inner border of the cerebrum and floor of the diencephalon (mammalian brain) that forms the limbic system. The limbic system, which consists of the limbic lobe (parahippocampal, cingulate gyri and hippocampus), dentate gyrus, amygdala, septal nuclei, mammillary bodies of the hypothalamus, anterior nucleus of the thalamus, olfactory bulbs and bundles of interconnecting myelinated axons, functions in

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emotional aspects of behaviour such as pain, pleasure, anger, rage, fear, and sorrow. Therefore, the mammalian brain is often referred to as the "emotional brain" (Tortora, *et al*. 1993:422, 423). Emotions dictate what a student wants to learn, dares to learn, wants to forget and does not want to forget (Schuwirth, 2012:14,15). According to authors such as Goleman (1995), Izard (1984), LeDoux (1994), Kort, Reilly, and Picard (2001) and Piaget (1989), there is a strong correlation between emotional status and learning. "Emotions can affect attention, meaning creation, and the formation of memory channels" (Chen & Sun, 2012:1273). As a result, this "emotional brain" should be taken into consideration by educators in their teaching practice.

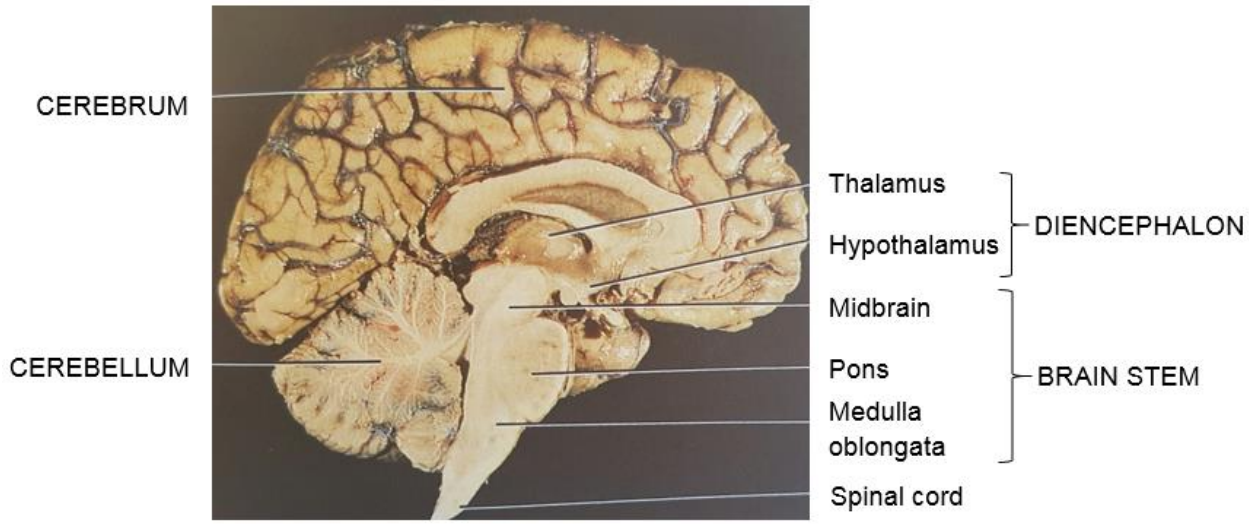

Figure 3.2 Sagittal section of the brain (Tortora *et al*., 1993:407)

3.3.1.1.3 The neo-mammalian brain

The neo-mammalian brain, also known as the cerebrum that includes the neocortex or the cerebral cortex, envelops the mammalian brain (see Figure 3.2) (Grové, 1995:21; Hart, 1975:51). It processes specific types of sensory, motor, and integrative signals in certain areas such as the sensory, motor and association areas. "Generally, the sensory areas receive and interpret sensory impulses, the motor area controls muscular movement, and the association areas deal with more complex integrative functions such as memory, emotions, reasoning, will, judgment, personality traits, and intelligence" (Tortora *et al*., 1993:423). In addition, the neo-mammalian brain is responsible for

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voluntary movements and the way human beings deal with complex external and environmental situations (Grové, 1995:21; Herrmann, 1995:31).

Within the neo-mammalian brain, thinking, planning, reasoning, decision-making, calculating and formulating takes place (Grové, 1995:21). The neo-mammalian brain is furthermore divided into two cerebral hemispheres: the left and the right. These hemispheres are connected by the corpus callosum that disseminates information from the cerebral cortex from the one side of the brain to the other side (MacLean, 1990:26). The division of the neo-mammalian brain into a left hemisphere and a right hemisphere, as illustrated in Figure 3.3, is linked to Sperry's (1990) left brain/right brain theory discussed in Section 3.3.1.2. According to Louis Cozolino (2013), in an excerpt from his book *The Greater Good*, both these hemispheres contribute to the completion of a variety of tasks. It is therefore important for educators to understand how to engage both in the classroom environment.

3.3.1.2 Sperry's left-brain/right-brain theory

Together with his colleagues, Joseph E. Bogen, Michael S. Gazzaniga, Jerre Levy, and others, Dr Roger W. Sperry conducted "split-brain" research at the California Institute of Technology, challenging the mid-nineteenth century notion that the left hemisphere of the brain was dominant over the right hemisphere of the brain (Benziger *et al*., 1993:246; Gazzaniga *et al*., 2003:114; Herrmann, 1995:9; Sperry, 1990:373-375).

Findings from their "split-brain" research changed the understanding of the human brain completely (Herrmann, 1995:9). It was established that sensory and motor control are located in one hemisphere, each hemisphere has a specific function, and the corpus callosum connects the two hemispheres. This connection combines attention and awareness and enables the two hemispheres to share learning and memory (Herrmann, 1995:9, 10; Sperry, 1990:371-375).

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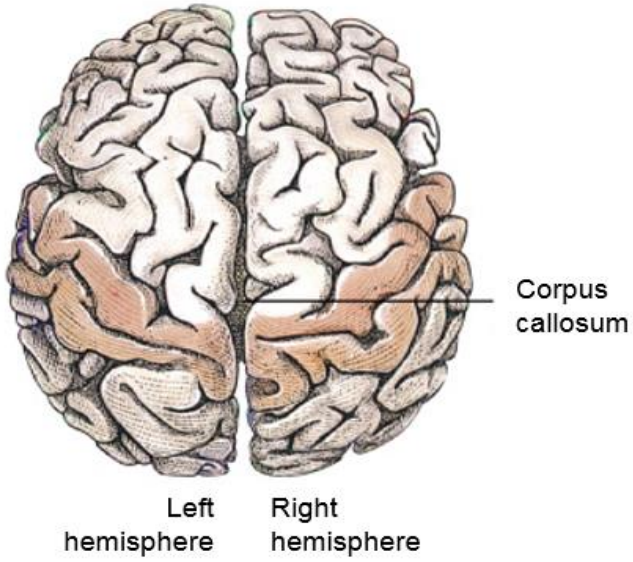

Figure 3.3 Split-brain (Psych Apprentice, 2013)

Brain imaging confirmed the lateralisation of mental abilities in the human brain (Herrmann, 1995:35). 'Lateralisation' refers to the subtle anatomical (structural) and functional differences between the two hemispheres (Tortora *et al*., 1993:426). Therefore, specific mental functions are associated and mainly controlled and coordinated by either one hemisphere or the other (Herrmann, 1995:11, 12; Sperry, 1990:375).

In order to understand Sperry's left-brain/right-brain theory, it is important to understand the structural specialisation of the brain – i.e. that the neocortex is divided into a left and a right hemisphere (half) (see Figure 3.3), that the limbic system is divided into a left and right hemisphere (half), and that the halves are connected by various connectors, such as the corpus callosum, that relay messages from and between the different parts of the brain (Herrmann, 1995:31, 32; Weiten, 2017:82). These specialised structures, together with the situational and iterative functioning of the brain, encapsulates the most important aspects of the left-brain/right-brain theory and is essential to the understanding of its application to whole-brain creativity and learning (Herrmann, 1995:32). To this end, Sections 3.3.1.2.1 to 3.3.1.2.5 that follow examine the left and right halves of the

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neocortex, the left and right halves of the limbic system, the connectors between the halves, and the two types of brain functioning (situational and iterative).

3.3.1.2.1 The left and right halves of the neocortex

The 2 to 4 mm-thick grey matter on the surface of the cerebrum is called the neocortex, also known as the cerebral cortex (Tortora *et al*., 1993:418; Weiten, 2017:82). It contains billions of neurons and makes up approximately 80 percent of the total grey matter of the brain (Herrmann, 1995:32; Tortora *et al*., 1993:418). Beneath the neocortex lies the cerebral white matter that is covered with myelin, a fatty substance that covers some brain cell connections (Herrmann, 1995:32; Tortora *et al*., 1993:418). The neocortex is divided anatomically into two halves, loosely referred to as the left and right hemispheres (see Figure 3.3) (Herrmann, 1995:32; Weiten, 2017:82). Each hemisphere is further divided into four lobes: frontal, parietal, temporal, and occipital (Tortora *et al*., 1993:418; Weiten, 2017:82, 83). The left and right hemispheres of the neocortex appear the same on both sides. However, detailed examination reveals subtle anatomical differences.

> "For example, in left-handed people the parietal and occipital lobes of the right hemisphere are usually narrower than the corresponding lobes of the left hemisphere. In addition, the frontal lobe of the left hemisphere of such individuals is typically narrower than that of the right hemisphere." (Tortora *et al*., 1993:426)

Due to the structural differences between the hemispheres there are important functional differences. The left hemisphere controls the right side of the body and is associated with spoken and written language, numerical and scientific skills, the ability to use and understand sign language, and reasoning. Conversely, the right hemisphere controls the left side of the body and is associated with musical and artistic awareness, spatial and pattern perception, insight, imagination, and generating mental images of sight, sound, touch, taste, and smell to compare relationships (Farmer, 2004:7; Herrmann, 1995:11, 12; Tortora *et al*., 1993:426; Weiten, 2017:82, 86). Even though one hemisphere might play a larger role in particular functions, such as the left hemisphere in speech function, it is important for educators to remember that "complex learning tasks involve a widely distributed network of brain areas" (Worden, Hinton & Fischer, 2011:11). As a result,

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educators need to steer away from purely left-brain/right-brain teaching and learning practices based on student profiles of hemispheric dominance. These profiles are much more complex as both sides of the brain are constantly collaborating and, because the brain is extremely flexible and adaptive ("plastic"), these profiles are also malleable and, thus, not resistant to good teaching and learning (Weiten, 2017:84, 89; Worden *et al*., 2011:11).

3.3.1.2.2 The left and right halves of the limbic system

The two halves of the limbic system, comprising the remaining part of the "brain's thinking cortex", are buried at the centre of the two cerebral hemispheres (Herrmann, 1995:32, 33). It is an interconnected group of limbic brain structures (Vander, Sherman & Luciano, 1994:221). Several of these limbic brain structures are important and work together to regulate some brain processes. These structures are the amygdala, hippocampus (linked to limbic lobe), hypothalamus, thalamus, basal ganglia, and cingulate gyrus (also linked to the limbic lobe) (Benziger & Sohn, 1993:249, 250; Boundless, 2016; Hannaford, 1995:53; Tortora *et al*., 1993:422). The first of these important limbic structures, the amygdala (see Figure 3.4), known as the emotional centre of the brain, is a small almond-shaped structure located in each of the left and right temporal lobes of the cerebral hemispheres.

The amygdala is involved in evaluating the emotional valence of situations and helps the brain to recognise potential danger. In recognising potential danger, the amygdala also prepares the body for fight-or-flight reactions by increasing the heart and breathing rate (Boundless, 2016; Weiten, 2017:81). Moreover, the amygdala is responsible for learning on the basis of reward or punishment and is also involved in the modulation of memory consolidation (turning short-term memories into more permanent, long-term memories), particularly emotionally-laden memories. Consequently, a learning event accompanied by an emotional arousal enhances the retention of that learning event (Boundless, 2016; Chen & Sun, 2012:1273).

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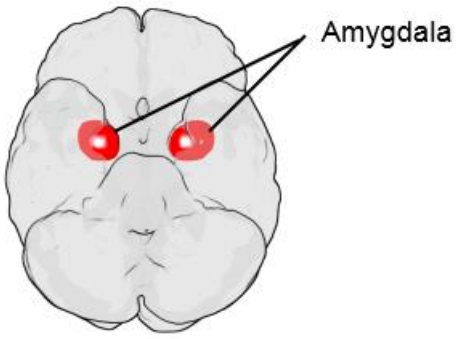

Figure 3.4 Amygdala (Boundless. 2016. [Image online]. Retrieved 20 August, 2016, from https://www.boundless.com/psychology/textbooks/boundless-psychology-textbook/biological-foundations-of-psychology-3/structure-and-function-of-the-brain-35/the-limbic-system-154-12689/ .)

The hippocampus consists of two horn-like structures curving back from the amygdala and plays a role in the formation of new memories about past experiences as well as in long-term memory, where facts and events are stored (Boundless, 2016; Weiten, 2017:81). The hypothalamus, located just below the thalamus, controls and integrates activities of the autonomic nervous system – thus regulating the contraction of both smooth and cardiac muscle, as well as the secretions of many glands, such as the pituitary gland, which regulates the body by means of hormones (refer to Figure 3.5) (Boundless, 2016; Ornstein & Thompson, 1985:28; Tortora *et al*., 1993:428). It is also connected with feelings of rage and aggression, controls body temperature and food intake, and comprises the thirst centre and one of the centres that sustains the waking state and sleep patterns (Herrmann, 1995:33; Ornstein *et al.*, 1985:28; Tortora *et al*., 1993:418).

The thalamus, located just above the hypothalamus, measures about 3 cm in length and consists of paired oval masses of mostly grey matter. Usually, the right and left portions of the thalamus are connected via a bridge of grey matter (Boundless, 2016; Tortora *et al*., 1993:415, 416). The thalamus is the primary sensory relay station for the rest of the brain and connects various limbic-system structures (Boundless, 2016; Tortora *et al*., 1993:416). It relays sensory input related to vision, taste and somatic sensations to the

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cerebral cortex and is also associated with voluntary motor actions, arousal and certain emotions and memory (Tortora *et al*., 1993:416, 417). Several groups of nuclei (nerve cell bodies) are called 'the basal ganglia', situated in the frontal lobes of each of the cerebral hemispheres, which serves as a relay station for physical movements (Boundless, 2016; Tortora *et al*., 1993:421, 422). The basal ganglia is also involved in rule-based habit learning, working memory and attention (Boundless, 2016). The last of the important limbic structures, the cingulate gyrus, links smell and sight with pleasant memories of previous emotions, participates in emotional reaction to pain, and regulates aggressive behaviour (Boundless, 2016). The limbic system, including the important limbic structures described above, is positioned between the brain stem and the cerebral hemispheres. It is connected to both cerebral hemispheres by thick and highly developed interconnections acting as a go-between for any brain activity situated above or below it (Herrmann, 1995:33). These thick and highly developed connectors will be described next.

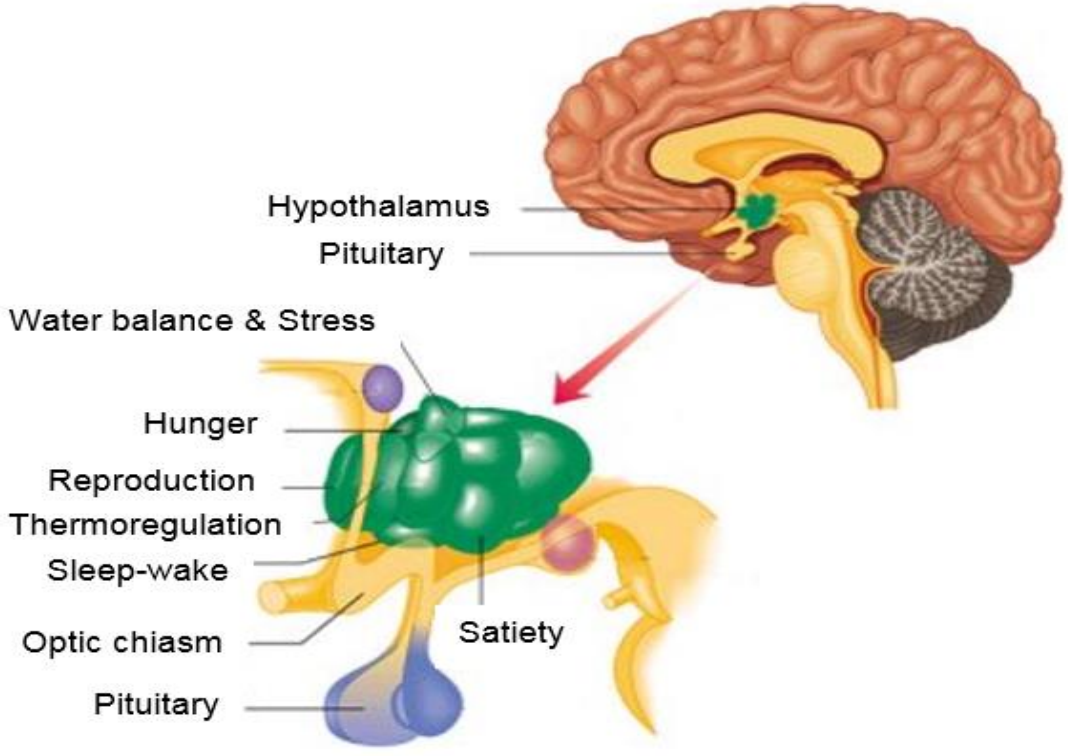

Figure 3.5 The hypothalamus and pituitary gland (Upright-health, 2013: [Image online]. Retrieved 20 August, 2016, from http://www.upright-health.com/pituitary-gland.html.)

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3.3.1.2.3 The connectors

The connectors are fibres that relay messages from one part of the brain to another. These connectors, for the purpose of Herrmann's whole-brain model, can be divided into two groups: those that link the two cerebral hemispheres and those that link the two halves of the limbic system. "[…] These connectors provide the physiological basis for wholeness in mental functioning" (Herrmann, 1995:35). The connectors, or fibres, allocated in both cerebral hemispheres consist of three different types: the association fibres, projection fibres and commissural fibres (see Figure 3.6).

The association fibres connect and transmit nerve impulses between gyri in the same hemisphere (Donnelly, 2014:198; Tortora *et al*., 1993:421). It forms an intricate communication system, which enables each of the hemispheres to integrate its functioning (Herrmann, 1995:35). The projection fibres transmit impulses from the cerebrum and other parts of the brain to the spinal cord and from the spinal cord to the brain (Donnelly, 2014:198; Tortora *et al*., 1993:421). The commissural fibres transmit impulses from the gyri in one cerebral hemisphere to the corresponding gyri in the other cerebral hemisphere and connect the two halves of the limbic system.

Commissural fibres, such as the corpus callosum, the anterior commissure, and the hippocampal commissure, are three bundles of axonic fibres that specifically provide pathways between the two halves of the cerebral cortex (Donnelly, 2014:198; Herrmann, 1995:35, Tortora *et al*., 1993:421). These connections allow the brain to coordinate activities located in parallel areas of each cerebral hemisphere and each halve of the limbic system (Herrmann, 1995:35). Therefore, the three commissural fibres provide the "physiological means [interconnection] for information transfer, collaboration, and integration between" the most important structures of the two brain halves (Herrmann, 1995:37). In addition to being interconnected, the brain is also situational and iterative in its functioning (Herrmann, 1995:37). As a result of this interconnectedness and situational and iterative functioning, a widely distributed network of brain areas function together when students are faced with complex learning tasks (Worden, Hinton & Fischer, 2011:11).

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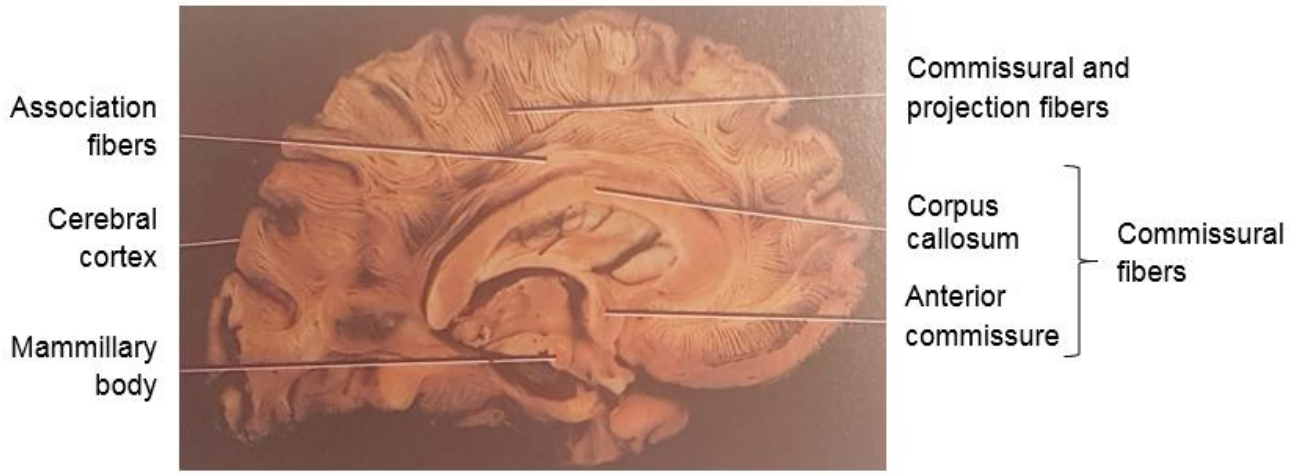

Figure 3.6 The connectors (fibres) (Tortora *et al*., 1993:420)

3.3.1.2.4 The types of brain functioning (situational and iterative)

There are two types of brain functioning: situational functioning and iterative functioning (Vaezipour, 2013:10). 'Situational functioning' refers to the activation of a specific area or areas of the brain to perform a specialised task when presented with a situation, while the areas not involved in the task go into a state of rest (Herrmann, 1995:37; Vaezipour, 2013:10). Situational functioning can be determined by recording the brain waves or electrical activity of the brain using an EEG (Tortora *et al*., 1993:425). The part of the brain that is activated sends out beta waves, whilst the part or parts of the brain that are inactive or in a state of rest sends out alpha or theta waves (Herrmann, 1995:37).

Beta waves, with a frequency of 14 to 30 hertz (Hz), generally appear when the nervous system is active – i.e. during sensory input and mental activity. Alpha waves, with a frequency of 8 to 13 Hz, are present when a person is awake and in a resting state with their eyes closed. Theta waves have a frequency of 4 to 7 Hz, and normally present when a person experiences emotional stress (Tortora *et al*., 1993:425, 426). For example, the area of the brain associated with language is active when speaking, sending out beta waves whilst simultaneously the area of the brain associated with calculations is at rest sending out alpha waves. The reverse is then that if the person does a calculation, say 5 times 24, the area associated with language will be at rest and the area associated with

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calculations active. The ability of the brain to function situationally is extremely important as it is crucial in ensuring that an individual functions effectively. The ability of the brain to situationally deactivate certain areas depending on the need, task or situation allows for the particular area that is active to function without competition or interference from other areas of the brain (Herrmann, 1995:38).

Conversely, 'iterative functioning' refers to the back-and-forth movement of impulses between specialised centres in the brain. Depending on the complexity of a task, the iterative process could involve a single back-and-forth movement or a number of them. The back-and-forth movement can take place within or between hemispheres (Herrmann, 1995:38; Vaezipour, 2013:10). For example, if a person is asked to view a short film and to write down the interpretation of its meaning thereafter, a couple of back-and-forth mental processes will occur. While watching the short film, the nonverbal/conceptual part of the brain will process the information received visually and develop a spatial concept. In order to write down the interpretation of the film's meaning, words are required to illustrate the conceptual understanding. As a result, the first iterative motion occurs when the conceptual centre of the brain sends a signal to the language centre of the brain enabling the individual to put the concept into words and to physically write them down. As the individual writes, the iterative motion will repeat itself a couple of times (Herrmann, 1995:38, 39).

Iterative functioning and situational functioning, briefly described above, together with the specialisation, as discussed in Section 3.3.1, and interconnectivity, as discussed in Section 3.3.1.2.3, of the brain are the four key characteristics of the human brain. These characteristics relate to the first theoretical component of Herrmann's whole-brain model (Herrmann, 1995:39). The second theoretical component of Herrmann's whole-brain model, dominance, will be discussed next.

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3.3.2 Dominance

The two hemispheres of the brain are not only different in their functioning, but are also physiologically asymmetrical. “The left hemisphere, for example, has a greater specific gravity, relatively more [grey] matter, and a wider occipital lobe. In contrast, the right hemisphere is heavier, with a larger internal skull size and a wider frontal lobe” (Arshad, Siddiqui, Ramachandran, Goga, Bonsu, Patel, Roberts, Nigmatullina, Malhotra & Bronstein, 2015:484; Herrmann, 1995:15). The brain in its functional and structural asymmetries is similar to the rest of the human body that is made up largely of paired structures (arms, legs, face, and eyes) seemingly symmetrical, but, in reality, an array of asymmetrical parts (Herrmann, 1995:15; Herrmann, 1998:2). According to Corballis (2014:3), cerebral asymmetries and handedness, for example, can already be detected in the foetus. This fundamental asymmetry leads to the concept of dominance. For example, one hand, eye, foot, and leg will become more dominant as an individual develops and ages. The more a preferred body part is used, the stronger and more dominant it becomes. Consequently, the dominant hand becomes the hand a person uses to write, the dominant leg is used to kick a ball, and the dominant eye focuses the visual field (Herrmann, 1995:16). However, the non-dominant hand, leg or eye assists the dominant hand, leg or eye.

According to Herrmann (1995), the notion of dominance also applies to the brain – i.e. as the brain matures, it acquires lateralised preferences. Even though the brain functioning of the two hemispheres (left hemisphere and right hemisphere) are different – i.e. a function may depend more on one hemisphere than the other – this notion of dominance is probably too simplistic for describing most tasks. Neuroscience related to the theories of the functional specialisation and lateralisation of the brain, as previously described in this chapter, “were, from the start, vulnerable to metaphoric interpretation” (Helding, 2014:83). It is with this in mind that the notion or metaphoric interpretation of brain dominance by Herrmann (1995) is described.

Brain dominance refers to how we prefer to learn, understand (think) or express something (Herrmann, 1995:17). The preference to learn, think or express something in

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a particular way results in more frequent use of that particular part of the brain (one hemisphere or one limbic half). This results in the development of greater competency for that set of mental activities located in those specialised areas of the brain. Similar to the dominant hand being assisted by the non-dominant hand, the less developed brain structures collaborate with the more preferred (and therefore dominant) thought processes of the brain in order to better apply mental ability to daily activities (Herrmann, 1995:17; Herrmann, 1998:2). However, the preferred or dominant thought processes of the brain are the most likely to be used by an individual when faced with the need to solve a problem or to select a learning experience. An individual with a strong left-brain preference or dominance would, for example, solve a problem using a fact-based, analytical, and step-by-step approach favouring words, numbers, and facts presented in a logical sequence. An individual with a strong right-brain preference or dominance would prefer, for example, to seek out insight, images, concepts, patterns, sounds, and movement, all integrated into a perceptive sense of the whole (Healy, 1994:125, 126; Herrmann, 1995:17; Springer & Deutsch, 1998:294). This left-brain/right-brain preference or dominance is strongly linked to what an individual prefers to learn and how an individual prefers to go about learning it. For example, a left-brain preference or dominant individual may prefer to study engineering or law whilst a right-brain preference or dominant individual may prefer to study art, music or psychology. A left-brain preference or dominant individual will learn about the arts by reading about its history, techniques, and famous artists, whereas the right-brain preference or dominant individual will learn about art by watching and doing it. The stronger the preference or dominance, the more likely it is the individual will reject the other preference of learning, thinking or expressing. The individual might even find it difficult or impossible to problem solve or to learn by using the other mode of learning, thinking or expressing (Herrmann, 1995:17).

According to Hart (1983:xiv), “the brain has modes of operation that are natural, effortless, and effective in utilising the tremendous power of this amazing instrument”. However, as a rule, the brain will work slower, more hesitantly, and with more mistakes if forced to work differently (Hart, 1983: xiv). Learning could therefore become a great effort, frustrating, demanding, boring, non-productive, and even unfulfilling if an individual’s

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preference of learning, thinking or expressing is not matched with the delivery system of the information to be learned (Herrmann, 1995:17). However, according to Herrmann (1995:19, 20), an individual can change and improve their non-preferred or non-dominant thinking style through repeated usage and positive reinforcement. Herrmann (1995:23) further believes that individuals can move beyond the mental conflict between left- and right-brain preference or dominance to a more integrated wholeness that reflects a smoother collaboration among the specialised parts of the brain. This could be achieved by emphasising all of the mental skills people favour in order to develop a full repertoire of potential behavioural responses. This full repertoire of potential behavioural responses should then allow for an individual to respond to any type of learning activity more effectively. "[…] The physiological precondition for wholeness already exists," as the brain – described in Section 3.3.1 – is already organised to allow for intercommunication among the specialised areas of the brain and, as a result, between the different modes (styles) of thinking as presented in Herrmann's whole brain model (Herrmann, 1995:19, 23).

3.4 Herrmann's whole brain model

Based on the research by MacLean (1990) and Sperry (1990), Herrmann (1995) developed a metaphoric whole-brain model that represents the four thinking structures of the brain linked to different thinking and learning styles, or thinking and learning preferences (De Boer, Steyn & Du Toit, 2010:186; Herrmann, 1995:39). The Herrmann Whole Brain Model (Herrmann, 1995:411) presented in Figure 3.7 consists of four quadrants that each represents one of the four thinking structures of the brain. The whole-brain model consists of a circular graph that is divided into four quadrants. Instead of using the physiological terms to describe the quadrants, Herrmann (1995) assigned a letter, A, B, C and D, to each of the four quadrants moving in an anticlockwise direction. The HBDI, as discussed in Chapter 2, is used to determine an individual's brain dominance profile.

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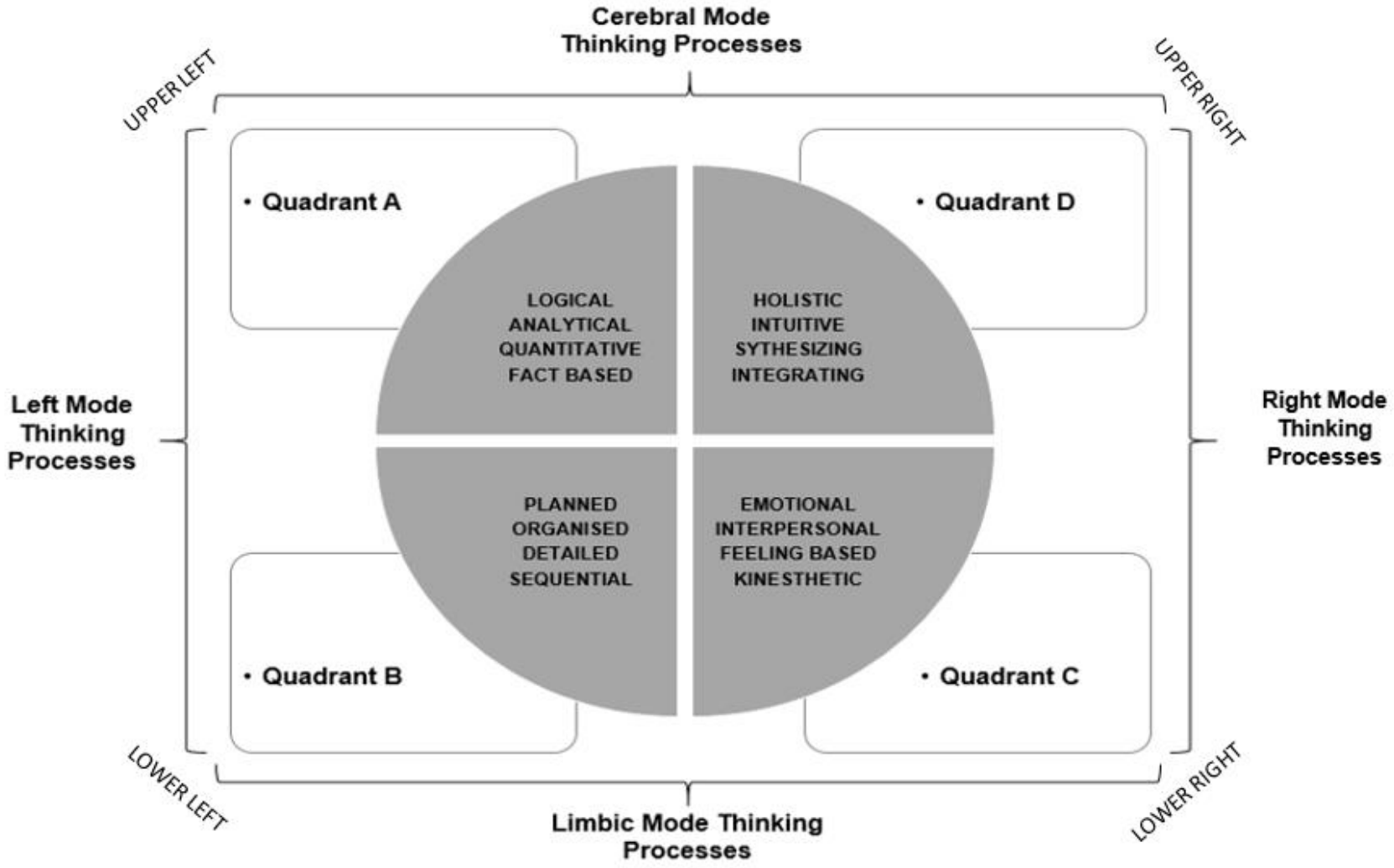

Figure 3.7 The Herrmann Whole Brain Model (Adapted from Herrmann, 1995:411)

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The four quadrants, each representing one of the four thinking and learning structures/ styles of an individual's brain dominance profile, are:

- A: Facts (Upper or Cerebral Left Brain);
- B: Form (Lower or Limbic Left Brain);
- C: Feelings (Lower or Limbic Right Brain); and
- D: Future (Upper or Cerebral Right Brain).

As indicated by De Boer *et al.* (2010:186), distinct clusters of cognitive functions or processes are associated with each one of the four quadrants. Quadrant A represents the cluster of cognitive functions or processes related to the preference for mathematical, technical, analytical, and logical thinking. Quadrant B represents the cluster of cognitive functions or processes related to the preference for an organised, planned, orderly, and step-by-step approach. Quadrant C refers to the cluster of processes described as concerned with emotions, interpersonal warmth, and feelings, and as having an interest in music and communication through speaking, writing, and reading. Quadrant D relates to the synthesising and intuitive modes of thought that include holistic, visual and imaginative thinking (Herrmann, 1995:220).

Based on the Herrmann Whole Brain Model, Herrmann (1995) developed various other whole-brain models including the Whole Brain Creativity Model, the Whole Brain Teaching and Learning Model, and the Whole Brain Learning Group Model. These whole-brain models are used as a standard against which to compare or measure whole-brain content, whole-brain delivery, whole-brain learning groups and whole-brain environments (Herrmann, 1995:219, 2020, 221). The Whole Brain Creativity Model can be used to base the design of learning content upon. The Whole Brain Teaching and Learning Model can be used to set the standards of the delivery of the learning content which would include the design of learning activities. The Whole Brain Learning Group Model can be used to set up learning groups in order to ensure the group's collective brain dominance profile constitute a composite whole brain (Herrmann, 1995:219, 220, 221). Based on the proposed uses of the different whole-brain models and the aim of this study (to analyse the application of a whole-brain approach to the design of learning activities), it is

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important to review the Whole Brain Teaching and Learning Model (Herrmann, 1995:220) in more detail.

3.4.1 Whole Brain Teaching and Learning Model

The Whole Brain Teaching and Learning Model (Herrmann, 1995:220), as shown in Figure 3.8, first divides the learning process into the four brain quadrants, then summarises these four quadrants into two categories, namely: structured (left) and unstructured (right). Herrmann (1995:220, 221) associates 'hard' processing – which deals with logical, rational, critical, quantitative issues and activities together with some procedural activities that involve planned, organised, and sequential elements of the learning process – with the structured modes linked to the left brain (Quadrant A and B). Associated with the non-linear, non-verbal, unstructured modes of the right brain (Quadrant C and D) are visual, conceptual, and simultaneous processing as well as 'soft' processing that involves emotional, expressive, and interpersonal activities (Herrmann, 1995:220, 221). "Together, these comprise the full range of preferences for teaching and learning" (Herrmann, 1995:221). In designing learning activities, every learning activity can be checked against the model to ensure the learning content (material) is delivered through media that respond to each of the four quadrants – thus, ensuring that each learning activity expresses some kind of experiential or unstructured medium in addition to verbal, didactic information (Herrmann, 1995:221).

Even though Herrmann's Whole Brain Teaching and Learning Model (Herrmann, 1995:220), as illustrated in Figure 3.8, together with the HBDI, was used as an organising tool for this study, it has to be acknowledged that higher education is multi-faceted and that other learning theories, models and influences are to be integrated in order to form a holistic view of practice. For this reason, it is important to also highlight recent developments linked to Herrmann's Whole Brain Teaching and Learning Model. Based on more than a decade of research and use in practice of the whole-brain model, De Boer, Du Toit, Scheepers and Bothma (2013) expanded on Herrmann's Whole Brain Teaching and Learning Model (Herrmann, 1995) offering a comprehensive model to not

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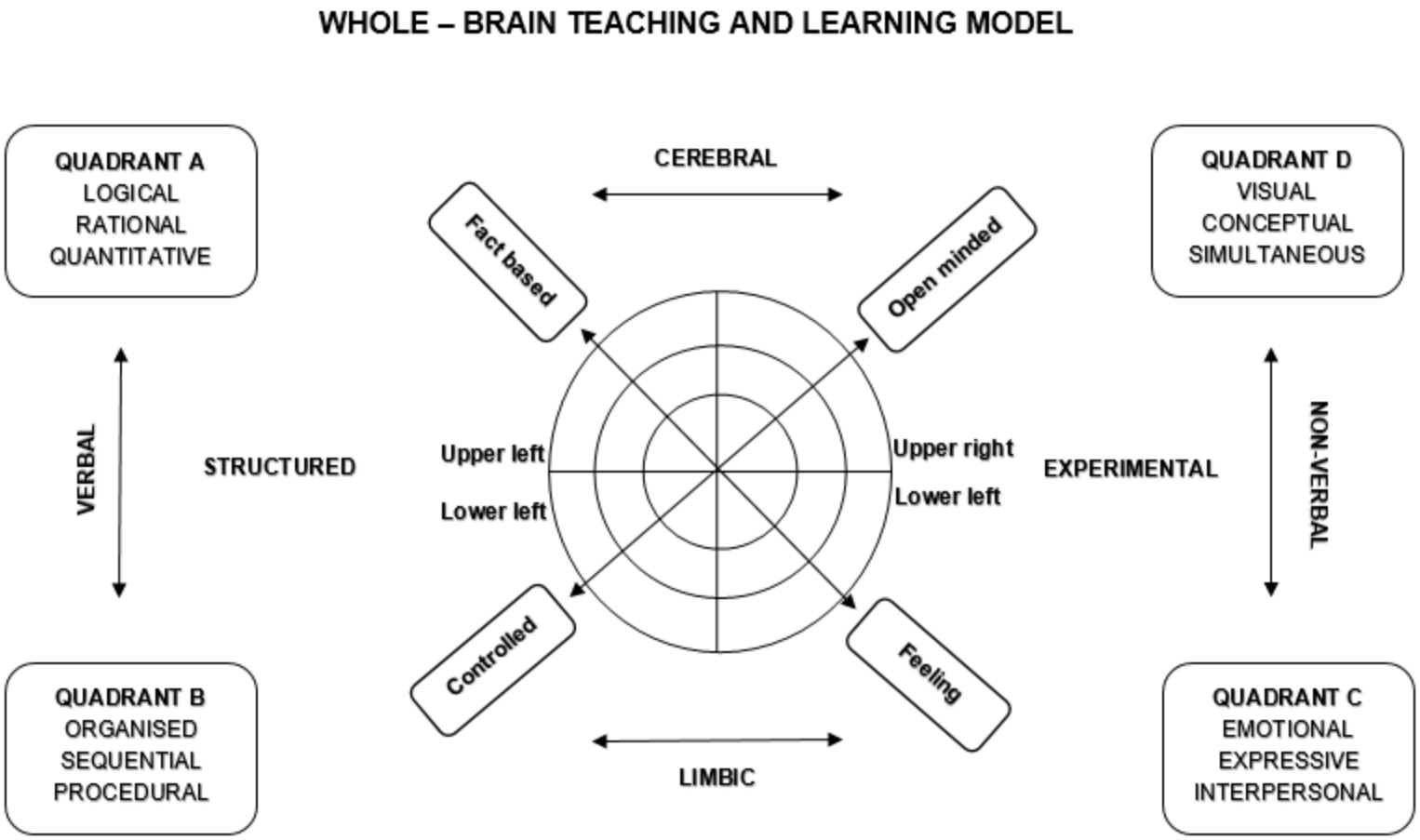

Figure 3.8 Whole Brain Teaching and Learning Model (Adapted from Herrmann, 1995:220)

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only facilitate whole-brain learning, but to also incorporate learning opportunity design to promote deep and constructivist learning. The Whole Brain Teaching and Learning Model of Herrmann is a baseline and centre of the expanded model. This expanded model also focusses on the culture in which the learning process is applied and highlights other aspects – such as ethnic, family, social and organisational ones – that have an influence on the learning process. The expanded model also takes into consideration the surrounding environment in which the culture exists, including the physical, geographical, economic, temporal and motivational environments (De Boer *et al*., 2013:1). For the purpose of this study, however, using the original Herrmann Whole Brain Teaching and Learning Model (Herrmann, 1995) together with the HBDI provided the necessary framework required to analyse and organise the learning activities included in the Business Management modules offered in the Bachelor of Commerce degree. The original Herrmann Whole Brain Teaching and Learning Model and HBDI allowed for the extraction of the necessary data required to address the research questions posed in Chapter 1. Using the Herrmann Whole Brain Teaching and Learning Model (Herrmann, 1995:220) together with the HBDI as an organising tool is described in more detail in Chapter 4. In order to understand the Whole Brain Teaching and Learning Model further, it is important to indicate what Herrmann meant by the concept of 'whole brain teaching and learning'.

3.5 What is Whole Brain Teaching and Learning (WBTL)?

According to Herrmann, "the human brain functions at its most innovative, productive best only when all four quadrants engage situationally and iteratively in the process" (Herrmann, 1995:126). This means that an individual should have equal access to each quadrant in order to be able to, when a situation calls for a specific mental function or process, respond in the best possible way to the situation (Herrmann, 1995:127). Therefore, the four quadrants work as a team. Whilst Quadrants A and B identify the problem or issue, Quadrant B and C supply the intuitive and emotional components. Quadrants C and D permit the individual to develop solutions and allows for it to mature in order to provide an understanding. These solutions are then processed iteratively by Quadrants A and D to ensure that the imaginative solution becomes logical (Herrmann,

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1995:127). From the above, it can then be deduced that whole-brain teaching refers to an integrated approach in which an educator – regardless of his or her own preference – creates a learning environment, develops learning content, and designs learning activities and situations that maximise the engagement of students to use each one of the four quadrants equally, resulting in whole-brain learning. The primary focus of this study is on only one aspect – i.e. learning activity design. Therefore, it is important to elaborate on whole-brain teaching and learning's relevance to learning-activity design. The next section then aims to describe the relevance of whole-brain teaching and learning on learning-activity design.

3.5.1 Relevance of whole brain teaching and learning to learning activity design

According to De Boer *et al.* (2010:187), the cognitive or mental functions or processes as associated with each one of the four quadrants are accommodated when teaching and learning activities are constructed to comply with a student's preferred thinking and/or learning style. Developing learning activities across the four quadrants that require students, regardless of their preferred thinking and learning style, to utilise cognitive functions associated with all four quadrants allows for students to utilise the whole brain when learning (De Boer *et al.*, 2010:187). Continuously stimulating and utilising the whole brain when learning allows students to become more flexible and to adopt different learning styles more easily as required by the learning event or activity provided, resulting in learning-style flexibility (Snowman *et al.*, 2012:121). De Boer *et al.* (2010:187) state that Lumsdaine and Lumsdaine's (1995) four modes of HE students' learning complements Herrmann's model even further in that:

- external learning related to teaching from authority through lectures and learning material are associated predominantly with Quadrant A learning;
- procedural learning related to the methodical step-by-step testing, practice and repetition are associated predominantly with Quadrant B learning;
- interactive learning related to discussions, physical activities and sensory based activities with an opportunity for verbal feedback and encouragement are associated predominantly with Quadrant C learning; and

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- internal learning related to the visualisation, synthesis of data and the holistic understanding of concepts are associated predominantly with Quadrant D learning.

The Whole Brain Teaching and Learning Model (Herrmann, 1995:220), as presented in Figure 3.8, together with the HBDI can therefore be used as a tool to analyse and organise existing learning activities as well as to design and deliver teaching and learning activities that support the four modes of HE students' learning as indicated by Lumsdaine and Lumsdaine (1995). Consequently, using the Whole Brain Teaching and Learning Model (Herrmann, 1995:220) and HBDI can ensure the design of learning activities that not only provide students with the opportunity to use their preferred thinking and learning styles, but also that of their less preferred thinking and learning styles – thus developing the mental dexterity of students which could positively impact on students potential for achievement (De Boer *et al.*, 2010:188; De Boer *et al*., 2001:188, 189; Felder, 1996:18). Coffield *et al*. (2004a:83) support this notion indicating that considerable benefits could be derived from using the HBDI by curriculum developers – i.e. learning activity designers. Furthermore, incorporating a WBTL approach when designing and developing learning activities could also address the increased need, resulting from the widening access to HE specifically within South Africa, to accommodate students within HE with varying learning styles and approaches to learning (Lowery, 2009:52).

3.6 Summary

This chapter provided detailed information on Ned Herrmann's whole-brain model. The chapter included biographical information on Ned Herrmann as well as detail on events that awakened his interest in the human brain. Furthermore, the chapter described the two theoretical components – i.e. specialised functioning and dominance – that led Herrmann to the development of the Herrmann Whole Brain Model (1995). The Herrmann Whole Brain Model (1995) and its associated models are discussed with a particular focus on the Whole Brain Teaching and Learning Model (1995). In addition, this chapter provides information that addresses two subsidiary research questions posed in Chapter 1, namely: *What is Whole Brain Teaching and Learning (WBTL)?* (as discussed here in Section 3.5) and *What is the relevance of WBTL in learning activity design in the context*

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of student achievement? (as discussed in Section 3.5.1). Chapter 4 that follows provides detailed descriptions of the methodology used in this study. Chapter 4 also provides a description of the use of the Herrmann Whole Brain Teaching and Learning Model (Herrmann, 1995:220) together with the HBDI as an organising tool of this study.

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CHAPTER FOUR
RESEARCH METHODOLOGY

4.1 Introduction

This chapter introduces the reader to the field of social science research and some of the paradigms used within social research, specifically focusing on the interpretive paradigm. Information about the philosophical assumptions associated with the interpretive paradigm that guided the selection of the research design, methodology and methods for this study is discussed. In conclusion, this chapter reviews the credibility and trustworthiness of this study, as well as provides the ethical considerations taken into account by the researcher.

4.2 Social science research

'Science' is defined by Oxford Dictionaries (2016) as "the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment". The sciences are broadly classified and consist of their division into the natural sciences, formal sciences, social sciences, and humanities (Mouton, 1996a:9). Education, within which this study falls, forms part of the broader group of social sciences (De Vos *et al*., 2011:4). Social science research "involves the study of people's beliefs, behaviour, interaction and institutions in order to test hypothesis, acquire information and solve problems pertaining to human interrelationships" (Barker, 2003:406; De Vos *et al*., 2011:42; Neuman, 2000:6).

The primary and subsidiary research questions that aim to acquire information guided the research design of this study, positioning it within the interpretive paradigm, as described in Section 4.4. For ease of reference, the primary and subsidiary research questions are again provided below.

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4.3 The research questions

The aim of this study is to determine how, if at all, the Whole Brain Teaching and Learning (WBTL) approach was applied to the learning-activity design of the main discipline, Business Administration and Management (General), within the Bachelor of Commerce degree offered by the PHEI. Therefore, the following research questions were identified and formulated for the study.

4.3.1 Main research question

How, if at all, does one private higher education institution apply a whole-brain teaching and learning approach to the design of learning activities within selected modules in a Bachelor of Commerce degree?

4.3.2 Subsidiary questions

i. What is Whole Brain Teaching and Learning (WBTL)?
ii. What is the relevance of WBTL in learning activity design in the context of student achievement?
iii. How, if at all, is WBTL applied to the design of learning activities within the Business Management modules in the Bachelor of Commerce degree?
iv. What interventions, based on the findings of this study, could enhance the application of WBTL to learning activity design for the Business Management modules within the Bachelor of Commerce degree?

The study is set within an interpretive paradigm using a case-study design as described in the next section.

4.4 Research paradigm and design

4.4.1 Research paradigm

According to De Vos *et al*. (2011:5), social science research can be approached from seven main paradigms: positivism, postpositivism, constructivism, interpretive, critical, feminism and postmodernism. A paradigm is a fundamental model or frame of reference the researcher uses to organise observations and reasoning (Babbie, 2001:42).

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Researchers approach their studies from a certain paradigm, which is a set of beliefs or assumptions that guides the inquiry (Creswell, 2003:82). Each paradigm is informed by philosophical assumptions about the nature of reality (ontology); the ways of knowing (epistemology); and the ethics and value systems (axiology) (Patton, 2002:266). A paradigm may therefore be described as a cluster of beliefs that dictates to scientists in a particular discipline what should be studied, how research should be done, and how results should be interpreted (Du Plooy-Cilliers *et al*., 2014:19).

The interpretive paradigm has its origin in hermeneutics. 'Hermeneutics' is the study of the theory and practice of interpretation. It was developed in the 19th century as a philosophical theory of meaning and understanding (Maree, 2007:58). As indicated above, each paradigm is informed by philosophical assumptions about the nature of reality (ontology) and the ways of knowing (epistemology) (Patton, 2002:266). Central to the ontological assumption of the interpretive paradigm is that social reality should be viewed as subjective. Reality can only be constructed through an understanding of the meanings that people give to their own human experience or the phenomenon being studied (Cohen, Manion & Morrison, 2011:17; Maree, 2007:309, 310; Murray, 2005:2). This is also known as the 'social construction of reality' (Andrade, 2009:44; Henn, Weinstein & Foard, 2009:28; Maree, 2007:309). The researcher believes that there is no single reality or truth and that reality or truth is created by the researcher and the participants. In this study, the reality or truth of using a WBTL approach in the design of learning activities was created by the researcher and the participants – i.e. the HoP, IDs and the module lecturers. Reality can therefore not be separated from the researcher or the participants. Behind this ontological position lies a theory of epistemology or theory of knowledge and perception (Maree, 2007:309).

Epistemologically, the interpretivist position is that knowledge arises from the understanding of the meaning given to the life, world or phenomenon by the research participants. Knowledge is therefore a transactional process, where 'knowledge' is seen as something that is socially constructed and negotiated (Littlejohn, 1996:13; Maree, 2007:311). This means that interpretivists believe that what people know and believe to

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be true about the world is constructed – in other words, what people know is made up as people interact with one another over time in specific social settings (LeCompte & Shensul, 1999:48). According to McMillan and Schumacher (2001:15, 16), a study is positioned within the interpretive paradigm of knowledge if such a study is more concerned with understanding a social phenomenon from the perspectives of the participants and the researcher, as is the case within this study. In addition, this study uses qualitative data in order to address the research questions posed. The use of qualitative data could also imply an interpretive paradigm (Creswell, 2003:82). As a result, the researcher interprets the data by developing descriptions of participants or contexts, analysing the data for themes or categories, and finally making an interpretation or drawing conclusions about their meaning (Creswell, 2003:182).

According to Denzin and Lincoln (2000:22), the research design sets paradigms or lenses of interpretation into motion. Maree (2007:70) defines a research design as a plan or strategy which moves from the underlying philosophical assumptions to specifying the selection of participants, the data gathering techniques to be used, and the data analysis to be done. In addition, the research design also assists with how to proceed in gaining understanding of the phenomena in more natural settings (Ary, Jacobs & Razavieh, 2002:426). Thus, the purpose of a research design is to provide, within an appropriate mode of inquiry, the most valid and accurate answers possible to the research question or questions (Denzin & Lincoln, 2000:22; McMillan & Schumacher, 2001:31). Within the interpretive paradigm in which qualitative data is collected, the researcher has various types of research designs to choose from. The more popular and frequently used research designs include narrative research, phenomenology, grounded theory, ethnography and case study (De Vos *et al*., 2011:312). This study employed a case-study design as described next.

4.4.2 Case study design

Since this study falls within education, only the definitions of three seminal authors whose methodological suggestions largely impact educational researchers' decisions concerning case-study design are provided. These authors are Yin (1984), Merriam

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(1998) and Stake (1995). Yin (1984:23; 2002:13) defines a case study as a study of "a contemporary phenomenon within its real life context, especially when the boundaries between a phenomenon and context are not clear and the researcher has little control over the phenomenon and context". This means that the boundary between the phenomenon and its context is blurred as the case study is a study of a case in a context and it is important to set the case within the context. For this reason, rich descriptions and details are often provided in a case study (Cohen *et al*., 2011:289). Multiple sources of evidence are used in order to gather the rich descriptions and details and to address "how" and "why" questions concerning the phenomenon of interest (Yin, 1984:23; 2002:13-14; 2003:15).

Merriam (1998:27) defines a case study by the fact that it is a bounded system. In her view, the case is "a thing, a single entity, a unit around which there are boundaries" (Merriam, 1998:27). Therefore, Merriam's (1998) definition of what can be regarded as a case represents a more comprehensive list than that of Yin's and Stake's. In her view, a researcher can name it a case as long as the researcher is able to specify the phenomenon of interest and draw its boundaries (Yazan, 2015:134).

According to Stake (1995:2), a precise definition is not possible. However, he agrees that a case should be viewed as "a bounded system" that researchers should inquire into "as an object rather than a process". Some of the attributes that Stake (1995:2) assign to a case is that a case is "a specific, a complex, functioning thing." More specifically, Stake (1995:2) argues that a case is "an integrated system" which "has a boundary and working parts" and is purposive in social science.

According to the definitions and descriptions provided by Yin (1984), Merriam (1998) and Stake (1995), a case study methodology was chosen for this study because the case is the learning-activity design for the Business Management modules of the Bachelor of Commerce degree. Case studies offer multi-perspective analysis. Therefore, multiple units of analysis could be used in which the researcher considers not just the voice and perspectives of one or two participants, but also the views of other relevant groups of

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actors (Maree, 2007:75). In this case, the voice and perspectives of the HoP, IDs, and module lecturers were considered. The case could, however, not be considered without the context, the PHEI, and more specifically the CAT and the three sites of delivery of the brand that offers the Bachelor of Commerce degree. It was in these settings that the application of the WBTL approach to learning-activity design was developed and utilised.

The overall purpose of the study further guided the selection of the specific type of case study design used in this study. A descriptive case study was chosen as it yields a rich, thick description of the phenomenon under investigation (Yin, 2003:5). In order to gather the rich descriptions and detailed data, multiple sources of evidence were used in this study (Yin, 1984:23; 2002:13-14; 2003:15). Multiple sources of evidence are seen as a "key characteristic of case study research" as all evidence gathered is useful to the researcher (Gillham, 2000:2; 20). The convergence of the data accumulated from these different sources, although each has its own strengths and weaknesses, could give the researcher reasonable confidence that the true picture of the case is observed and presented in a study (Gillham, 2000:13).

4.4.3 Population and sampling

This study employed non-probability purposive sampling as the researcher sought neither to sample a population on a random basis nor to generalise the findings to a population. The population in this study was sampled in a strategic way to ensure that those sampled had relevant information pertaining to the purpose of the research. For this reason, the researcher had to be clear on what the relevant criteria were regarding the inclusion or exclusion of data sources (whether the sources were qualifications, modules, sites, participants, or documents) (Bryman & Bell, 2011:319). Based on the criteria, the researcher then chose the elements to include. Any elements that fell outside the criteria set by the researcher were disregarded (Du Plooy-Cilliers *et al*., 2014:142).

The first criterion relates to the selection of the qualification for this study. The PHEI offers more than 90 accredited qualifications. Since the quality of research using qualitative data is marked by a worthy topic that is relevant and that addresses contextual priorities (Tracy,

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2010:839), in this case the strategic priorities of the PHEI, the criteria for the selection of a qualification included that the qualification had to have a high number of student enrolments, a high monetary value in terms of income generation for the institution, and a high perceived reputational value or risk. In addition, considering the researcher's positionality – i.e. an HoP in the Faculty of Social Sciences – a qualification, and as a result modules within the qualification, outside of the faculty in which the researcher was employed had to be selected to limit any researcher biases.

The Bachelor of Commerce degree within the Faculty of Commerce offered by the PHEI is not only the first degree that was accredited to be offered by the PHEI, it is also one of the qualifications with the highest number of student enrolments. Furthermore, the income generated from enrolments on this qualification is greater than other qualifications with similar student numbers. The reputational value or risk associated with this qualification is also substantial since its quality together with student achievement are scrutinised with rigour, not only for reaccreditation purposes by the HEQC, but also by reputable other HEIs where graduates from this qualification apply for entry into further studies. Consequently, the Bachelor of Commerce degree was selected for this particular study. Table 4.1 indicates the modules and structure associated with the Bachelor of Commerce degree selected.

The second criterion related to the selection of the modules in the qualification for this study. The criteria for the selection of the modules within the qualification included that the modules had to relate to the core discipline of the qualification, and had to be representative or offered at the first-, second- and third-year programme level of the qualification – i.e. at NQF levels 5, 6 and 7 of the Higher Education Qualifications Framework (HEQF). Each NQF level, and its related level descriptor, indicates the knowledge and skills that a student needs to acquire, integrate and demonstrate at each level of cognitive complexity on the HEQF. In addition, the modules had to include online learning material. The core discipline within the Bachelor of Commerce degree is the Business Administration and Management (General) discipline.

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Table 4.1 Bachelor of Commerce modules and structure

1ST YEAR	**SEMESTER**
ACCOUNTING 1A	1
ACCOUNTING 1B	2
APPLIED COMMUNICATION TECHNIQUES	1
BUSINESS MANAGEMENT 1A	1
BUSINESS MANAGEMENT 1B	2
MARKETING 1A	1
MARKETING 1B	2
ECONOMICS 1A	1
ECONOMICS 1B	2
QUANTITATIVE TECHNIQUES A	2
2ND YEAR	**SEMESTER**
BUSINESS MANAGEMENT 2A	1
BUSINESS MANAGEMENT 2B	2
BUSINESS LAW	2
FINANCIAL MANAGEMENT 2A	1
INDUSTRIAL RELATIONS	1
PROJECT MANAGEMENT	2
QUANTITATIVE TECHNIQUES B	1
RETAIL MANAGEMENT	2
3RD YEAR	**SEMESTER**
BUSINESS MANAGEMENT 3A	1
BUSINESS MANAGEMENT 3B	2
ENTERPRISE RISK MANAGEMENT	2
INFORMATION AND KNOWLEDGE MANAGEMENT	2
INTRODUCTION TO RESEARCH	1
RESEARCH PRACTICE	2
SUPPLY CHAIN MANAGEMENT	1
WORK INTEGRATED LEARNING BUSINESS PROJECT (YEAR MODULE)	1 & 2

The Business Management modules falls within the core discipline and are offered on first-, second- and third-year level. Online learning material is included in five of the six

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Business Management modules. The sixth module is in the development stage of its online learning material offering.

Three of the Business Management modules offered in the Bachelor of Commerce degree were selected for analysis in this study, each on a different NQF level. The three Business Management modules selected are Business Management 1A, Business Management 2A, and Business Management 3A. As a result, all learning material associated with these modules formed part of the documentation analysed in this study. The two criteria discussed above had a direct influence on the selection of the three levels of participants (actors) in this study. In order to gather information and data that would offer a multi-perspective to the study (Maree, 2007:75), the researcher included three levels of participants relevant to this study including the relevant HoP, the IDs involved, and (at site or campus level) a sample of the Business Management module lecturers. The population and sample sizes for the semi-structured interviews and observed classes as explained below are provided in Table 4.2. Each HoP at the CAT, depending on his/her academic background – i.e. qualification and/or credentials – are allocated a set of modules, usually within the same or a related discipline or disciplines to that of their academic background. Modules within the Business Administration and Management (General) discipline are allocated to six different HoPs within the Faculty of Commerce. The Business Management modules selected are allocated to one of these six HoPs. Consequently, the HoP who is ultimately responsible for the planning, design, development and moderation (quality assurance) of the Business Management modules' learning material – and therefore its learning activities – was invited and included as a potential participant in this study. Similarly, the IDs who, with the input and support of the HoP, designed and developed the online learning material for the specific Business Management modules were also invited and included as potential participants in this study. The online learning material, including the learning activities associated with the selected Business Management modules, is deployed via a Learning Management System (LMS) (an online learning platform) in order for lecturers and students across all sites of delivery to have access. The selection of the sites of delivery and the Business

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Management module lecturers were dependent on the brand of the PHEI that offers the Bachelor of Commerce degree.

Table 4.2 Population and sample sizes for the semi-structured interviews and observed classes

Population and sampling of HoPs	
Total number of HoP at PHEI	27
Total number of HoPs responsible for modules within the Business Administration and Management (General) discipline	6
Total number of HoPs responsible for the Business Management modules offered in the Bachelor of Commerce degree	1
Total number of HoPs selected for semi-structured interview	1
Population and sampling of IDs	
Total number of IDs at PHEI (including independent contractors)	11
Total number of IDs responsible for the Business Management modules offered in the Bachelor of Commerce degree (including 1B, 2B and 3B)	5
Total number of IDs selected for semi-structured interview	2*
** At least one of the two were involved in all three Business Management modules included in this study, the other in two of the three Business Management modules.*	
Population and sampling of observed classes (module lecturers)	
Total number of Business Management module lecturers at the three identified sites of delivery	23
Total number of Business Management module lecturers at the three identified sites of delivery that lectured the module(s) at least once before	11
Total number of the 11 Business module lecturers demonstrating most activity on the online learning material as per activity overview reports	4
Total number of Business module lecturers observed	3
Total number of Business Management module lecturers per site observed	1*
** Each module lecturer observed lectured more that one of the three Business Management modules. Each lecturer was observed for two sessions.*	

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The PHEI offers its qualifications at various brands nationally. A brand refers to a trading division that is managed as a business entity by its own management team. Only one of the six brands offers the Bachelor of Commerce degree. This brand has eight sites, three located in Gauteng, three in KwaZulu-Natal, one in the Western Cape, and one in the Eastern Cape. The researcher is based in the Gauteng province. Therefore, the three sites within this province were selected for inclusion in the sample as the inclusion of these sites in the study was more feasible. Across the three sites, 23 lecturers were contracted to lecture one or more of the three Business Management modules selected at the time of the study. The criteria chosen by the researcher to determine the sample size included that the lecturer should have lectured the given module at least once before. By having lectured the module or modules at least once before, it was assumed that these lecturers would be more confident and familiar with the learning material. They would thus be in a better position to provide richer information for analysis. In addition, selected lecturers should have demonstrated some activity for these modules on the online learning platform. The incorporation of online learning material is relatively new to the PHEI and adoption from users such as the lecturers are slow. However, since the online learning material and learning activities are central to the learning-activity analysis of this study, it was deemed appropriate to include this as part of the criteria. User-activity overview reports were used to determine whom of the 23 lecturers were ‘active’ on the online learning platform for the selected modules. Based on these criteria, 11 Business Management lecturers were identified. However, only one lecturer per module who demonstrated the most activity on the online platform for that particular module was selected to be observed in class. The data-collection techniques used in this study, which includes the observations, are further described in Section 4.4.4.

4.4.4 Data-collection techniques

Data collection, viewed as the identification of the subject and the methodical gathering of information relevant to the research study, is a series of interrelated activities for the purpose of obtaining information to answer the research question or questions (Burns & Grove, 2007:536; Creswell, 1994:110; Leedy & Ormrod, 2005:143). Data-collection methods for this study were chosen on the basis of the best ways in which to obtain the

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data required to explore the particular research question or questions posed (De Vos, Strydom, Fouché, Poggenoel & Schurink, 1998:82). Building on the premise that a qualitative data-collection strategy involves the gathering of information from a variety of sources, the data-collection methods chosen and used in this study comprised document analysis, semi-structured interviews and observations (Holloway, 1997:45).

4.4.4.1 Document analysis

Document analysis refers to a research method used to analyse text data from original documents, notes and text transcribed from original comments, interviews and observations (Hsieh & Shannon, 2005:1277; Maree, 2007:83). The collection of data for this study commenced with the sourcing and analysis of curriculum documentation; namely, the online learning material and learning activities of the Business Management modules identified. The purpose of the analysis of the online learning material and learning activities was to understand how each selected Business Management module is structured and to determine if and how the learning activities included, individually, and also jointly as a cluster of learning activities, demonstrate the application of the Whole Brain Teaching and Learning (WBTL) approach. In addition to the original source documents, text data from detailed notes of the semi-structured interviews, and observations, together with the transcription thereof, formed the remainder of the data collected for analysis. Each of the aforementioned data-collection methods that were used are further described in the sections that follow (Section 4.4.4.2 to 4.4.4.3). Thereafter, the systematic approach to analysing the qualitative data collected are further described in Section 4.4.4.4 and elaborated on in Chapter 5.

4.4.4.2 Semi-structured interviews

In order to test both the procedure of conducting a semi-structured interview and the method of using a semi-structured interview to collect data, a pilot study was conducted (Leedy & Ormrod, 2010:110; 111). The pilot study was carried out in March 2017 to test the procedure used and the questions asked. Based on the results of this pilot study, the questions were checked to ensure that none were compound and that they were unambiguous and non-biased (Bryman & Bell, 2015:197). Since it is advised that

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participants in the pilot study should be similar to those of the actual study because of their familiarity with the topic (Bradley, 2010:211; Magnessen and Marecek, 2015:71), one HoP and one ID, neither of which were associated with the Business Management modules, were asked to partake in this pilot study as they had similar experiences in terms of the learning-activity design of modules for the online learning platform. Suggestions from these two individuals were considered and incorporated in order to improve the process and questions used.

Semi-structured interviews with open-ended questions that are fairly specific in their intent (refer to Addendum F) were employed to elicit detailed descriptions and to explore the participants' interpretation, perception and understanding of WBTL, its relevance to learning-activity design and its application (or lack of), within the selected Business Management modules, as well as suggestions on possible interventions to ensure or enhance the application of a WBTL approach to learning-activity design (Creswell, 1994:1; De Vos, Strydom, Fouché & Delport, 2005:296; McMillan, 2001:269). The exact wording and sequence of questions asked during the semi-structured interview was determined in advance. Participants were asked the same questions in the same order – thus increasing comparability and completeness of data (Cohen *et al.*, 2011:413). The semi-structured interviews, though limited, allowed for some flexibility in that they provided the researcher with an opportunity to probe and expand on responses from the interviewees where relevant and appropriate (Hitchcock, 1997:156). By default, the HoP responsible for the planning, designing and development or moderation (quality assurance) of the online learning material and learning activities for the three Business Management modules was selected to partake in the semi-structured interviews. Similarly, the IDs that reworked and designed learning activities for the online platform for the selected modules were identified and selected as interviewees. The researcher approached the interviewees via electronic mail after receiving approval and consent from the PHEI as well as ethical clearance from Stellenbosch University (refer to Addenda B and C). All participants agreed to participate in the interviews. Interview dates and times were determined at a time and venue convenient to both the researcher and the interviewees. Before the commencement of the interviews, the researcher provided an

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overview of the study. Thereafter, interviewees were requested to sign the consent form (refer to Addendum D) detailing aspects related to the purpose of the study, the procedure, potential risks or discomfort, potential benefits to subjects and/or to society, payment for participation, confidentiality, participation and withdrawal, identification of the researcher, and the rights of research subjects. Interviewees were further informed that the interview would be voice-recorded and transcribed verbatim (Maree, 2007:89), but that information they shared would be kept confidential and that their anonymity would be protected as indicated in the consent form signed. Despite the interviews being voice-recorded, the researcher made detailed notes during the interviews. Furthermore, the researcher made post-interview notes that allowed the researcher to monitor the process of data collection and to start analysing the information (Merriam, 1998:75).

4.4.4.3 Observation

Observation is considered an important data source in research using qualitative data, since it provides the researcher with a first-hand account of the situation under investigation (Engelbrecht, Eloff, Oswald & Swart, 2003:17). Observation in this study allowed the researcher to observe *in situ* how the learning activities were translated in terms of the delivery of the identified Business Management modules, if at all, and whether Whole Brain Teaching and Learning (WBTOL) was evident (Cohen *et al.*, 2011:456). The delivery of the learning material and learning activities of three lecturers – one lecturer per Business Management module selected for this study – were observed. The three lecturers observed were selected based on the user activity reports pulled from the LMS. Each of the three lecturers observed demonstrated activity (as per the user-activity overview reports) on the online platform in that particular Business Management module (1A, 2A or 3A). The researcher approached the lecturers telephonically and/or via electronic mail after receiving approval and consent from the PHEI (refer to Addendum B and C), as well as the brand site of delivery where the lecturer was contracted. All participants agreed to be observed during a lecture of the particular Business Management module they were appointed to lecture. Observation dates and times were determined at a time and venue convenient to both the researcher and each of the lecturers. Before the commencement of the observation, the researcher again provided

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an overview of the study. Thereafter, lecturers were requested to sign the consent form (refer to Addendum D). The researcher took on the role of a non-participating observer during the lecture of the particular Business Management module in order to limit altering the situation – thus observing, from a distance, the unhindered behaviour of the participants (Cohen *et al*., 2011:457; De Vos *et al.*, 2011:329; 330, Maree, 2007:85). Since it is desirable to use a standardised procedure during observation in order to maximise observational efficacy, minimise researcher bias, and allow for the verification of the data, the researcher used a checklist (refer to Addendum H). This checklist was derived from the learning material and learning activities on the online learning platform to record predetermined actions. In addition, and because of the observations during the first scheduled observation, the researcher also felt it necessary to pose a question to the observed lecturers and the attending students at the end of each lecture/class that will be elaborated on in Chapter 5. Furthermore, the researcher made detailed notes during and after the observed lectures (De Vos *et al*., 2011:335; Maree, 2007:85).

Each lecture was also voice-recorded, with consent, in order to verify recordings made against the checklist and notes taken during and after the lecture.

4.4.4.4 Data analysis and interpretation

'Data analysis' can be described as the process or procedure used by the researcher to analyse – thus order, structure and bring meaning – to the data collected (De Vos *et al*., 2011:397; Maykutt & Morehouse, 1994:127). This study adopted a qualitative thematic data-analysis approach that allowed the researcher to identify recurrent, salient as well as absent themes. Thematic data analysis is a method used to discover and analyse the patterns or themes presented in the data (Braun & Clark, 2006:79). According to Maxwell (2008:236-238), qualitative thematic data analysis involves breaking down data into categories enabling the data to be analysed, compared and contrasted in order to interpret and make sense of what is included in the data. Categories, according to Hsieh and Shannon (2005:1285), "are patterns or themes that are directly expressed in the text or are derived from them through analysis".

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The text data from all the data collected was systematically analysed and organised into categories. The Herrmann Whole Brain Teaching and Learning Model (WBTL) (Herrmann, 1995:220) together with the Herrmann Brain Dominance Instrument (HBDI) (Herrmann, 1995) were used as organising tools that provided the categories and subcategories into which most of the data relating directly to the learning activities could be organised. Learning activities within the online learning material of the selected Business Management modules were then coded through the process of grouping similar ideas or themes into the relevant categories and subcategories provided by the WBTL model and HBDI. Similarly, data obtained from the observations were coded in relation to the observed delivery of learning material and the use of learning activities, where evident, within the class environment.

The semi-structured interviews and observations were transcribed verbatim. Data from the semi-structured interviews that could not be organised in terms of the given categories from the WBTL model and HBDI were grouped into different themes linked specifically to the questions asked during these interviews in relation to the study. Once the initial categorisation and coding were completed, the data were re-examined. More detailed descriptions of the data-analysis process followed by the researcher are provided below.

4.4.4.4.1 Coding and data analysis

During the first cycle of analysis, the text data from the curriculum documentation – i.e. the online learning material and learning activities – were captured and coded using words or short phrases that symbolically assigned a collective attribute or theme to a portion of the language-based or visual data in a 'document analysis matrix' (refer to Addendum E) using an excel spreadsheet. According to Saldaña (2013:4), this researcher-generated construct or theme (representative of the words or short phrases) attributes interpreted meaning to the data in order to detect patterns, categorise, build theory, and for other analytical processes.

The codes used in the first cycle of document analysis reflect the constructs, concepts, language, model, and theory that structured this study. Where appropriate and justifiable,

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according to the interpretation of the researcher, the researcher assigned more than one code to a portion of language-based or visual data during the first cycle of analysis. As part of the second and third cycles of analysis, first cycle codes were categorised according to main categories and subcategories, and again coded accordingly, as explained later on in this section.

The Herrmann Whole Brain Teaching and Learning Model (WBTL) (Herrmann, 1995:220) together with the Herrmann Brain Dominance Instrument (HBDI) (Herrmann, 1995) provided the main categories and subcategories into which the first-cycle codes could be organised. The four main categories were Quadrant A, B, C and D. The subcategories included concepts relevant to each quadrant of the WBTL model and HBDI as illustrated in Table 4.3 below. Each portion of language-based and/or visual data coded during the first cycle of analysis was categorised during the second cycle of analysis into a main category, as indicated in Table 4.3, and assigned a main-category code. For example, in the introduction section of each learning unit of each of the three Business Management modules, the timeline for completing the actual or official learning activities within that learning unit is provided e.g.: "*Time on task for activities: 6 hours*". This portion of language-based text, interpreted as providing students with a measurable timeline that provides a holistic perspective of the expectation in a particular learning unit, resulted in three codes being assigned – i.e. "quantifiable numbers", "timeline" and "holistic". In this example, the code "quantifiable numbers" was categorised under Quadrant A. Consequently, the main-category code A was assigned to the code "quantifiable number". Furthermore, the code "quantifiable number" with the main-category code A was further categorised under the subcategory of "Quantitative" and thus assigned the subcategory code "Q" (refer to Table 4.3). As a result, the main category code "A" and subcategory code "Q" were assigned to the first-cycle code "quantifiable number" providing the researcher with the code string AQ. The combined code string for this portion of text is illustrated in Table 4.4. The coding of the text data produced 'code strings', enabling the researcher to identify the typical approach followed in the design of the online learning material, its associated learning activities and/or the actual or official learning activities of

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each section, learning unit and module. These code strings are described in more detail in Chapter 5.

Table 4.3 Categories and subcategories

Main category	Main category code	Subcategory	Subcategory code
Quadrant A (analytical thinking)	A	Logical	L
		Rational	R
		Quantitative	Q
		Verbal	V
		Structured	S
		Fact based	F
Quadrant B (practical thinking)	B	Organised	O
		Sequential	Se
		Procedural	P
		Verbal	V
		Structured	S
		Controlled	C
Quadrant C (relational thinking)	C	Emotional	E
		Expressive	Ex
		Interpersonal	I
		Non-verbal	N
		Experimental	Exp
		Open minded	Op
Quadrant D (experimental thinking)	D	Visual	Vi
		Conceptual	Co
		Simultaneous	Si
		Non-verbal	N
		Experimental	Exp
		Feeling	Fe

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Table 4.4 Illustration of code string for a portion of text

First-cycle code	Second-cycle code – main category code	Third-cycle code – subcategory code	Code string (Single and Multiple)
Quantifiable numbers	Quadrant A – therefore code A	Quantitative – therefore code Q	AQ
Timeline	Quadrant B – therefore code B	Organised – therefore code O	BO
Holistic	Quadrant D – therefore code D	Conceptual – therefore code Co	DCo
Multiple code string			*AQ_BO_DCo*

4.4.4.5 Crystallisation

According to Tracy (2010:843), the practices of triangulation and crystallisation "align in craft but differ in paradigmatic motivation". Triangulation involves an attempt to bring multiple forms of data and analysis to a central point or truth in order to clarify and enrich a report on a phenomenon (Ellingson, 2009:22). It therefore assumes a single reality. From an interpretative paradigm, triangulation does not overlap as the interpretative paradigm views reality as socially constructed. As a result, different methods, data, or researchers often do yield different results. These results allow for "different facets of problems to be explored, increased scope, deepens understanding, and encourages consistent (re) interpretation" (Tracy, 2010:843). According to Richardson (Denzin & Lincoln, 2000:963), "there are far more than three sides by which to approach the world. We do not triangulate; we crystallize". Richardson (2000) broadly introduced the concept of crystallisation in her classic essay and chapter, "Writing a method of inquiry," in Denzin & Lincoln (2000:963). Crystallisation reflects a different goal to triangulation. Crystallisation seeks to problematize the multiple truths it presents (Ellingson, 2009:22). It therefore "presupposes that no truth exists, but only multiple and partial truths that researchers (and others) co-construct" (Ellingson, 2009:22). Crystallisation therefore views a phenomenon from multiple points of view. Using multiple methods of data

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collection and analysis and three levels of 'actors' – i.e. the HoP, the IDs and the module lecturers – in this study allowed the researcher to view the phenomenon of the application of WBTL to learning-activity design from multiple points of view, as illustrated in Figure 4.1 below. Figure 4.1 uses a triclinic crystal shape to illustrate the multiple points of view considered and presented in this study, as discussed in Chapter 5.

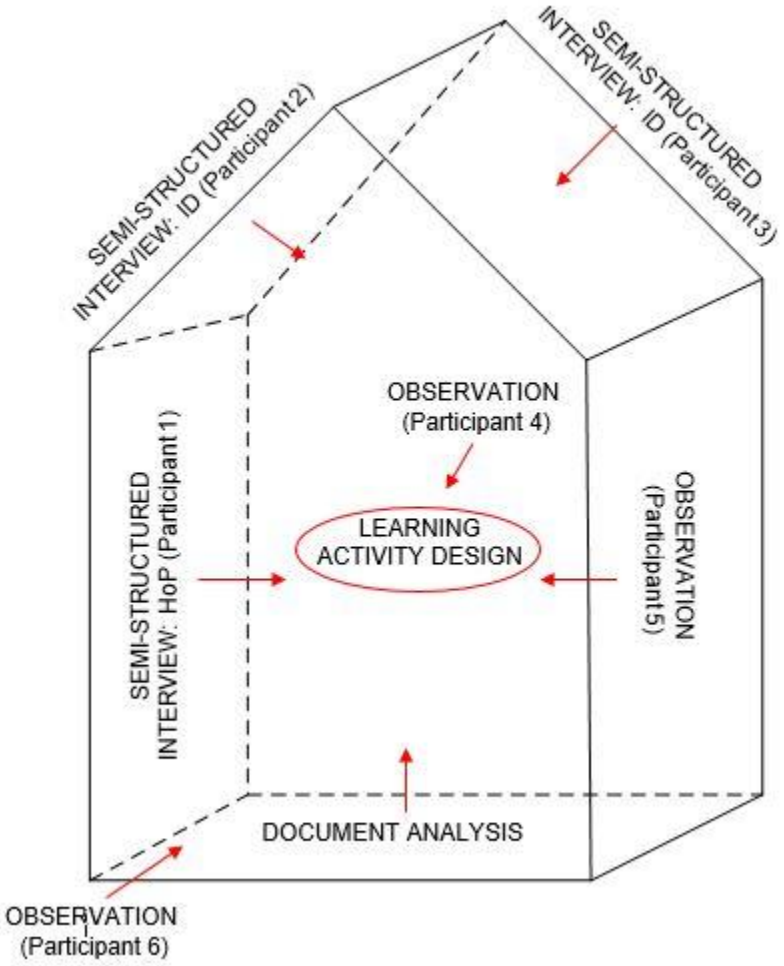

Figure 4.1 Illustration of crystallisation of this study

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4.5 Credibility and trustworthiness

In order to increase trustworthiness in a qualitative study, it is suggested that researchers should pay attention to the following dimensions, some of which overlap: credibility (alternative to inter-validity), transferability (external validity), dependability (reliability), confirmability (objectivity), worthy topic, rich rigour, sincerity, resonance, significant contribution, meaningful coherence and ethical considerations (Denzin & Lincoln, 2011:646; Lincoln & Guba, 1985:219, 247; Tracy, 2010:840).

For this study, the researcher selected a worthy topic that was relevant to and addressed the contextual priorities of the PHEI (Tracy, 2010:841). The study was based on suitable theoretical constructs as is discussed in Chapter 2 and Chapter 3, implying rich rigour as described by Tracy (2010:843). In addition, theoretical constructs and frameworks used by the researcher were accurately identified and described – thus ensuring credibility or internal validity (De Vos, Strydom, Fouché, & Delport, 2011:420). Furthermore, the researcher used multiple types of data by engaging multiple methods of data collection in order to provide a more complex, in-depth understanding of the issues related to this study (Lincoln & Guba, 1985:305; Maree, 2007:80; Tracy, 2010:843). Rich descriptions of the context – i.e. the PHEI context and that of the participants – have been provided in Chapter 1, this chapter (Chapter 4) and Chapter 5. In addition, in Chapter 5, the researcher provides detailed explanations to show the complexity of the data gathered to facilitate generalisability (referring to external validity) (Maree, 2007:37-38; Tracy, 2010:843).

The document analysis, in combination with data sources that included the semi-structured interviews and observations, were used in this study to facilitate crystallisation. Through the crystallisation of the data collected, the researcher provided evidence to support the findings demonstrating the dependability (reliability) of the research conducted (Eisner, 1991:110; Lincoln & Guba, 1985:317; Maree, 2007:38). Furthermore, it is believed that this study achieved what it set out to achieve, used appropriate methods and made meaningful connections based on the literature used (meaningfully coherent) (Tracy, 2010:844; 846; 848). The researcher was honest and transparent: any possible

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biases and weaknesses within the study were clearly indicated (sincerity) (Tracy, 2010:841). It is further believed that the findings of this study can be transferred to another one and that these findings can affect an audience (transferability and resonance) (Lincoln & Guba, 1985:316; Tracy, 2010:845). From an ethical perspective, the researcher took a holistic approach to research ethics as described further in Section 4.6 below (Tracy, 2010:847).

4.6 Ethical considerations

The researcher considered the following ethical issues and concerns whilst conducting this study: informed consent; anonymity; confidentiality; the right to withdraw; ethical approval and permission to conduct research; do no harm; openness and honesty regarding research; competing ethical obligations; accessibility of results; protection and preservation of records/ data; and the ethical-professional relationship with others (the participants) (Henning, Van Rensburg & Smit, 2004:73; American Anthropological Association, 2012). The researcher applied for ethical clearance from the University of Stellenbosch, as well as from the PHEI, to conduct this study, and ethical clearance was granted by both (refer to Addendum A & B). In addition, the PHEI and the brand sites of delivery also provided permission to conduct the study at the sites of delivery identified (refer to Addendum C & D). Participants – the HoP, the IDs and the identified module lecturers – provided informed consent to take part in this study (refer to Addendum D). The consent form to participate in the study, as can be viewed in Addendum D, provided information to participants about the reason for the study, what their participation would entail and what their rights as participants were. Information related to the PHEI and the personal details of the participants were treated as confidential. Participants are kept anonymous in the reporting of the data, even though they are a part of the same PHEI and known to the researcher whilst conducting the study.

Aggregated research results were made available to the PHEI. At the discretion of the PHEI, the results could also be made available to participants. All research records/data were password protected and stored either in a lockup cupboard or on a central server on which the files containing the research data are only accessible to the researcher.

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Throughout the study, the researcher maintained a respectful and ethical professional relationship with representatives of the PHEI and research participants. Furthermore, the researcher carefully weighed competing ethical obligations to research participants, professional colleagues and employers.

4.7 Summary

This chapter provided an overview of the research design and case-study methodology employed in this study. In particular, the chapter outlined the paradigm and theoretical framework that informed the philosophical assumptions of this study and guided the selection of the type of research design and research methods used by the researcher. The research methods used in this study were discussed by referring to the population and sampling, data-collection techniques, and data analysis and interpretation. The chapter also included the considerations of the researcher to ensure the credibility and trustworthiness of the study as well as a number of ethical considerations. In Chapter 5, findings from the empirical part of the study that examined how the principles of a WBTL approach were applied to the design of learning activities of the selected Business Management modules are discussed.

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CHAPTER FIVE

FINDINGS FROM THE EMPIRICAL PART OF THE STUDY

5.1 Introduction

Chapter 4 describes the research methodology and explains the research design and the instruments used to collect data. In this chapter, the data collected through the document analysis, semi-structured interviews and observations are presented and analysed. The chapter starts with a brief outline of the background of the teaching and learning strategy of the PHEI that informs learning material creation and therefore learning activity design, followed by an overview of the learning-material development process undertaken by the PHEI. In addition, some background information of the participants and a brief description of their role in terms of learning-activity design for the Business Management modules analysed in this study are provided. Hereafter, the most prominent themes of each data set that emerged will be discussed followed by a general discussion of the findings. Lastly, this chapter presents a summary of the current study's main findings. This chapter further provides information that addresses three of the subsidiary research questions posed in Chapter 1. These include:

- What is the relevance of WBTL in learning activity design in the context of student achievement?
- How, if at all, is WBTL applied in the design of learning activities within the Business Management modules in the Bachelor of Commerce degree?
- What interventions, based on the findings of this study, could enhance the application of WBTL to learning-activity design of the Business Management modules within the Bachelor of Commerce degree?

5.2 Background of the teaching and learning approach

As indicated in Chapter 1, Section 1.2.1, HEIs in South Africa implement various initiatives to improve quality, add additional support services, and to adapt teaching and learning approaches that may positively influence learning and achievement. One such initiative by the PHEI includes the drive and strategic prioritisation of the use of technology – i.e.

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the integration of appropriate use of technology (specifically, the LMS) – to present material; to allow students to access information independently; to facilitate presentation of learning; and to ensure engagement, collaboration and feedback. Since learning material plays a supportive role in the delivery of programmes and is required to be responsive to student diversity (as outlined in the Improving Teaching and Learning (ITL) Resources, CHE, 2004:48; 113), stakeholders from the PHEI responsible for converting existing (and producing new) learning material for the LMS committed to not merely producing 'paper behind glass'. Stakeholders, including the HoPs and the IDs, therefore, attempt to drive the teaching and learning strategy adopted by the PHEI. This is partly achieved through the design of learning material and learning activities that aims to promote deep and constructivist learning, whilst taking cognisance of the method in which it will be presented; the profile of student it aims to engage; and the range of needs and learning styles of students (IIE, 2017:12).

The teaching and learning strategy adopted by the PHEI recognises that learning is a process of construction where students learn by assimilating new information into the framework of what they already know. According to the PHEI, this is best achieved in a context that links learning to its application through activity, and takes cognisance of the context in which an idea is presented, as well as the students' beliefs and attitudes that help shape what is learned. In addition, the PHEI believes that student success can be advanced through teaching and learning activities that require and enable students to actively participate in their learning, and that provide opportunities for them to apply what they learn to authentic contexts (to solve problems rather than just to master content). To translate the teaching and learning strategy into practice, the PHEI provides the developers of learning material with specifically designed development templates that ensure that all material at the PHEI is written and presented in a standard format. Furthermore, the PHEI follows a rigorous development process as briefly outlined next.

5.3 Overview of learning material development process

The development process followed annually by the PHEI can be divided into six phases. During the first phase, the development plan and budget are finalised. The development

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plan is informed by existing module feedback from students and lecturers related to enhancements, required changes or updates; brand requirements and planned new or existing qualification and programme offerings. During this first phase, HoPs usually identify a Subject Matter Expert (SME), either internal or external to the PHEI, as a learning material developer. In some instances, HoPs take on the role of the developer. A dedicated project team thereafter commences with phase two: the briefing process. During this phase, briefing documentation informed by the development plan is prepared. Development templates, developer brief and developer annexures form part of the briefing documentation.

The Academic Development Manager together with the Teaching and Learning Manager in collaboration and consultation with the Senior Instructional Designer (SID), IDs and HoPs construct the development templates used by developers of learning material. These development templates are reviewed annually. Development templates include detailed instructions, explanations, as well as sample text to guide the nature of the development in line with the teaching and learning strategy outlined in Section 5.2. During the third phase of the development process, the HoPs review the briefing documentation. Where appropriate and required, the HoPs add information or instructions to the development templates for the developer. In addition, the HoP also checks and completes the prepared developer brief and annexures. Hereafter, the project team will compile all required documentation to be sent to the developer in order to commence with the development phase (third phase) of the learning material. The required documentation is then sent to the developer and includes the briefing documents – i.e. the developer templates, developer brief and developer annexures; contractual documentation; and general informative documentation such as the Developer's Handbook.

The Developer's Handbook details the teaching and learning paradigm of the PHEI. The Developer's Handbook also provides additional guidelines on the development of learning material, including that of the learning activities at the appropriate cognitive level as well as general and specific principles and requirements relating to:

- the construction of learning materials and learning activities;

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- the differentiation between module purpose, module outcomes and learning unit objectives;
- the qualities of the learning materials and learning activities;
- the contents expected in the learning materials;
- constructive alignment;
- assessment questions;
- evaluation of student performance; and
- the construction of question papers and marking memoranda.

Developers are encouraged to engage and collaborate with the HoPs and or the IDs throughout the development phase to ensure the set requirements are met. As soon as the learning material and learning activities are developed and received from the developer, phase four – i.e. the moderation phase – commences. During this phase, the HoP and/or the ID reviews and moderates (quality assures) the learning material and learning activities subject to the policies (including, but not limited to the Teaching and Learning Strategy policy), governance and operational procedures of the PHEI. This phase generally follows an iterative and collaborative back-and-forth process between the HoP and IDs until consensus is reached that the learning material and learning activities meet the requirements for each subsequent section and the quality expected as outlined by the PHEI. A dedicated editing team thereafter commences with the editing phase (phase five), which includes language editing, formatting and styling, followed by the approval phase (phase six) to release learning material and learning activities either to the brands for distribution to lecturers and students, or to Content Developers (CDs) responsible for placing the approved learning material and learning activities onto the LMS.

For this study, the learning material and learning activities of the Business Management 1A, 2A and 3A modules, as indicated in Chapter 4, Section 4.4.3, that were placed onto the LMS and approved during the approval phase for 2017, were analysed. The empirical part of the study relating to the analysis of the learning material and learning activities is presented next in Section 5.5.1, following the brief description of participant backgrounds

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and their role relating to the design of learning material and learning activities for the Business Management modules provided.

5.4 Background information of participants and their role in terms of learning activity design

5.4.1 Participant 1

Participant 1 was the HoP and custodian of the three Business Management modules analysed in this study. This participant holds qualifications in a related discipline to that of the Business Management modules. For this reason, a SME was contracted to develop the learning material. However, the moderation (quality assurance) and the subsequent coversion of the developed learning material into the appropriate format required for the LMS (as analysed in this study) was done by the HoP and IDs, with the SID overseeing the work. This participant did not hold any qualifications in education and therefore was not necessarily familiar with educational discourse related to, for example, learning styles, but had sufficient experience in the educational landscape and has been employed in an academic capacity in HE in South Africa since 2011. In addition, this participant also did not attend the Facilitating Learning Programme (FLP) as discussed in Chapter 1. Despite not attending the FLP, the participant had been exposed to on-the-job and in-house training informed by the teaching and learning strategy of the PHEI and the requirements set out in the development templates of learning material.

5.4.2 Participant 2

Participant 2 participated in this study in the capacity as an ID. This participant was involved in assisting and guiding the HoP with the moderation (quality assurance) and conversion of the developed learning material of the Business Management modules received from the developer into the appropriate format required for the LMS (as analysed in this study). This participant held qualifications in education and has extensive experience in instructional design. Therefore, this participant was quite familiar with educational discourse, including that of learning styles.

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5.4.3 Participant 3

Participant 3 was an ID who worked closely with Participants 1 and 2 on the moderation (quality assurance) and translation of the developed learning material of the Business Management modules received from the developer into the appropriate format required for the LMS (as analysed in this study). This participant also held qualifications in education and has extensive experience in designing and developing learning material and some experience in instructional design.

5.4.4 Participant 4

Participant 4, from site one, was a lecturer at one of the sites identified for this study. The participant had been lecturing Business Management 2A since 2015 and Business Management 3A since 2016. As a lecturer, this participant had not been involved in the design or development of the learning material and learning activities. However, this participant, as a lecturer, was responsible for the delivery of the learning material in class.

5.4.5 Participant 5

Participant 5, from site 2, was a lecturer at one of the sites identified for this study. The participant had been lecturing Business Management 1A since 2015 and Business Management 2A since 2016. As with Participant 4, this participant had not been involved in the design or development of the learning material and learning activities and was responsible for the delivery of the learning material in class.

5.4.6 Participant 6

Participant 6, from site 3, was a lecturer at one of the sites of delivery identified for this study. The participant had been lecturing the Business Management 2A and 3A modules since 2015. As with Participants 4 and 5, this participant had not been involved in the design or development of the learning material and learning activities and was responsible for the delivery of the learning material in class.

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5.5 Prominent themes of each data set

5.5.1 Document analysis

Supporting the notion that the PHEI provided developers of learning material with specifically designed development templates, Participants 1, 2 and 3 – i.e. the HoP and the two IDs – indicated that all learning material developers, be they HoPs or SMEs contracted to develop learning material, receive and use the same development templates. These development templates included clear guidelines and stipulations on the requirements for each sequential section of the learning material in an attempt to ensure that the teaching and learning strategy is translated into practice. Therefore, the findings from the empirical part of the study are presented according to the sequential format and structure of the online learning material (that follows the development template as indicated in Section 5.2 and 5.3). The sequential format and structure that the online learning material of the three Business Management modules follow is indicated as a) to k) below, with section k) representing the actual or official learning-activities section of the learning material analysed.

a) Module overview;
b) Module purpose and outcomes;
c) Module pacer;
d) Assessment information;
e) Module glossary;
f) Introduction (to each learning unit);
g) Learning unit objectives (for each learning unit);
h) Think about;
i) Active learning;
j) Textbook;
k) Activity.

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a) Module overview [AF_AL_AR_AV_BC_BV_DCo]

The coding of the text data of the 'Module overview' section produced a code string, as explained in Chapter 4, Section 4.4.6. The code string produced for the online learning material section, the 'Module overview', in each of the Business Management modules (1A, 2A and 3A) is indicated in the heading above. This code string demonstrated the incorporation and consideration of teaching and learning elements that could be associated with Quadrants A, B and D of the WBTL model (Herrmann, 1995) (refer to Figure 3.8) as explained below.

The associated learning activity for this section of the online learning material is the reading of a theoretical overview of the module that contains detailed factual information. Considering the theoretical components of Herrmann's whole-brain model in terms of the functional specialisation of the brain, reading requires the movement of the eyes in response to visual stimuli – i.e. reading of the fact-based text of the 'Module overview' section. Therefore, the student employs the midbrain that contains the sensory fibres and that serves as the reflex centre for the movement of the eyes in response to the visual stimuli (Tortora *et al*., 1993:414, 415). These sensory stimuli – i.e. the visual stimuli – are then relayed through the thalamus to the sensory association area of the neo-cortex where it is consolidated into objects that are recognisable to the student – i.e. words and sentences. This information is then sent to the amygdala for emotional evaluation and the frontal cerebral cortex for content evaluation. As indicated in Section 3.3.1.1.2, based on this evaluation and analysis, the brain begins to construct meaning and since the information provided in the fact-based text of the 'Module overview' section to the students is relevant to their studies, it is believed that this new information could possibly be retained in memory.

Bearing in mind that the aforementioned is a simplification of the process the brain follows when reading theoretical text, it can still be deduced that both the limbic and the cerebral modes of thinking processes as per Herrmann's whole-brain model are represented in the learning activity of reading. In addition, written language (and therefore the fact-based text read in this section of the online learning material) is associated with the left brain,

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as described in Section 3.1.1.1.1. The left brain is associated with Quadrants A and B of The Herrmann Whole Brain Model (Herrmann, 1995) (refer to Figure 3.7) and the WBTL model (Herrmann, 1995) (refer to Figure 3.8) with Quadrant A being linked to the cerebral mode of thinking processes and Quadrant B being linked to the limbic mode of thinking processes.

According to Herrmann (1995:79-85), activities that includes logical, analytical and fact-based information in combination with the ability to perceive, verbalise and express information precisely can be associated with Quadrant A. Therefore, reading the fact-based theoretical text (written language linked to the concept verbal) of the 'Module overview' section can be associated with 'hard' processing dealing with logical and rational issues and activities linked to Quadrant A. As a result, the theme 'reading text' was identified for this section of the online learning material. Subsequently, this theme was categorised as Quadrant A and subcategorised as 'verbal', 'fact based', 'logical' and 'rational' in accordance with the WBTL model (Herrmann, 1995). Quadrant B, similar to Quadrant A, involves a linear approach to activities and students with a preference for the B-quadrant favour organised, sequential, planned and detailed information (Herrmann, 1995:79-85), that this part of the online learning material included. In addition, 'verbal' as a subcategory (refer to Table 4.3) is also associated with Quadrant B. Therefore, reading text was also categorised under Quadrant B and subcategorised under 'verbal'. Furthermore, the information provided in the 'Module overview' section provided students with information that can be associated with the 'controlled' element of the WBTL model (Herrmann, 1995) that is associated with Quadrant B. The theme 'directing learning' was identified for this section of the online learning material as the information provided in the text (written language) directed students on how to approach the study of the module. It is believed that 'directing learning' accommodates the cognitive functioning represented in Quadrant B, as indicated by Herrmann (1995:220) that relates to the preference for an organised, planned, orderly, and step-by-step approach. The theme 'directing learning' was therefore categorised as Quadrant B and subcategorised as 'controlled'. In addition, the information provided was viewed as a theoretical overview in which the concepts and theory covered within the module in question were conceptualised and synthesised for

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the student. For this reason, the researcher also included the theme 'theoretical overview' in the 'Module overview' section of the learning material. The theme 'theoretical overview' was then categorised under Quadrant D as it was believed that the cognitive functioning of students with a preference for Quadrant-D thinking and learning is accommodated through the conceptualisation and synthesising of the theoretical concepts of the Business Management modules. Consequently, the theme 'theoretical overview' was subcategorised under 'conceptual' - an identifiable element within the WBTL model (Herrmann, 1995:220) associated with Quadrant D. After reading the 'Module overview' section in the online learning material, students would generally move to the next section and read the module purpose and module outcomes as described next.

b) Module purpose and outcomes [ABS_BC_BO]

The 'Module purpose and outcomes' section of the online learning material provided students with a summarised overview of the purpose of the module as well as the required or expected outcomes for that module. The module purpose and outcomes provided in this section seemingly aimed to direct students' learning through indicating what the expectations of them are. As a result, the module purposes and outcomes provided in this section of the online learning material were interpreted and coded by the researcher with the theme 'directing learning'. As a recurring theme, it was again categorised under Quadrant B and subcategorised under 'controlled'. Furthermore, the module purposes and outcomes of each of the Business Management modules analysed were organised and structured in a similar format resulting in the identification and inclusion of the themes 'organised' and 'structured'. Presenting the information in an organised and structured fashion accommodates Quadrant-B cognitive functioning and processing (Herrmann, 1995:220). Therefore, the themes 'organised' and 'structured' were categorised under Quadrant B. Whilst the theme 'organised' can be associated with Quadrant B considering the WBTL model (Herrmann, 1995), the theme 'structured' can be associated with both Quadrant A and Quadrant B. The sub-categorisation of these themes is self-evident i.e. 'organised' and 'structured' (refer to Table 4.3).

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Based both on the interpretation of the researcher, and the categorisation and sub-categorisation of the themes identified for the 'Module purpose and outcomes' section, a code string was produced (as indicated in the heading above). The produced code string demonstrated the incorporation and consideration of teaching and learning elements as described here that could be associated with Quadrant A and B of the WBTL model (Herrmann, 1995).

In order to further guide and support students' learning, the learning material included a module pacer that again was structured and organised similarly in all three of the Business Management modules as discussed next.

c) Module pacer [ABS_AQ_BC_BO_DSi]

The 'Module pacer' section of each Business Management module was structured and organised into different learning units to be covered. Consequently, the themes 'structured' and 'organised' were identified linking this section of the online learning material with Quadrant A and B, as explained in Section b). Moreover, the 'Module pacer' section provided a holistic perspective of the expectation in each learning unit and, thus, the whole module. Considering that this section provides a holistic perspective, the theme 'holistic' was identified and later linked to the main category 'Quadrant D'. Presenting a holistic perspective accommodates Quadrant-D cognitive functioning that includes holistic thinking as indicated by Herrmann (1995:220). The theme 'holistic' was then sub-categorised under subcategory code 'simultaneous' as the researcher interpreted this specific section to provide the holistic expectations of all learning units at once, or–simultaneously.

Every learning unit in all the online learning material analysed was subdivided into themes. Under each theme, learning-unit objectives that could be linked to that theme were provided. Each learning unit objective provided was clear and measurable and seemingly aimed at directing students' learning in order to meet the module outcomes. For this reason, the researcher coded this section of all the Business Management modules' online learning material under the theme 'directing learning' that is linked to the

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category and subcategory Quadrant B ‘controlled’ (as explained in Section a). In addition, it was believed that this section of the online learning material provided students with information that could assist in their planning and organising of their own learning. For this reason, the theme ‘planning and organising’ was identified and categorised under Quadrant B ‘organised’ since the information provided supported the cognitive functioning and processes for Quadrant B – i.e. the preference for an organised and planned approach.

Furthermore, the module pacer indicated the total amount of contact time allocated to the whole module as well as to each learning unit. The provision of the timelines was coded with the theme ‘quantifiable numbers’ as well as ‘timeline’, which were categorised under the main category Quadrant A and B respectively. The subcategories ‘quantifiable’ and ‘organised’ were chosen – thus representing Quadrant A and B within the WBTL model (Herrmann, 1995). The researcher interpreted and believed that the provision of quantifiable numbers and a timeline accommodated the cognitive functioning of students with a preference for both Quadrant A and B in that mathematical processing could be used to plan and organise their time accordingly.

Based on the interpretation of the researcher and the categorisation and sub-categorisation of the themes identified and explained above, a code string was produced (as indicated in the heading of Section c). The produced code string demonstrated the incorporation and consideration of teaching and learning elements as described here that can be associated with Quadrant A, B and D of the WBTL model (Herrmann, 1995).

d) Assessment information [ABS_AQ_BC_BO]

The online learning material contained an ‘Assessment information’ section for each Business Management module. This section provided the student with structured information on the types of formal assessments included in each module such as assignments, tests, and exams. The theme ‘structured’ was assigned to this section of the online learning material and is associated with the main categories Quadrant A and B and the subcategory ‘structured’ (similar to the explanation provided in Section b and c

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above). The 'Assessment information' section furthermore provided a breakdown of the number of assessments, the weighting of each assessment, the time or duration of each assessment, as well as which learning units will be assessed in each assessment.

Furthermore, this section included some general information about the format and expectation of each assessment together with some preparation hints for each. Recurring themes were identified and used in the coding of this section of the online learning material i.e.:

- 'quantifiable numbers' (related to amount, weighting, time or duration);
- 'planning and organising' (related to the information provided within the section assisting students in their planning and organising of their own learning); and
- 'directing learning' (related to the information provided in this section that provides guidelines that directs students learning).

This interpretation and coding resulted in a code string (as indicated in the heading above) that could be associated with Quadrants A and B of the WBTL model (Herrmann, 1995). The identifiable subcategories and elements were 'structured', 'quantitative', 'organised' and 'controlled'.

e) Module glossary [ABS_AF_AL_AR_AV_BO_BV_DCo]

Only the online learning material of Business Management 1A and 3A included module glossaries. The 'Module glossary' section provided students with all the key terms and definitions used in the module in table format. Presenting information in table format and in alphabetical order resulted in the themes 'structured' and 'organised' being allocated to this portion of the online learning material. Therefore, linking and associating it with Quadrants A and B of the WBTL model (Herrmann, 1995). By reading the fact-based text provided in this section, students are provided with an overview of all the important concepts and their meaning within a particular module – thus assisting students in their general understanding of the module content. As in Section a, the theme 'reading text' was allocated resulting in the similar categorisation of the theme under categories Quadrant A and B, and the subcategories 'verbal', 'fact based', 'logical', and 'rational'. In addition, the theme 'theoretical overview' was included as it relates to the overview of all

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the important theoretical concepts within the Business Management modules. As indicated in Section a, the theme ‘theoretical overview’ was then categorised under Quadrant D and subcategorised under ‘conceptual’, which is an identifiable element within the WBTL model (Herrmann, 1995).

f) Introduction (to each learning unit) [AF_AL_AQ_AR_AV_BO_BV_DSi]

The multiple (or combined) code string extrapolated from the ‘Introduction’ section in all learning units for each of the Business Management modules are provided in the heading above and could therefore be associated with Quadrants A, B and D of the WBTL model (Herrmann, 1995). Similar to the previous sections where fact-based texts (that could be directly linked to subject matter) are required to be read, the theme ‘reading text’ was assigned. Therefore, the ‘Introduction’ section was also linked to categories Quadrants A and B and subcategories ‘verbal’, ‘fact based’, ‘logical’, and ‘rational’. Moreover, this portion of the online learning material provided students with a measurable timeline that indicated how long it should take them to complete the activities within that particular learning unit. The theme ‘quantifiable numbers’ was allocated to this portion of the online learning material. ‘Quantifiable numbers’ as indicated in Chapter 4, Section 4.4.6 and Section b are categorised under category Quadrant A ‘quantitative’. The timelines provided also allowed for students to organise and plan their own learning. Therefore, the theme ‘organising and planning’ was linked to the ‘Introduction’ section of the online learning material, which resulted in the categorisation of this theme under the category Quadrant B and the subcategory ‘organised’. In addition, this part of the online learning material provided students with a holistic overview – a summary – of what was covered within a particular learning unit. The theme ‘holistic’ was identified and categorised under Quadrant D ‘simultaneous’, similar to the explanation provided earlier in Section c.

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g) Learning unit objectives [BC_BO_DSi]

After the 'Introduction' section of each learning unit, the relevant learning unit objectives are provided. Within the 'Learning unit objective' section, students are again provided with not only an overview of what the expectations are of them for the learning unit, but also information that could assist in the planning and organising of their own learning. It appears that through repeating the learning unit objectives from the 'Module pacer' section here, its importance is stressed and students' learning is again directed in order to meet the module outcomes. In line with the explanations provided under Section c, in terms of the learning unit objectives, themes and categories were established and a code string was produced (as indicated in the heading). The produced code string demonstrated the incorporation and consideration of teaching and learning elements that can be associated with Quadrants B and D of the WBTL model (Herrmann, 1995).

h) Think about [AF_AL_AR_AV_BC_BO_BP_BV_CE_DVi]

Each theme, as indicated in the pacer, begins with a 'Think about' section. Code strings extrapolated from the 'Think about' sections in the three different Business Management modules' online learning material varied. However, a combined multiple code string (as included in the heading above) considering all possible variations identified was produced and is explained here. The 'Think about' sections follow a Socratic approach by asking questions. It seemed like the questions asked to students in the 'Think about' sections were designed to engage students in logical and rational thinking linked either to theory they might already know or to their own, real-life experience and/ or feelings and emotions that harmonises with the content. Considering this interpretation, the researcher coded this section of the online learning material with the themes 'logical thinking', 'rational thinking', and 'feelings and emotions'. The themes 'logical thinking' and 'rational thinking' that can be associated with the cognitive functioning and processes of Quadrant-A preferences as indicated by Herrmann (1995:220) were categorised under the main category Quadrant A and the subcategories 'logical' and 'rational'. According to Herrmann (1995:220), Quadrant C refers to the cluster of processes described as concerned with emotions and feelings. Therefore, the theme 'feelings and emotions' was categorised under Quadrant C and subcategorised under 'emotional'.

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In addition, it appeared that the questions asked in this section of the online learning material generally required students to think in an organised manner in order to answer 'why' and 'what' questions. These questions were therefore coded with the theme 'why what questions'. Other types of questions appeared to be those that required students to answer procedural/methodical 'how' questions – these were therefore coded with the theme 'how questions'. This instructional approach, using these types of questions, accommodated the cognitive functioning and processing related to the preference for an organised, orderly and step-by-step approach that is associated with Quadrant B as indicated by Herrmann (1995:220). Therefore, both these themes – i.e. 'why what questions' and 'how questions' – were categorised under Quadrant B and subsequently subcategorised as 'organised' and 'procedural' leading to the inclusion of BO and BP in the code string for this section of the online learning material.

Furthermore, where appropriate, to support students, and in some instances direct their thinking, fact-based e-readings or video clips were made available within the 'Think about' sections in all three the Business Management modules. Themes identified in terms of this interpretation and these findings included 'directing thinking', 'e-readings' and 'video-clips'. Similar to one of the previous themes 'directing learning', the theme 'directing thinking' was categorised under the main category Quadrant B and subcategorised under 'controlled'. 'E-readings' as fact-based text to be read was treated as similar to the theme 'reading text' discussed in Section a and was therefore categorised under Quadrant A and subcategorised under 'verbal', 'fact based', 'logical', and 'rational' as well as with Quadrant B 'verbal'. However, since online text generally includes visuals and graphics, the theme 'e-reading' was also categorised under Quadrant D and subcategorised under 'visual'. This categorisation was based on Herrmann's notion that Quadrant D represents the cluster of cognitive functioning and processing that relates to the intuitive modes of thought, which includes visual thinking (Herrmann, 1995:220). Finally, the theme 'video-clip' that was associated with the visual presentation of subject matter/content for this portion of the online learning material was also categorised under Quadrant D and subcategorised under 'visual'. Ultimately, the code string produced for the 'Think about' sections of all Business Management modules' online learning material demonstrated the

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incorporation and consideration of teaching and learning elements that can be associated with Quadrants A, B, C and D of the WBTL model (Herrmann, 1995).

i) Active learning [AF_AL_AR_AV_BC_BO_BP_BV_DVi]

Slight variations of the multiple-code strings were identified within the various 'Active learning' sections. However, the general trend identified by the researcher seemed to allow for one combined multiple-code string as can be seen in the heading of this section above and explained next.

Similar to the 'Think about' sections, the 'Active learning' sections also followed a Socratic approach in which questions that aimed to guide students' learning were posed. As a result, the recurring theme 'directing learning' and its associated categorisation, as detailed in Section a, were applied to this section of the online learning material – thus associating this portion of the online learning material with Quadrant B. In order to answer the questions, the learning activity required students to read and study the factual content and theory within the sections of the textbook relevant to the theme, learning unit objectives and 'Active learning' questions. Consequently, the 'Active learning' section included the theme 'reading text'. In line with the explanation provided for the categorisation of this theme in Section a, this portion of online learning material was linked to Quadrant A 'verbal', 'fact based', 'logical' and 'rational' subcategories, and Quadrant B to the 'verbal' subcategory.

In addition, links to online resources were provided that included different kinds of material, from online articles to graphics and video clips, within the 'Active learning' sections, seemingly to provide students with an overview of the concepts relevant to that particular theme, learning unit objectives and/or active-learning questions. Moreover, where appropriate and to support students further, a 'That's Life' link was included in the 'Active learning' sections. These were links to online articles, websites and/or video clips about either real-life events or examples that could be linked to concepts covered within the 'Active learning' section. Where these links were included in the online learning material, short blurbs that gave students context for the linked resources to guide their

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thinking were also provided. Based on this interpretation of this section, the researcher, similar to the 'Think about' section discussed in Section h, allocated the themes 'e-readings' and 'video-clip' to this section of the online learning material linking it to Quadrants A and D. Furthermore, it appeared that the questions asked in this section generally also required students to think about the factual content and theory in an organised manner in order to answer 'why' and 'what' questions or procedural to answer 'how' questions comparable with the coding and analysis of the themes 'why what questions' and 'how questions' discussed in Section h.

Based on the interpretation of the researcher and the categorisation and sub-categorisation of the themes identified and explained above, a code string was produced (as indicated in the heading of Section i). The produced code string demonstrated the incorporation and consideration of teaching and learning elements as described here that can be associated with Quadrants A, B and D of the WBTL model (Herrmann, 1995).

j) Textbook [BC]

The 'Textbook' section of the online learning material was designed to clearly indicate to the students which sections of the theory in the relevant chapter of the fact-based textbook they should read and study in order to answer the questions posed in the 'Active learning' section. This results in directing students' learning. Therefore, the theme 'directing learning' was identified for this section of the online learning material. As indicated in Section a, it is believed that 'directing learning' accommodates the cognitive functioning represented in Quadrant B. The theme 'directing learning' was therefore categorised as 'Quadrant B' and subcategorised as 'controlled'. As a result, the code string for the 'Textbook' sections in all the Business Management modules is BC.

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The relevant chapter or section within the textbook indicated in the 'Textbook' section was directly linked to the themes, learning unit objectives and active-learning questions. It appeared that if students first read and studied the sections indicated in the 'Textbook' sections, they would be better prepared to engage in the actual or official learning activities in the 'Activity' section that generally follows the 'Textbook' sections as elaborated on next.

k) Activity [AF_AL_AQ_AR_AV_BC_BO_BP_BS_BSe_BV_CE_CEx_CI]

The information provided below explains the general findings in terms of the 'Activity' sections of the online learning material. Thereafter, Sections i to iv provide insight into specific findings related to specific activity types – i.e. the use of discussions, blogs, wikis, and journal entries. Therefore, the code string provided in the heading above only represents the generic findings that were evident in all types of activities.

In general, it appeared that each learning unit of each of the Business Management modules was designed to incorporate a minimum of three engaging activities. As a result, each theme in the learning unit did not necessarily include a related activity. However, each activity analysed, directly related to the objectives of the learning unit concerned. All the activities, regardless of the type of activity, followed a specific sequence and structure. Moreover, all the activities included step-by-step instructions that directed students in organising the completion of each activity. All 'Activity' sections were therefore coded with the themes 'sequenced', 'structured', 'controlled', 'organising completion' and 'step-by-step instructions'. Since the interpretation of the 'Activity' sections and the associated themes were concomitant with the idea that these activities accommodated students' cognitive functioning and processes related to the preference for an organised, planned, orderly, and step-by-step approach, all these themes were categorised under Quadrant B. This categorisation was informed by Herrmann's view of cognitive functioning and processes that relate to Quadrant B (Herrmann, 1995:220). The sub-categorisation, considering Table 4.3 in Chapter 4, was therefore apparent – i.e. 'sequential', 'structured', 'controlled', 'organised' and 'procedural' subcategories.

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It seemed that in order to complete most of the activities, students were required to think logically about the factual content and the relevant theory they had read and studied. In some instances, students were even directed to read specific sections within a chapter of the prescribed textbook. Based on the probability and assumption that students had to read the text in order to complete an activity, the theme ‘reading text’ was assigned in general to all the ‘Activity’ sections of the online learning material of all three Business Management modules. Following the same thought processes as indicated in Section a, the theme ‘reading text’ was categorised under the main category ‘Quadrant A’ and subcategorised as ‘verbal’, ‘fact based’, ‘logical’ and ‘rational’, as well as under the main category ‘Quadrant B’ and subcategory ‘verbal’, in accordance with the WBTL model (Herrmann,1995).

Furthermore, measurable timelines were provided to indicate to the students how much time the activity should take them, thus assisting students in planning and organising their time accordingly. As in Sections b and f, the theme ‘quantifiable numbers’ was therefore allocated and categorised under the main category ‘Quadrant A’ and the subcategory ‘quantitative’. In addition, the theme ‘organising and planning’ was linked to the ‘Activity’ sections of the online learning material, resulting in the categorisation of this theme under the main category ‘Quadrant B' and the subcategory ‘organised’.

In most of the activities in the ‘Activity’ sections of the online learning material, interaction with the lecturer and/or other students as well as commenting on other students’ input was required. Instructions that accompanied these activities generally reminded students to express their views in a manner that is respectful and in which they clearly motivate their input and contributions. Consequently, the theme ‘communication’ was associated as a general theme with the ‘Activity’ sections. According the Herrmann (1995:220), the cognitive functions and processes associated with ‘Quadrant C’ include processes concerned with communication through writing and reading. Therefore, the theme ‘communication’ was categorised under the main category Quadrant C. Hereafter, the theme ‘communication’ was subcategorised under both ‘expressive’ and ‘interpersonal’.

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Although it was not evident in all the types of activities analysed, it is important to note that, in a number of the activities, the questions or scenarios used may have potentially created an 'environment' in which students could harmonise with the content. Harmonising with the content, according to the researchers' interpretation, would require students to think of themselves, their situation and their future in relation to the theory and the application thereof, thus creating an 'emotional connection'. For this reason, the theme 'emotional connection' was identified. As indicated in Section h, Herrmann (1995:220) associated the cognitive processes concerned with emotions and feelings with Quadrant C. Consequently, the theme 'emotional connection' was categorised under 'Quadrant C' and subcategorised under 'emotional'.

The four types of activity generally used in the online learning material of the Business Management modules, together with the associated code strings that indicate the activity design trend identified for each type of activity, are described next. Note that the "generic code string" for the 'Activity' section based on the above general description and provided alongside the heading above is included in the code strings for each activity, but are not necessarily discussed again under each of the types of activity described next.

i) Discussions [AF_AL_AQ_AR_AV_BC_BO_BP_BS_BSe_BV_CE_CEx_CI_DVi]

In the 'Discussion' activities, students were presented with a particular question or set of questions linked to a topic or a scenario for discussion. The questions, topics or scenarios presented required students to think logically about the factual content they had been engaging with up to that particular point. As a result, students had to read through the relevant theory in the prescribed material again in order to successfully apply the theory. In addition, where appropriate or required, images or links to articles and video clips or other types of artefacts that could assist students in completing the activity were provided. The theme 'additional electronic resources' was therefore included in terms of the 'Activity' section related to the discussion activity type. Similar to the themes 'e-readings' and 'video clip' discussed in Section h, the theme 'additional electronic resources' was associated with and categorised under the main category 'Quadrant A', and the

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subcategories ‘verbal’, ‘fact based’, ‘logical’, and ‘rational’, category Quadrant B and subcategory ‘verbal’ as well as under category ‘Quadrant D’ and subcategory ‘visual’.

ii) Blogs [AF_AL_AQ_AR_AV_BC_BO_BP_BS_BSe_CE_CEx_CI_DVi]

As in the ‘Discussion’ activities, the ‘Blog’ activities presented students with a particular question or set of questions linked to a topic, a scenario or, in some cases, an actual physical task. The ‘Blog’ activities analysed required students to work independently, opening the blog tool, either by entering the answers to the questions posed or by attaching an artefact created by the student – such as an organogram, a completed table or a created word cloud. In some of the ‘Blog’ activities, students were required to comment on each other’s blog entries and, in some, they were even required to indicate what they have learned from them. The notion of creating an artefact resulted in the association of the theme ‘create artefact’ with some of the Blog activities. An artefact was viewed by the researcher as a visual product, be it a graphic or a document containing a table. The intuitive modes of thought that include visual thinking is associated with Quadrant D resulting in the theme ‘create artefact’ to be categorised under the main category ‘Quadrant D’ and subsequently to be subcategorised under ‘visual’. As a result, the code DVi (as per Table 4.3 in Chapter 4) was added to the “generic code string” for the ‘Activity’ section for Blogs (refer to code string in the heading above).

iii) Wikis [AF_AL_AQ_AR_AV__BC_BO_BP_BS_BSe_BV_CE_CEx_CI_DCo_DVi]

The ‘Wiki’ activities encouraged students as a group to create or work on a single document or artefact in order to collectively organise their knowledge. The ‘Wiki’ activities analysed in the online learning material allowed students to collaborate in groups or teams. The general trend within the ‘Wiki’ activities designed for the Business Management modules seemed to lean towards mental conception based on the fact-based content, theory or case studies of existing businesses provided through links to relevant websites. For example, students in their groups were required to come up with ideas that could bring about change in a business, develop guidelines for a business or process or set up goals for their ‘imaginary’ business. Based on this interpretation of the researcher on the ‘Wiki’ activities, the themes ‘mental conception’ and ‘create artefact’

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were added. Both of these themes were categorised under and linked to Quadrant D as it aligned with Herrmann's view on the cognitive functions and processes associated with Quadrant D. The theme 'mental conception' was then subcategorised under 'conceptual', and similar to, Section ii, the theme 'create artefact' was subcategorised under 'visual'. As a result, the codes DCo and DVi (as per Table 4.3 in Chapter 4) were added to the "generic code string" for the 'Activity' section for Wikis (refer to code string in the heading above).

iv) Journal entries [AF_AL_AQ_AR_AV_BO_BP_BS_BSe_CE_CEx_CI_DVi]

The journal entries required students to interact directly with the lecturer on a one-on-one basis. Questions posed and their accompanying instructions provided in the 'Journal entries' section guided students carefully on what the expectations were. The 'Journal entries' activities therefore seemed to create a safe space (which can be associated with Quadrant C – emotional) in which students could interact with the lecturer on an interpersonal level. Activities in these sections furthermore encouraged students to express their personal views, test and evaluate the theories, or to create their own artefacts – such as a diagram illustrating, for example, how the South African economy operates and who its key role players are. In line with the coding described in Sections ii and iii, the theme 'create artefact' was associated with and linked to the 'Journal entries' section. Therefore, associating it with Quadrant D and subcategory 'visual'.

Table 5.1 below presents a summary of all the single codes, multiple-code strings and associated main categories and subcategories deduced from the document analysis of the online learning material for all three of the Business Management modules for this study. It appears, considering the discussion in Section 5.5.1 and Table 5.1, that the learning material and its associated learning activities included teaching and learning elements that are representative of all four quadrants of the WBTL model (Herrmann, 1995).

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Table 5.1 Summary of codes, code strings and associated main and subcategories[3]

Module online learning material	Associated multiple code string	Associated individual code strings	Associated main category	Associated subcategory
a) Module overview	AF_AL_AR_AV_BC_BV_DCo	AF	Quadrant A	Fact based
		AL	Quadrant A	Logical
		AR	Quadrant A	Rational
		AV	Quadrant A	Verbal
		BC	Quadrant B	Controlled
		BC	Quadrant B	Verbal
		DCo	Quadrant D	Conceptual
b) Module purpose and outcomes	ABS_BC_BO	ABS	Quadrant A	Structured
			Quadrant B	Structured
		BC	Quadrant B	Controlled
		BO	Quadrant B	Organised
c) Module pacer	ABS_AQ_BC_BO_DSi	ABS	Quadrant A	Structured
			Quadrant B	Structured
		AQ	Quadrant A	Quantitative
		BC	Quadrant B	Controlled
		BO	Quadrant B	Organised
		DSi	Quadrant D	Simultaneous
d) Assessment information	ABS_AQ_BC_BO	ABS	Quadrant A	Structured
			Quadrant B	Structured
		AQ	Quadrant A	Quantitative
		BC	Quadrant B	Controlled
		BO	Quadrant B	Organised
e) Module glossary	ABS_AF_AL_AR_AV_BO_BV_DCo	ABS	Quadrant A	Structured
			Quadrant B	Structured
		AF	Quadrant A	Fact based
		AL	Quadrant A	Logical
		AR	Quadrant A	Rational
		AV	Quadrant A	Verbal
		BO	Quadrant B	Organised

[3] Table 5.1 continues on the next page

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Table 5.1 (Continued)[4]

Module online learning material	Associated multiple code string	Associated individual code strings	Associated main category	Associated subcategory
e) Continued		BV	Quadrant B	Verbal
		DCo	Quadrant D	Conceptual
f) Introduction (to each learning unit)	AF_AL_AQ_AR_AV_BO_BV_DSi	AF	Quadrant A	Fact based
		AL	Quadrant A	Logical
		AQ	Quadrant A	Quantitative
		AR	Quadrant A	Rational
		AV	Quadrant A	Verbal
		BO	Quadrant B	Organised
		BV	Quadrant B	Verbal
		DSi	Quadrant D	Simultaneous
g) Learning unit objectives	BC_BO_DSi	BC	Quadrant B	Controlled
		BO	Quadrant B	Organised
		DSi	Quadrant D	Simultaneous
h) Think about	AF_AL_AR_AV_BC_BO_BP_BV_CE_DVi	AR	Quadrant A	Rational
		AV	Quadrant A	Verbal
		BO	Quadrant B	Organised
		BV	Quadrant B	Verbal
		DSi	Quadrant D	Simultaneous
		BO	Quadrant B	Organised
		BP	Quadrant B	Procedural
		BV	Quadrant B	Verbal
		CE	Quadrant C	Emotional
		DVi	Quadrant D	Visual
i) Active learning	AF_AL_AR_AV_BC_BO_BP_BV_DVi	AF	Quadrant A	Fact based
		AL	Quadrant A	Logical
		AR	Quadrant A	Rational
		AV	Quadrant A	Verbal
		BC	Quadrant B	Controlled
		BO	Quadrant B	Organised
		BP	Quadrant B	Procedural

[4] Table 5.1 continues on the next page

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Table 5.1 (Continued)

	Module online learning material	Associated multiple code string	Associated individual code strings	Associated main category	Associated subcategory
i)	Continued		BV	Quadrant B	Verbal
			DVi	Quadrant D	Visual
j)	Textbook	BC	BC	Quadrant B	Controlled
k)	Activity (including codes from all types of activity)	AF_AL_AQ_AR_AV_BC_BO_BP_BS _BSe_BV_CE_CEx_CI_(DCo &/ DVi)	AF	Quadrant A	Fact based
			AL	Quadrant A	Logical
			AQ	Quadrant A	Quantitative
			AR	Quadrant A	Rational
			AV	Quadrant A	Verbal
			BC	Quadrant B	Controlled
			BO	Quadrant B	Organised
			BP	Quadrant B	Procedural
			BS	Quadrant B	Structured
			BSe	Quadrant B	Sequential
			BV	Quadrant B	Verbal
			CE	Quadrant C	Emotional
			CEx	Quadrant C	Expressive
			CI	Quadrant C	Interpersonal
			DCo	Quadrant D	Conceptual
			DVi	Quadrant D	Visual

However, it cannot be said that the online learning material and learning activities of the Business Management modules as a whole fully demonstrated the application of a WBTL approach. According to Herrmann (1995:126), “the brain functions at its most innovative, productive best only when all four quadrants engage situationally and iteratively in the process” (Herrmann, 1995:126). As indicated in Chapter 3, this means that an individual should have equal access to each quadrant (Herrmann, 1995:127). This implies that teaching and learning instruction employed in learning material (including learning activities) should encourage an individual to access and use each quadrant equally. To

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determine if the learning material and learning activities within the Business Management modules encouraged equal access of the cognitive functions and processes of each of the four quadrants, the occurrence of each single code was calculated as presented in Table 5.2 and Table 5.3.

Table 5.2 below illustrates the occurrence of each single-code string identified within the learning material and the percentage associated with each. In addition, it includes the combined percentage of teaching and learning that can be associated with teaching and learning elements indicated for each quadrant – i.e. Quadrants A, B, C and D. The distribution of teaching and learning instruction deduced from the analysis of the documents – i.e. the online learning material including the learning activities of the Business Management 1A, 2A and 3A modules as shown in Table 5.2 – indicates that approximately 34.91% of the learning material could be associated with Quadrant A, 38.30% with Quadrant B, 4.84% with Quadrant C and 21.95% with Quadrant D.

Table 5.3 below illustrates the occurrence of each single-code string identified within the learning-activity sections only and the percentage associated with each. In addition, it includes the percentage of teaching and learning elements associated with the WBTL model (Herrmann, 1995) and each quadrant – i.e. Quadrants A, B, C and D. The distribution of teaching and learning instruction deduced when only sections specifically designed for or included as learning activities were considered – i.e. the ‘Think about’, ‘Active learning’, ‘Textbook’ and ‘Activity’ sections, as shown in Table 5.3. These indicate a marginal difference: approximately 34.11% of the learning activities could be associated with Quadrant A, 38.44% with Quadrant B, 5.18% with Quadrant C, and 22.27% with Quadrant D.

Based on all the findings presented, it can therefore be indicated that teaching and learning elements associated with the WBTL model (Herrmann, 1995) could be identified for each Quadrant. However, it appears that a WBTL approach to learning activity design has not yet been applied in a way and to the extent that learning activities designed for the online learning material for the Business Management

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Table 5.2 Occurrence of single code strings for the all sections of learning material

Single code string	Occurrence	Percentage occurrence in learning material	Percentage associated with each Quadrant
ABS	8	0.13%	**Quadrant A**
AF	485	8.18%	
AL	485	8.18%	
AQ	123	2.07%	
AR	485	8.18%	
AV	485	8.18%	34.91%
BC	639	10.77%	**Quadrant B**
BO	518	8.73%	
BP	450	7.59%	
BS	90	1.52%	
BSe	90	1.52%	
BV	485	8.18%	38.30%
CE	132	2.23%	**Quadrant C**
CEx	75	1.26%	
CI	80	1.35%	4.84%
DCo	24	0.40%	**Quadrant D**
DSi	63	1.06%	
DVi	1215	20.48%	21.95%

Table 5.3 Occurrence of single code strings for the learning activities only

Single code string	Occurrence	Percentage occurrence in learning material	Percentage associated with each Quadrant
AF	450	8.12%	**Quadrant A**
AL	450	8.12%	
AQ	90	1.62%	
AR	450	8.12%	
AV	450	8.12%	34.11%
BC	600	10.83%	**Quadrant B**
BO	450	8.12%	
BP	450	8.12%	
BS	90	1.62%	
Bse	90	1.62%	
BV	450	8.12%	38.44%
CE	132	2.38%	**Quadrant C**
Cex	75	1.35%	
CI	80	1.44%	5.18%
Dco	19	0.34%	**Quadrant D**
Dvi	1215	21.93%	22.27%

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modules equally engages each Quadrant associated with the WBTL model (Herrmann, 1995). In order to ensure the application to the extent that it does demonstrate an equal engagement of all Quadrants for all learning activities it is important to also consider the views and input from some of the stakeholders i.e. the participants in this study. As a result, the next sections, Section 5.5.2 and 5.5.3 presents the findings from the semi-structured interviews and the observations.

5.5.2 Semi-structured interviews

The aim of the semi-structured interviews was to determine the perspective of each of the participants, either in their role as Head of Programme or Instructional Designer, on WBTL and its relevance to learning activity design, or to extract their opinion of the relationship between learning-activity design using a WBTL approach and student achievement. Furthermore, the semi-structured interviews aimed to determine if the participants conscientiously used a WBTL approach to plan; design; moderate (quality assure) or rework the learning activities of the three Business Management modules for this study. In addition, the researcher posed questions to determine how the participants designed, moderated (quality assured) or reworked the learning material and the associated learning activities for the three Business Management modules (and which approach they followed if not WBTL). Moreover, participants were also asked what interventions or changes to the process they would suggest to enhance the application of a WBTL approach to the design of learning activities. The interpretation and findings of the semi-structured interviews are provided in the next Sections, Section 5.5.2.1 to 5.5.2.3, clustering the main themes of the interview questions together – i.e. whole brain teaching and learning, learning-activity design of the Business Management modules and interventions and suggestions.

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5.5.2.1 Whole brain teaching and learning

The interpretation of the participants of what WBTL entails demonstrated that they were not particularly familiar with The Herrmann Whole Brain Model (Herrmann, 1995) or its associated WBTL model (Herrmann, 1995). However, their responses did support aspects of WBTL as described in Chapter 3. When asked the question, "What is your interpretation of whole-brain teaching and learning?" Participant 1 (Head of Programme) provided the following answer:

> *"… well, uh (sigh), whole brain teaching and learning, I think would be that you (sigh) look at the various topics, or not topics, topics is the wrong word, the various components that one uses in studying or understanding or interpreting information. Uhm, some people might like more visual or ja, more visual[ly] aligned or somebody might use colour to remember something, where other people if they see, if they can read it they can understand it. Other people once again wants you to explain the concept before they actually understand the concept. And, I think with the whole brain teaching and learning is that you incorporate all those components, and I am not sure how many there are, but incorporate all of them so that you actually address each and every type of learning style or method used to learn (pause) uhm for your student market."*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

Participant 2 (Instructional Designer), indicated the following:

> *"Uhm, I would say that whole brain teaching and learning refers to a teaching and uh, learning approach that includes a, well a variation of different teaching approaches in the design and the delivery to facilitate learning that incorporates the whole brain - left and right. It would, for example, require that educational activities are designed to incorporate and consider, uhm, different learning styles - how students prefer to learn. It would most probably also have to consider the profile of the student, their cognitive level and context, as well as, maybe creating an environment where students are actively involved in the learning process and linking activities to …say … real-world problems … promoting deeper learning."*
>
> [Participant 2, Instructional Designer, Interview notes, 8 May 2017]

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Participant 3 (Instructional Designer) provided a similar response to Participants 1 and 2. Considering the participants' responses, the researcher deduced that the participants for this study linked the idea of WBTL to an approach that includes the incorporation of various teaching and learning strategies – approaches and techniques to promote deep learning. In addition, it was found that the participants agreed that WBTL considers the different learning styles of students, the influence of students' environments and backgrounds, and that students learn best when they are active participants in the process of learning. This consideration of students' environments and backgrounds can be associated with the expanded WBTL model (Herrmann, 1995) that was suggested by De Boer, Du Toit, Scheepers and Bothma (2013), briefly described in Chapter 3 Section 3.2.1.

Participants further believed that considering a WBTL approach in the design of learning activities is important and that it would benefit all students. Participant 1 (Head of Programme), for example, indicated that:

> *"I think (cough) the relevance (long pause). I think it is important to do that (sigh) and an important tool to use, however, I think it is challenging in order to design an activity that addresses all those various types of learning or understanding methods. Uhm, and I think by designing activities that incorporates those components you will be able to support uhh, a larger market, student market or student population in understanding what they are studying towards. So, I think it is quite important at the end of the day and it uh, and it can make a huge difference if you apply it (pause) across the board".*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

Whereas Participant 3 (Instructional Designer) added that:

> *"It is our job to develop our students. (pause) When you design learning activities that uhm requires students to move outside of their own, well, comfort zone by asking them to complete say an activity that cognitively stretches their mental capacity, then we get it right. So, (pause) yes, considering an approach that involves the whole brain is important and quite relevant to designing activities".*
>
> [Participant 3, Instructional Designer, Interview notes, 10 May 2017]

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In terms of the relationship between learning-activity design using a WBTL approach and students' achievement, only the Instructional Designers felt strongly that there is a positive correlation between the use of a WBTL approach to learning-activity design and student achievement. It therefore appears that the Instructional Designers support the notion of De Boer, Steyn and Du Toit (2001:188-189) and Felder (1996:18) that applying a whole-brain approach to teaching and learning could influence the development of the mental dexterity of students, thus, in turn, their potential for achievement. However, it was stressed that it is a timeous process and that results would not necessarily be visible right away. Participant 2 (Instructional Designer) indicated that: *"Student achievement will only increase or improve as students get used to the approach. or as they develop, their results would probably improve."* [Participant 2, Instructional Designer, Interview notes, 8 May 2017]. Participant 1 (Head of Programme) had an opposite reaction. When considering this participant's response (below) to the question it appears as if the participant probably believes in the neuromyth that all individuals learn better when they receive information in their preferred learning style or styles, that is scrutinised by neuroscientists such as Howard-Jones (2014:1-2). The participant's response was:

> *" (long silence) Well, uhm, if I look at myself (sigh) I would want someone to explain something to me first before I read it, only then I would understand it. Now, if you just give me a document and I had to go figure out, it will take me most probably longer to figure out what you expect of me or what you want me to do uhm and it might to a certain extend (pause). I don't want to say disadvantaged but I might get a poorer mark, a weaker or bad mark or whatever the case might be in terms of other students because it is not addressing my way of interpreting or understanding what you're asking. So I interpret, … so I get what you're saying, I interpret it slightly different, so not giving you a hundred percent what you expect of me uhm and that's just because my interpretation of that question or activity is slightly skewed, different to what you want".*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

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After gaining an understanding of the participants' interpretation of WBTL as well as their opinion on its relevance to learning activity design as discussed here it was important to investigate whether their interpretation and opinion, be it aligned with the Herrmann's theoretical framework or not, impacted on their approach when they worked on the Business Management learning material and learning activities.

5.5.2.2 Learning activity design of the Business Management modules

When asked, participants indicated that they did not necessarily conscientiously use a WBTL approach in their planning, designing, moderation (quality assurance) or reworking of the Business Management modules' learning activities. Rather surprisingly, there was a disparity between the Head of Programme and the Instructional Designers on the approaches they believed informed their specific approach when they worked on the Business Management modules. Participant 1 (Head of Programme) indicated that:

> *"The method that I used is the traditional approach to teaching (pause) and that is straightforward – what is this, or how does this work or why would you say this is working or and not … and just it's, … it's basically a traditional approach of teaching. Uhm, and that might be because of my background. That is the way I was taught so I should teach the same way and not a, … not adapting to new theories or approaches to learning. So, I have never incorporated that at all. It's looking at the activity, whether it is a video or an article – is it relevant to the theory. Am I understanding it, do I think my students at the NQF level which it has been pitched at will understand it, would it be interesting for them, it is for me interesting so, it might be for them, it might not be for them. And if it is working with the content, then yes I approved it, but (pause) not thinking about that - the variety of methods (pause) when designing the activities".*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

Whilst Participant 1 (Head of Programme) was focussing on the content and theory associated with each module and section within the learning material informed by a traditional approach to teaching and learning, the Instructional Designers were more concerned about ensuring that the learning activities were relevant and iterative. It was also indicative that the Instructional Designers were cognisant about ensuring that

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activities at regular intervals engaged students at a social level through the use of the LMS in the completion of a task. This social engagement of students in the completion of tasks aimed to assist students as a group or team in order to extend their collective knowledge through the construction of meaning. Instructional Designers' responses included reference to the consideration of various learning approaches, such as behaviourism, cognitivism, constructivism and connectivism, as well as different learning styles with a stronger emphasis placed on constructivism. When probed into what they mean with learning styles, Gardner's theory of Multiple Intelligences (Gardner, 1983) was raised. However, the main approach that informs the design seemed to be Activity Theory (AT) – predominantly associated with Yrjö Engeström (1987) that is linked to a constructivist approach.

According to Participant 3 (Instructional Designer),

> *"Uhh, (sigh) we use Activity Theory as the base. Activity types were used repetitively. Obviously, the actual task in each activity was different the tools we used to get students to do the activity that was uhm, the same and used repeatedly Wikis, Blogs, Discussion tools. By reworking activities that were well, very much about the theory or subject matter we tried to adapt it to, … to enable students to uh relate the theory to their own world and to construct meaning. Other influences would probably relate to learning styles. Making sure that activities included, … that activities considered that some students like to interact with others, that some like to write, and uh others like to create or produce an artefact and some like music and visuals. (pause) Gardner's intelligences is quite useful here".*
>
> [Participant 2, Instructional Designer, Interview notes, 8 May 2017]

Since the learning material and learning activities across the three Business Management modules were similarly sequentially structured (as discussed in Section 5.5.1), the researcher probed participants further in terms of the development template used and each subsequent section of the learning material. The aim was to get a better understanding of how their approaches – as discussed above – or the development template potentially informed what ended up to be the final online learning material for the 2017 Business Management modules. When probed, it did seem like the development

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template used (which includes instructions, requirements, examples for each subsequent section) structured their thinking, especially when considering the responses in relation to the actual learning material sections described below. These sections follow the same sequence as the online learning material analysed in Section 5.5.1. Participants also indicated that it was important to plan, design, moderate (quality assure) or rework the Business Management modules in line with the core expectations or requirements for each sequential section as determined by the PHEI at large.

The 'Module overview' sections, for example, were checked to ensure that they provided students with a theoretical overview of the module and information that provided guidance to students on how to approach the study of the module. Participants seemed to consider the purpose of this section when they worked on the learning material. Participant 2 (Instructional Designer) indicated that the purpose of the 'Module overview' section was to provide:

> *"… a brief narrative introduction and overview of the module, uhm, including some of the key concepts that will be covered. The central point of this section is to briefly outline the core focus of the module. Uhm. Where applicable, other important aspects that students should, uh for example, consider may be covered, including, (pause) for example, how the module ties in to the broader programme of study, or how to best approach its study".*
>
> [Participant 2, Instructional Designer, Interview notes, 8 May 2017]

Additionally, participants aimed to ensure that the stated module purposes and module outcomes provided students with an overview of the module and what the expected outcomes should be on completion of the module, and, that what was stated, was in actual fact achievable. According to Participant 3 (Instructional Designer) the module purposes and outcomes were *"… generally written quite broadly, (pause) however, these outcomes do provide students with uhm an overall 'big picture' idea of what the expectations are in order to successfully complete each module".* [Participant 3, Instructional Designer, Interview notes, 10 May 2017].

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In terms of the 'Module pacer' section, participants checked that each learning unit was subdivided into *"… a maximum of five themes by grouping learning unit objectives together and then naming each theme appropriately"* [Participant 1, Head of Programme, Interview notes, 8 May 2017]. According to Participant 1 (Head of Programme), the learning unit objectives were reviewed and changed when required to ensure that the learning unit objectives were *"… measurable, clear and suitable for the NQF level at which the module is offered"* [Participant 1, Head of Programme, Interview notes, 8 May 2017]. In addition, the 'Module pacer' section was reviewed to ensure that information provided was arranged in such a way that it would assist students and lecturers in terms of what to learn from the prescribed textbook. Furthermore, it was indicated that the amount of time the developer suggested that students and lecturers spend on each learning unit – for example, 3 sessions, 5 sessions, etc. – were carefully considered and judged and, in most instances, amended. Participant 3 (Instructional Designer) also indicated that the themes and learning unit objectives provided in the pacer were checked to ensure it provided students with *"information that could assist in planning and organising their own learning*" [Participant 3, Instructional Designer, Interview notes, 10 May 2017].

The 'Introduction' section for each learning unit for each of the Business Management modules was evaluated to ensure that it provided students with an overview and that it was linked to the learning-unit objectives by ensuring that it was *"… a brief narrative… in which… what is covered in each learning unit [is summarised]. This [was] guided by the learning unit objectives"* [Participant 1, Head of Programme, Interview notes, 8 May 2017]. In addition, the time on task that provided the time it would take a student to complete the activities in a learning unit was carefully considered in terms of how much time it would take an average student to complete the activities.

Considering a Socratic approach, the 'Think about' sections were reviewed to see if the questions asked would trigger students' thinking linked to what they may already know. Participants made sure that each theme, as indicated in the pacer, began with:

> *"… a 'Think About' item uhm that, that (pause) well, contextualises what students might already know, … know about the topic. It would not usually include theory,*

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> *uh unless it is theory that students will already be familiar with. In this section, a question or two that gets the student to reflect on how this might impact him or her is required".*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

According to Participant 2 (Instructional Designer), *"These questions should help students recognise or think about the application of the theory in the world around them or in the world of work"* [Participant 2, Instructional Designer, Interview notes, 8 May 2017]. Furthermore, Participant 2 (Instructional Designer) indicated that:

> *"… from a constructivist approach, it is important to (sigh) uh entice students to be active participants in the process of learning. As such, the 'Think about' sections, similar to other sections uh within the material tries to create environments that help students learn deeper whilst enabling students to relate the material to their own world. Students are not blank slates they always approach new concepts in the context of what they already know. Thus, to create the interest and get the attention of students, the 'Think about' sections requires students to reflect on what they already know and, reflection is required to build upon previous knowledge".*
>
> [Participant 2, Instructional Designer, Interview notes, 8 May 2017]

Within the 'Think about' sections in all three of the Business Management modules, participants also checked and ensured that, where appropriate, and to support students, links to relevant e-readings or video clips were made available.

Similar to the 'Think about' sections, the 'Active learning' sections that also follow a Socratic approach in which questions are posed were then scrutinised to ensure that it:

> *"… include[d] questions or short, simple bulleted statements that guide[d] students through the critical aspects relevant to the learning [unit] objectives for each theme. The number of questions or statements listed [were] determined by the number and level of learning objectives for the theme".*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

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The ‘Active learning’ sections were checked against the textbook sections relevant to that theme, learning unit objectives and active learn section to ensure that students would be able to find the answers posed in the section. In addition, the ‘Active learning’ sections were checked to ensure that:

> *“… in order to address various learning styles and where necessary, to make the prescribed work more accessible to the students, two or three online resources that the students can work through in order to gain a better understanding of the concepts covered in the questions or statements [were] presented”.*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

Additionally, participants validated, for example, the articles or video clips provided in line with content of the textbook suggested by the developer within the ‘Active learning’ sections. According to Participant 2 (Instructional Designer), consideration was given to if the sources were *“… credible online articles, graphics and or video clips … [ideally] resources should be a mix of different kinds of material [such as] YouTube videos, TedX, Graphics, Infographics, Texts, Articles, Journals etc.”* [Participant 2, Instructional Designer, Interview notes, 8 May 2017]. Furthermore, where provided or as needed the participants reviewed or added the ‘That’s Life’ in the ‘Active learning’ section to ensure that the:

> *“That’s Life’ tags [that] links to articles etc. (pause) uhm … relate the theme’s topic to real life. These are not necessary for every Active Learning box, (pause) uhh but they are useful in trying to make the theory ‘come alive’ for students”.*
>
> [Participant 1, Head of Programme, Interview notes, 8 May 2017]

Participants also ensured that the short blurbs linked to the resources for the ‘That’s Life’ sections were provided and gave students context. Simultaneously, the participants confirmed that the detail provided in the ‘Textbook’ sections aligned with the related theory used to develop the aforementioned ‘Active learning’ section.

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Each learning unit of each of the Business Management modules incorporated a minimum of three engaging activities. According to Participant 2 (Instructional Designer), the:

> *"… teaching and learning approach emphasises the importance of iterative practice and use of the Socratic Method… asking questions. It supports active learning and is activity-based. As such, each learning unit in a module incorporated at least three engaging activities".*
>
> [Participant 2, Instructional Designer, Interview notes, 8 May 2017]

Participants finally considered the activities suggested by the developer for each theme in the learning unit to validate that each activity directly related to the content and to the objectives of the learning unit concerned. In addition, participants ensured that each learning activity followed a specific sequence and structure, namely *"… a numbered heading that briefly describes the focus or nature of the activity, a short sentence on the context of the activity, a short sentence on what the activity aims to achieve and numbered instructions"* [Participant 1, Head of Programme, Interview notes, 8 May 2017]. Moreover, the timelines suggested by the developer to complete each activity were evaluated to establish if what was indicated would be sufficient. According to Participant 2 (Instructional Designer) this time allocation is *"… estimated, taking into consideration all the time the student will spend conducting research, formulating responses, commenting on other students' responses etc."* [Participant 2, Instructional Designer, Interview notes, 8 May 2017].

When reviewing the various types of activities, participants ensured that the questions presented were linked to a topic or a scenario for discussion or the completion of a physical task. Participants ensured that where relevant, activities clearly indicated the expectation that *"students are expected to collaborate, discuss, and learn from each other, either in a group context or via the online discussions [and that] … students are encouraged to interact with one another in a constructive and collaborative spirit"* [Participant 1, Head of Programme, Interview notes, 8 May 2017]. In addition, Participant 2 indicated that it is also important to ensure that *"the activities [are] not merely … a reproduction of the theory covered in the theme, but rather the application thereof"*

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[Participant 2, Instructional Designer, Interview notes, 8 May 2017]. Where the developer suggested images or links to articles or other types of artefacts, these were also evaluated in terms of their appropriateness and if they would assist students in completing the activity.

At this stage, the researcher was satisfied that a detailed understanding of the approaches followed by Participants 1, 2 and 3 – i.e. the Head of Programme and the two Instructional Designers – that informed the learning activity design of the Business Management modules was reached. Therefore, the researcher posed the next question "What intervention(s) or change to the process would you suggest be used to enhance the application of a WBTL approach to the design of learning activities within the modules in future?"

5.5.2.3 Interventions and suggestions

The participants (especially the Instructional Designers) believed that the approach followed already supported a WBTL approach to an extent. The Head of Programme, however, did not come across to be as confident. Participant 1 (Head of Programme) suggested *"one-on-one sessions with an expert in the field …"* [Participant 1, Head of Programme, Interview notes, 8 May 2017] with the aim of showing the participant how a WBTL approach can be applied using one of the existing modules. As indicated in Section 5.4.1, Participant 1 (Head of Programme) did not attend the FLP in which Heads of Programmes workshopped the application of WBTL in learning-activity design and therefore would not necessarily be comfortable with its application. Other suggestions included training interventions with developers, Heads of Programmes, Instructional Designers and lecturers as well as encouraging consistent collaboration in order to create a community of practice. Additionally, it was suggested to develop an online WBTL short-learning programme (SLP) that demonstrates its application as well as to review the development template that guides the development and incorporates more specific instructions and examples. It was also stressed that the lecturers' buy-in and embrace of such an approach, if that is what the PHEI wants, will have to be sought after, especially

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considering the slow acceptance and 'onboarding'[5] of lecturers to use, for example, the LMS. This notion of slow acceptance and 'onboarding' was supported by the findings from the observations that are discussed next.

5.5.3 Observations

The purpose of the scheduled non-participant observation of classes presented by the selected module lecturers was to observe, in practice, how the online learning material and learning activities were then translated into the delivery of the Business Management modules in class. However, during the first observation, it was noted and observed that only one section – the 'Learning unit objective' section, discussed under Section g of this chapter – of the learning material was addressed in the lecture. For this reason only, Section g, the 'Learning unit objective' section, was ticked on the predetermined checklist (refer to Addendum H) used during the observations. In addition, no student used or had a printed hardcopy or an online softcopy of the online learning material opened or with them in class.

The researcher therefore opted to pose a question at the end of the lecture, after fulfilling the role of a complete observer, independently to both the lecturer and the students: "Do you use the online learning material and learning activities, either in class or at home?" The participant lecturer, Participant 4, indicated that she only used the online platform to look at the learning-unit objectives and to upload her own PowerPoint slides for students to use [Participant 4, Lecturer, Observation notes, 23 May 2017]. The students merely indicated: "*No*." In order not to raise concern with the lecturer or students, no further probing was done. However, since the same was noted and observed in the other two observed lectures, the same question was posed with similar responses. Participant 5 (Lecturer) indicated that: *"You will probably find that no Business Management lecturer uses the online learning material or activities as it was intended to be used. A lot still needs to be done to get the buy-in from lecturers to use it"* [Participant 5, Lecturer, Observation notes, 29 May 2017]. It therefore appears that the activity logs used to

[5] 'Onboarding', in this context – i.e. the PHEI in terms of the LMS – refers to the process by which lecturers learn the ropes of using the LMS in a blended teaching and learning environment.

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determine activity in the online learning platform did not provide real data and did not indicate actual activity; instead, it merely indicated when lecturers were logged in and the time the online platform was open.

This then explains why no additional observed evidence could be found, and thus not be indicated on the predetermined checklist (refer to Addendum H). Therefore, no data from the observations, except the 'Learning unit objective' section, could triangulate with the document analysis and semi-structured interviews discussed in this chapter/. However, it did provide another perspective and reality to the researcher. The analysis of the transcripts of the observations revealed that lecturers also viewed the learning-unit objectives as quite important and useful in directing their students' learning through the fact-based content and theories in the textbook. During observations of the classes, all three observed lecturer participants (Participant 4, 5 & 6) either verbally and/or in writing provided the learning-unit objectives during the introduction of the lecture or referred to the learning-unit objectives during the lecture. For example, Participant 5 (Lecturer) was doing revision with the students and used the essentials of the learning unit objectives (not the actual learning unit objectives) to recap on what students should have learned to date. Participant 5 (Lecturer) started the revision session by asking students to remember that: "… *in Chapter 1 we started off with … why does business exist, what is the purpose of business … and … the structure of or the environment in which business exist …".* [Participant 5, Lecturer, Observation notes, 29 May 2017]. Whereas, Participant 6, as part of the introduction to the learning unit indicated to the students that: "… *as per normal, let's look at the learning [unit] objectives of this chapter …"* [Participant 6, Lecturer, Observation notes, 31 May 2017] and continued to display the learning unit objectives on the whiteboard whilst reading the learning unit objectives out loud. Participant 6 (Lecturer) only displayed the learning unit objectives at the onset of the lecture. As a result, this section was confirmed and ticked as being addressed during lectures on the predetermined checklist (refer to Addendum H).

The next section summarises the empirical findings as discussed in Sections 5 up to this point, and it presents a general discussion of these findings.

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5.6 General discussion of empirical findings

Based on all of the empirical findings presented in this chapter, it was deduced that a WBTL approach to learning-activity design has not yet been applied *per se* in the design of the learning activities of the Business Management modules offered on the Bachelor of Commerce degree. In order to fully demonstrate the application of a WBTL approach to learning-activity design, the learning material and learning activities have to demonstrate an equal engagement of all four quadrants (Herrmann, 1995:127). The findings from the analysis of the online learning material and learning activities did not indicate an equal consideration or an attempt to equally engage the cognitive functions and processes associated with each of the four quadrants (refer to Section 5.1). However, evidence did support the notion that teaching and learning elements associated with all four quadrants of the WBTL model (Herrmann, 1995) were evident (just not equally presented). The presence of teaching and learning elements that could be linked to the WBTL model (Herrmann, 1995) identified within the online learning material and learning activities of the Business Management modules could probably be assigned to various factors. These factors potentially include the PHEI's teaching and learning strategy, the development templates, the educational background and knowledge of Instructional Designers, the different approaches and considerations informing the work of the Head of Programme and Instructional Designers, all resulting in a collective product and the fairly general and basic understanding of WBTL.

It appeared from the answers and discussions with the participants in the semi-structured interviews that the participants had a fairly general and basic understanding of what WBTL entails. Despite not having a full comprehension of the WBTL model (Herrmann, 1995), and not conscientiously applying a WBTL approach, the participants agreed that incorporating learning activities that are varied and that stimulate or require students to access different areas of the 'brain' better prepare and develop students' abilities and skills. In addition, participants believed that a correlation between student achievement and the use of varied learning activities that engages the whole brain exists.

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Although none of the participants conscientiously used a WBTL approach to plan, design, moderate or rework learning activities in the Business Management modules, the Instructional Designers, in particular, indicated that they do consider various learning approaches, when they do. In addition, participants indicated that the development template, which includes clear instructions, examples and requirements *"… forces [them] to consider various possibilities and ways to approach the design of the learning activities"* [Participant 2, Instructional Designer, Interview notes, 8 May 2017].

Participants also appeared to be confident, with the exception of the Head of Programme, that the Business Management modules' online learning material and learning activities would demonstrate a WBTL approach, despite it not being the focus of their approach, merely because of the use of the development template, together with the considerations indicated above. This belief seemed to be supported by the findings in the document analysis of the online learning material and learning activities of the three Business Management modules. Even though participants indicated their belief that a WBTL approach would probably be identifiable in the Business Management module's online learning material and learning activities, participants continued to make suggestions about enhancing a WBTL specific approach. Suggestions included the inclusion of WBTL specific instructions and examples in the development template, as well as to "*engage all stakeholders and role players in continuous discussions on the WBTL approach, should that be the way the [PHEI] want to approach the design of the material"* [Participant 2, Instructional Designer, Interview notes, 8 May 2017].

Considering the discussions with the participants and their responses discussed in this chapter, it is believed that each participant's perspective or approach to learning activity design, in some way, shape or form, influenced their contribution in finalising the online learning material; however, complementing each other throughout the iterative process. The appearance of the different approaches could be assigned to the idea of Jordan *et al*. (2008:1) that all educators ascribe, whether consciously or unconsciously, to theories of learning that influence their design of learning activities. In this case, it appears that the theory of learning subscribed to by the developer and participants probably formed a

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coherent whole. However, to ensure an equal distribution of learning activities across the four quadrants of the WBTL model (Herrmann, 1995) in future, an increase of shared educational discourse between all stakeholders at the PHEI is required to ensure a common understanding and the sharing of ideas translated into practice.

5.7 Conclusion

This chapter presented the data collected from the different sources together with the researchers' interpretation and analysis thereof. The participants responsible for the planning, designing, moderating or reworking of learning activities for the Business Management modules analysed in this study did not consciously use a WBTL approach. However, through following the guidelines and instructions set out in the development template used to develop learning material and learning activities together with the consideration of various learning approaches and 'learning styles', it appears that a WBTL approach in the design of the learning activities can be identified as presented through the data analysed in this chapter. The next chapter will discuss the possible implications of the findings of this chapter for the application of the WBTL approach to the learning activity design of the Business Management modules within the Bachelor of Commerce degree. The limitations of this study will also be presented.

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CHAPTER SIX
CONCLUSION AND IMPLICATIONS

6.1 Introduction

This chapter discusses how the research questions were answered. Additionally, based on the findings reported in Chapter 5, this chapter addresses a number of conclusions drawn from the study and considers the implications for the application of a WBTL approach to learning-activity design. Consideration of the implications culminated in the suggestion to conceptualise a model that the PHEI may consider as a baseline model for learning-activity design of the online learning material and learning activities for the Business Management modules investigated in this study. Furthermore, the chapter suggests further research that deserves attention.

6.2 Discussion on how research questions were answered

The purpose of this study was to determine how, if at all, a Whole Brain Teaching and Learning (WBTL) approach was applied to the learning-activity design of modules in the main discipline, Business Administration and Management (General), within the Bachelor of Commerce degree offered by the private higher education institution (PHEI). In order to investigate how this approach was applied, the researcher embarked on an investigation into the learning-styles field in order to determine if the seemingly most obvious learning-style theory or model – i.e. The Herrmann Whole Brain Model (Herrmann, 1995) – is the most suitable to answer the primary research question:

“How, if at all, does one private higher education institution apply a whole brain teaching and learning approach in the design of learning activities within selected modules in a Bachelor of Commerce degree?”

It was envisaged that the above primary research question would be answered by the following subsidiary questions (see Chapter 1 Section 1.3 and Chapter 4 Section 4.3.2):

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i. What is Whole Brain Teaching and Learning (WBTL)?
ii. What is the relevance of WBTL to learning activity design in the context of student achievement?
iii. How, if at all, is WBTL applied to the design of learning activities within the Business Management modules in the Bachelor of Commerce degree?
iv. What interventions, based on the findings of this study, could enhance the application of WBTL in learning activity design for the Business Management modules within the Bachelor of Commerce degree?

From the literature reviewed in Chapter 2, it became apparent that The Herrmann Whole Brain Model (Herrmann, 1995), its associated models (as described in Chapter 3), and the HBDI were the most suitable to answer the questions posed for this study. The choice in selecting this model was motivated at the end of Chapter 2 with three considerations to support this choice. The theoretical framework of The Herrmann Whole Brain Model (Herrmann, 1995) and its associated models (as described in Chapter 3) yielded the answer to what WBTL is. It refers to an integrated approach in which an educator, regardless of his or her own preference, creates a learning environment, develops learning content, and designs learning activities and situations that maximise the engagement of students to use each one of the four quadrants equally, resulting in whole-brain learning. This answer guided the researcher on and assisted in determining if a WBTL approach to learning-activity design was applied to the Business Management modules investigated in this study. Chapter 3 also provides a theoretical overview of the relevance of WBTL to learning-activity design in relation to student achievement, answering subsidiary question number ii above. The overview provided in Section 3.5.1 Chapter 3 provided affirmation to the researcher of the importance of this study to the PHEI considering the problem statement in Chapter 1 Section 1.2.2. This understanding of the importance and relevance of WBTL to student achievement and the notion that academics as educators all subscribe to, whether consciously or unconsciously, to theories of learning that influence their design of learning activities (Jordan, Carlile & Stack, 2008:1) prompted the researcher to also consider the views of participants on the

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relevance of WBTL to learning activity design. Views of participants are presented in Section 5.5.2.1. Chapter 5.

In order to answer subsidiary question iii, the researcher considered documents related to the development of learning material and learning activities of the PHEI. In addition, an in-depth analysis was done on the actual learning material and learning activities of all three Business Management modules included in this study. Considering the answer to subsidiary question i, and the empirical findings as discussed in Chapter 5, the researcher was able to determine if a WBTL approach was applied to the learning-activity design of the modules investigated. This analysis, together with data collected through the semi-structured interviews and observations, provided information on how a WBTL approach to a certain extent, was applied to the learning-activity design of the three Business Management modules. It also provided information, which includes the view points and suggestions of participants, assisting the researcher to identify possible interventions that could enhance the application of WBTL to the learning-activity design of the Business Management modules within the Bachelor of Commerce degree.

6.3 Conclusions

Based on the findings from the literature presented in Chapter 2 and 3 and the empirical findings of the interpretive study presented in Chapter 5, deductions, rather than conclusions, can be drawn. Following the brief summary of the premises presented in this study as discussed next, these deductions are presented.

Firstly, the array of learning-style theories and models, together with the “conflicting assumptions about learning [that underpins] the mainstream ideas about learning and the best-known models of learning styles” (Coffield *et al*., 2004b:1) exacerbates educators’ misapprehensions about the field. In addition, neuromyths identified by neuroscientists associated with learning styles derived from research into brain functioning could potentially add to these misunderstandings resulting in erroneous assumptions made by educators. The assumption by Participant 1, the Head of Programme, that students would learn better when they receive information in their preferred learning style is one such

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neuromyth. This is understandable, given the complex nature of learning styles, as well as their definition and critique, discussed in Chapter 2, Sections 2.2.1 and 2.2.2, which includes the critique related to the large number of learning style theories and models. The report by Coffield *et al.* (2004a) attempts to clarify some of the misperceptions as well as provide educators with advice recommending the use and further research of six theories and models – one being the Herrmann Whole Brain Model (1995) (Coffield, *et al.,* 2004a:139).

Secondly, it is evident from the responses from the Head of Programme and Instructional Designers that the theories of learning subscribed to, whether consciously or unconsciously, influenced their design of learning activities – thus supporting the notion by Jordan *et al*. (2008:1). It further appears as if, collectively, the theories of learning subscribed to by each participant (Head of Programme and Instructional Designers) personally and/or as informed by the teaching and learning strategy of the PHEI, formed a coherent whole. Connections could be made between the different approaches informing the learning material and learning-activity design of participants and those underpinning the teaching and learning strategy of the PHEI to teaching and learning elements of the WBTL model (Herrmann, 1995) responding to each of the four quadrants. It is therefore not surprising that teaching and learning elements of all four quadrants of the WBTL model (Herrmann, 1995) could be identified in the online learning material and learning activities of the Business Management modules given the collective and collaborative manner in which learning material and learning activities are planned, designed, moderated (quality assured) or reworked. At every stage of the development process, as described in Chapter 5, Section 5.3, different learning approaches are considered and applied, either consciously or unconsciously. This, despite confirmation from the Head of Programme and Instructional Designers that they did not conscientiously consider or use a WBTL approach in the learning-activity design of the Business Management modules offered in the Bachelor of Commerce degree. However, the main approach that seemed to inform the online-learning material and learning-activity design, based on the input from the Instructional Designers, was Activity Theory (AT) associated with Yrjö Engeström (1987) and pioneered by Lev Vygotsky, Alexei Leont'ev and Sergei

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Rubinstein in the 1920s. Furthermore, Instructional Designers and, to a lesser extent, the Head of Programme, also demonstrated or indicated a cognisance of the seven intelligences associated with Gardner's theory of Multiple Intelligences (Gardner, 1983) when they were designing learning activities for the Business Management modules.

Thirdly, teaching and learning elements that relate to the different clusters of functioning and processes associated with each of the four quadrants of the WBTL model (Herrmann, 1995) were evident from the empirical findings of the document analysis. However, the learning material and learning activities designed (as a whole) did not comply with the requirement of equal access to or utilisation of each quadrant as set by Herrmann (1995:127). WBTL requires an integrated approach in which learning environments are created, learning content developed, and learning activities and situations designed that maximises the engagement of students to *equally* use each one of the four quadrants. Emphasis is therefore on equality.

Fourthly, similar to the belief of De Boer, Steyn and Du Toit (2001:188-189) and Felder (1996:18), the Instructional Designers believed that there is a positive correlation between the use of a WBTL approach and the potential for student achievement. The response from the Head of Programme, on the other hand, supported the notion that only learning in your own preferred style is beneficial. These beliefs could be as a result of their own approaches to learning and past personal experiences. Convincing the HoP (Participant 1) or other educators at the PHEI with similar beliefs as the HoP that applying WBTL to the design of learning activities could potentially improve the mental dexterity of students would be challenging. Empirical evidence that support the relationship between WBTL and student achievement within the realm of the Bachelor of Commerce degree offered at the PHEI could potentially influence these beliefs.

Fifthly and finally, interventions that could enhance the application of WBTL to the learning-activity design of the Business Management modules within the Bachelor of Commerce degree suggested by participants correlate with the notion of Jordan *et al*. (2008:1) that educational discourse to ensure a common understanding and the sharing

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of ideas is required. This educational discourse can be encouraged through the institution of one-on-one sessions between colleagues (one being an expert in the field), training interventions, and the creation of a community of practice that includes the lecturers. Within the collective, this community of practice can then inform the instructions, requirements and examples included in the development templates provided to developers. These development templates structure the thinking of the Head of Programme and Instructional Designers within each sequential section of the learning material, and they encourage lecturers to utilise the learning material provided to support their teaching practices.

From the premises in this study, the following can be deducted:

The theories of learning an educator subscribe to, whether consciously or unconsciously, influence the design of learning activities. In addition, the educator's own preferences (Quadrants A, B, C or D) influence the design of the learning activities. Therefore, educators within higher education who design learning activities in isolation and who do not consciously use Herrmann's whole-brain model to validate that the learning activities incorporate teaching and learning elements associated with all four quadrants of the WBTL model potentially could negatively affect the development of the mental dexterity of students.

Designing learning activities collectively with other educators without consciously using Herrmann's whole-brain model increases the probability of WBTL elements associated with each one of the four quadrants being present. This is because of each educator bringing the theories of learning he or she subscribe to and their personal thinking and learning preferences that would potentially be different to the equation. Therefore, learning activities that are collectively designed should demonstrate the incorporation of teaching and learning elements associated with all four quadrants of the WBTL model, as found in this study. However, it would not necessarily engage each one of the four quadrants equally. In order to effectively apply WBTL, educators working independently or collectively should follow an integrated approach in which learning environments are

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created, learning content is developed, and learning activities and situations are designed that maximise the engagement of students to use each one of the four quadrants equally resulting in whole-brain learning. Analysing the learning activities designed for a module in a similar way the learning material and learning activities were analysed in this study could assist educators in the identification of potential gaps. Using the WBTL model (Herrmann, 1995) when planning, designing or reworking learning activities whilst ensuring that there is an equal distribution amongst the four quadrants should further support the effective application of a WBTL approach to learning activity design. Without the conversion i.e. the use of these learning activities as designed to support the application of a WBTL approach in class the efforts would be fruitless. Implementers, in this case the lecturers, will have to not only understand this approach but also embrace it.

6.4 Possible implications

It can be argued that in order to develop the dexterity of students' cognitive functioning and processes across and among the specialised parts of the brain, as metaphorically represented by the WBTL model (Herrmann, 1995), the mental skills students favour in order to develop a full repertoire of potential behaviours have to be emphasised equally. A full repertoire of potential behaviours should allow students to be able to respond to any type of learning activity, and, as a result, to any type of real-world event more effectively (Herrmann, 1995:23). This full repertoire of potential behaviours can potentially lead to the 'development of a whole brain', which may affect students' potential for achievement – academically. The development of a 'whole brain' could therefore be achieved through ensuring that learning material and learning activities equally develop the mental skills of students across and among the specialised parts of the brain. In order to achieve this it is therefore suggested that a WBTL approach be applied to learning activity design. It is not suggested that the application of a WBTL approach to learning activity design is the only way in which to achieve the development of the whole brain. Especially since HE is multifaceted and that other learning theories, approaches, models and influences are to be integrated in order to form a holistic view of practice. The application of a WBTL

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approach should merely be added as an overlay to an already integrated approach that aims to develop the mental dexterity of a student.

In order to apply WBTL to the design of learning activities in the Business Management modules effectively, the researcher suggests the conceptualisation of a baseline learning-activity design model in which the WBTL model overlay models and theories already informing the practice of learning-activity design. This baseline learning activity design model can be considered by the PHEI as a possible future intervention tool, be it to plan, design, moderate (quality assure) or redevelop learning activities. It can furthermore support an initiative to address student achievement through the development of the mental dexterity of students – thus the development of the whole brain. The baseline learning-activity design model could be used to ensure that student engagement is maximised to use each one of the four quadrants equally resulting in whole brain learning.

This study determined that elements of an application of WBTL to learning-activity design is evident, despite stakeholders involved in the learning-activity design of the Business Management modules indicating that they did not consider WBTL whilst working with the learning material and learning activities. In line with the suggestion above, the researcher would therefore like to propose that stakeholders involved in the learning-activity design of the Business Management modules consider the development of a baseline learning-activity design model. This baseline learning-activity design model could potentially be based on an integration of the theories and models already used or considered by stakeholders during the learning-activity design process as indicated during the semi-structured interviews – i.e. Activity Theory (AT) and the seven intelligences associated with Gardner's theory of Multiple Intelligences (Gardner, 1983) together with the WBTL model (Herrmann, 1995). This model can thereafter be applied to the learning material and learning-activity design of a particular module, say Business Management 1A, throughout the development process. Hereafter the analysis of the learning material and learning activities can be approached in a similar way to that of the document analysis for this study. Should the analysis of the learning material and learning activities demonstrate the application of a WBTL approach, it can be released to the module lecturers and students. It is therefore suggested that it should be piloted first using one module and

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involving all stakeholders linked to that particular module – such as the Business Management 1A module. However, it has to be stressed that merely ensuring that the learning material and learning activities designed align with a WBTL approach are not sufficient to achieve success. To ensure its successful application, the learning material and learning activities must be used and converted into the delivery at grassroots – i.e. in class. Equality in delivery can only be achieved if the actual learning material and learning activities across all sites of delivery for that particular module is used in class and online using the LMS. Therefore, all lecturers must know, understand and embrace the approach prior to its roll-out.

6.5 Further research

Considering the implications discussed in Section 6.3, the conceptualisation and use of the baseline learning-activity design model could potentially be considered in a future pilot study. In addition, the use of the WBTL model (Herrmann, 1995) and the HBDI (Herrmann, 1995) have not yet been extensively validated in education (Coffield, et al., 2004a:84), opening considerable possibilities for further research. It would also be particularly interesting to see studies that provide empirical evidence to support or deny the assumption associated with greater mental dexterity (and possible improvement of student achievement) following longitudinal studies within the educational landscape.

6.6 Coda

This study set out to determine how, and if, the application of a “Whole Brain Teaching and Learning” (WBTL) approach to learning-activity design using Ned Herrmann’s whole brain model (Herrmann, 1995), was applied to the design of the learning activities of the Business Management modules within the Bachelor of Commerce degree offered by the PHEI. Although the evidence indicated that WBTL elements were evident within the design, it could not be confirmed that a WBTL approach was applied effectively due to the lack of equality across and between the use of learning activities linked to each of the four quadrants and the Head of Programme and Instructional Designers not conscientiously following the approach. Despite this study not setting out to prove the development of the mental dexterity and thus the development of the ‘whole brain’ when

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applying a whole-brain approach to learning-activity design, it did aim to provide support to the notion that:

"The whole is greater than the sum of its parts".

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ADDENDUM A

Approval Notice

New Application

13-Jun-2016
Kruger, Catharina CE

Proposal #: **SU-HSD-002669**
Title: **The implementation of a whole brain approach to learning activity design in a Bachelor of Commerce degree**

Dear Ms Catharina Kruger,

Your **New Application** received on **24-May-2016**, was reviewed
Please note the following information about your approved research proposal:

Proposal Approval Period: **09-Jun-2016 -08-Jun-2017**

Please take note of the general Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

Please remember to use your **proposal number** (**SU-HSD-002669**) on any documents or correspondence with the REC concerning your research proposal.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

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Also note that a progress report should be submitted to the Committee before the approval period has expired if a continuation is required. The Committee will then consider the continuation of the project for a further year (if necessary).

This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health). Annually a number of projects may be selected randomly for an external audit.

National Health Research Ethics Committee (NHREC) registration number REC-050411-032. We wish you the best as you conduct your research.
If you have any questions or need further help, please contact the REC office at 218089183.

Included Documents:

DESC Report
REC: Humanities New Application Sincerely,
Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

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ADDENDUM B

ADvTECH House
Inanda Greens
54 Wierda Rd West
Wierda Valley
2196

P.O. Box 2369
Randburg 2125

Tel: (011) 676 8021
Fax: (011) 783 2574

Our ref.: Erna Kruger-Pretorius
Enquiries: cmeyer@ie.ac.za

Date:	26 April 2016
Student number:	18890016
Institution where registered:	University of Stellenbosch
Qualification:	MPhil in Education and Training for Lifelong Learning

DECISION LETTER FOR THE APPLICATION FOR ETHICS CLEARANCE

Dear Mrs Erna Kruger-Pretorius

Thank you very much for your ethics application. As the Acting Academic Manager of The IIE, on behalf on the Research and Postgraduate Committee, I have considered your application for Ethics Clearance for your research proposal entitled:

"The implementation of a whole brain approach to learning activity design in a Bachelor of Commerce degree".

I am pleased to inform you that **clearance has been granted.**

Please note that you will be expected to submit to the Research and Postgraduate Committee, finalised tools for fieldwork before such activities are conducted.

All the best with your research project.

Yours sincerely,

Dr Zakhele Mbokazi
Acting Academic Manager
The Independent Institute of Education
+27 11 676 8021

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ADDENDUM C

THE INDEPENDENT INSTITUTE OF EDUCATION

ADvTECH House
Inanda Greens
54 Wierda Rd West
Wierda Valley
2196

P.O. Box 2369
Randburg 2125

Tel: (011) 676 8021
Fax: (011) 783 2574

Our ref.: Erna Kruger-Pretorius
Enquiries: cmeyer@ie.ac.za

DATE: 26 April 2016

DECISION LETTER FOR THE REQUEST TO CONDUCT RESEARCH AT VARIOUS SITES OF THE INDEPENDENT INSTITUTE OF EDUCATION (THE IIE)

Dear Mrs Erna Kruger-Pretorius

Thank you very much for your application to conduct research at various sites of The Independent Institute of Education (The IIE). As the Acting Academic Manager of the IIE and on behalf of the Postgraduate and Research Committee, I have considered your application for your research entitled:

"The implementation of a whole brain approach to learning activity design in a Bachelor of Commerce degree".

I am pleased to inform you that you have been **granted permission** to conduct research at various sites of The Independent Institute of Education (The IIE), as listed in your application form.

All the best with your research project.

Yours sincerely,

Dr Zakhele Mbokazi
Acting Academic Manager
The Independent Institute of Education
+27 11 676 8021

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ADDENDUM D:

STELLENBOSCH UNIVERSITY

CONSENT TO PARTICIPATE IN RESEARCH

The application of a whole brain approach to learning activity design in a Bachelor of Commerce degree

You are kindly requested to participate in a research project conducted by Mrs Erna Krüger-Pretorius. The researcher is conducting this investigation to fulfill the requirements of a postgraduate degree at the University of Stellenbosch. As Head of Programme, Instructional Designer or Module Lecturer in the Bachelor of Commerce degree offered by the Private Higher Education Institution you have been selected as a possible participant in this research project.

1. PURPOSE OF THE STUDY

The application of a whole brain teaching and learning approach to the design of learning activities of modules within a learning programme could positively influence students' mental dexterity, thus – in turn – positively influencing students' potential for achievement. As student achievement is such an important factor to consider within Higher Education in South Africa, it is imperative for the Private Higher Education Institution (PHEI) to determine how, if at all, the whole brain teaching and learning approach was applied in the design of learning activities. Student achievement, in particular, in the Bachelor of Commerce degree is of interest. The Bachelor of Commerce with the core discipline of

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Business Management was not only one of the first degrees that was accredited and approved by the Higher Education Quality Committee (HEQC), of the Council on Higher Education (CHE) to be offered by the Private Higher Education Institution (PHEI), it is also one of the qualifications with the highest number of student enrolments. Student achievement in the Bachelor of Commerce degree is therefore of paramount importance to all stakeholders. Not only is student achievement of reputational importance to the institution, it is also a necessary measure for evaluation and reaccreditation purposes by the HEQC as well as for students wanting to embark on further studies in the discipline Business Management. The purpose of this study is therefore specifically to analyse the design and application of learning activities within the Business Management modules in the Bachelor of Commerce degree.

2. PROCEDURES

As a participant to this study, you could depending on your designation be requested to:

- Participate in a semi-structured personal interview conducted in a private venue situated at the PHEI at a time that is convenient to both parties. The initial interview session will take approximately 60 minutes. These personal interviews will be digitally recorded.
- Be observed during a scheduled non-participant observation of classes presented at a time that is convenient to both parties. These lectures will be digitally recorded.

3. POTENTIAL RISKS OR DISCOMFORTS

None of the processes, described under Point 2. Procedures, to gather information will pose any potential risk or discomfort to you. The results of this investigation will be shared with the broader PHEI community in appropriate institutional forums to aid the institution with making informed decisions on possible future interventions, if relevant, to address concerns around learning activity design, application and student achievement.

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4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The results of this research project will be shared with the broader PHEI community in appropriate institutional forums such as the Academic Forums, Faculty Board Meetings and Senate committees to aid the institution with the drafting of an institutional implementation framework and strategy to embed the application of a whole brain teaching and learning approach, if appropriate, in the design of learning activities of modules offered at the PHEI. The results will also assist the institution to devise staff development opportunities to enhance teaching, learning and assessment practices, specifically aimed at the design of learning activities of modules offered at the PHEI.

5. PAYMENT FOR PARTICIPATION

You will not receive any payment as a participant.

6. CONFIDENTIALITY

No personal information of a sensitive nature about participants will be collected. Any information that is obtained in connection with this study and that could lead to identification will remain confidential and will be disclosed only with your permission. The data obtained from the interviews will be labelled and coded in such a manner that the confidentiality of individuals who have participated in the study is protected. Hard copies of data will be kept in a safe place. Electronic copies of data will be stored on the laptop computer and/or removable hard drive of the researcher and only the researcher and her supervisor(s) will have access to the data for the duration of the research project. You may request permission to listen to digital voice recordings in the presence of the researcher and edit any of your statements. The researcher will keep the digital voice recordings in a safe place for as long as deemed necessary for the completion of the research project or as stipulated by Stellenbosch University for assessment and moderation purposes. If the researcher uses the results for publication in reputable

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academic journals and/or conference presentations, confidentiality will be maintained through the labelling and coding system used during the research process.

7. PARTICIPATION AND WITHDRAWAL

Even though you have been identified as a suitable participant for this study you can choose whether to participate in this study or not. As a participant you may refuse to answer any questions you don't want to answer and still remain in the study. The researcher may also withdraw you from this study should circumstances arise that warrant such a decision.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research project, please feel free to contact the researcher: Mrs Erna Krüger-Pretorius, at tel. (011) 676 8021 during office hours or e-mail: kruger.erna@gmail.com.

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. Note that you are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

Thank you in anticipation

Regards
Erna Krüger-Pretorius

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SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to [*the participant]* by Mrs. Erna Krüger-Pretorius *[the researcher]* in English and I am in command of this language or it was satisfactorily translated to me. I *[the participant]* was given the opportunity to ask questions and these questions were answered to my satisfaction.

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

_____

Name of Subject/Participant

_____

Name of Legal Representative (if applicable)

_____ _____

Signature of Subject/Participant or Legal Representative **Date**

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to _____ [*name of participant]* and/or [his/her] representative _____ [*name of the representative]. [H*e/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in English and no translator was used.

_____ _____

Signature of Investigator **Date**

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ADDENDUM E:

DOCUMENT ANALYSIS MATRIX

Module Name: _____

Module Code: _____

		CODING							
		First cycle analysis and coding				Second cycle	Third cycle	Final code	
LEARNING MATERIAL ASPECT PER LU/THEME	DETAIL	Quadrant A	Quadrant B	Quadrant C	Quadrant D	Main category codes	Subcategory codes	Single Code string	Multiple Code string

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ADDENDUM F:

SCHEDULE OF SEMI STRUCTURED INTERVIEWS – HEAD OF PROGRAMME/ INSTRUCTIONAL DESIGNER

Thank you for taking part in this interview. This interview is about the application of a whole brain teaching and learning approach in the design of learning activities for the Business Management modules offered in the Bachelor of Commerce degree.

QUESTIONS:

Section 1: Whole Brain Teaching and Learning

1. **I would like you to think specifically about whole brain teaching and learning:**
   a. What is your interpretation/understanding of whole brain teaching and learning?
   b. What do you believe is the relevance of whole brain teaching and learning in learning activity design?
   c. What, in your opinion, is the relationship between learning activity design using a whole brain teaching and learning approach and student achievement?

Section 2: Learning Activity Design of the Business Management Module/s

2. **Now, I would like you to think specifically about the learning activities in the Business Management module/s offered in the Bachelor of Commerce degree:**
   a. Did you conscientiously use a whole brain teaching and learning approach to plan; design; moderate or rework these learning activities?
      If yes:
      i. Explain how you planned, designed, moderated or reworked the learning activities to ensure the application of a whole brain teaching and learning approach in the design of the learning activities?

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If no:

ii. Why not?

iii. What approach did you use to plan, design, moderate or rework the learning activities?

Section 3: Interventions

3. **Think about the process of planning, designing, moderating and or reworking learning activities in the Business Management modules offered in the Bachelor of Commerce degree:**

   a. What intervention/s or change to the process would you suggest be used to enhance the application of a whole brain teaching and learning approach to the design of learning activities within the modules in future?

Thank you for your valued participation.

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ADDENDUM G:

SCHEDULE OF OBSERVATION OF CLASSES PRESENTED

BRAND SITE/ CAMPUS: Campus 1

DATE OF OBSERVATION	MODULE NAME	MODULE LECTURER
23 May 2017	Business Management 2A	Participant 4

BRAND SITE/ CAMPUS: Campus 2

DATE OF OBSERVATION	MODULE NAME	MODULE LECTURER
29 May 2017	Business Management 2A	Participant 5

BRAND SITE/ CAMPUS: Campus 3

DATE OF OBSERVATION	MODULE NAME	MODULE LECTURER
31 May 2017	Business Management 3A	Participant 6

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ADDENDUM H:

CHECKLIST FOR OBSERVATION OF CLASSES

Module online learning material	**Observed/ used online learning material in class**	**Observed/ used own material in class**	**Additional comments and observations**
k) Module overview			
l) Module purpose and outcomes			
m) Module pacer			
n) Assessment information			
o) Module glossary			
p) Introduction (to each learning unit)			
q) Learning unit objectives			
r) Think about			
s) Active learning			
t) Textbook			
u) Activity			