A Learning Design Framework for Active Learning using Audience Response Systems

by

Marinda Faasen

Dissertation presented

for the degree of Doctor of Philosophy

at the Faculty of Education at Stellenbosch University

Supervisor: Prof Magda Fourie-Malherbe

Co-Supervisor: Prof Johannes Cronjé

March 2016

Declaration

Original work

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own work, that I am the sole author thereof, that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: March 2016

Summary

The aim of the study was to analyse the use of audience response activities as part of active learning at Stellenbosch University, South Africa, and to map out strategies to explore the most effective use of audience response technology.

As developer of the audience response system that was used at Stellenbosch University, I was required to attend lectures to identify problems with the use of the technology. During these lectures I also identified a lack of pedagogical expertise in the integration of audience response activities as part of the lesson designs. Consequently a detailed research study into the pedagogical aspects of the integration of audience response technology as part of teaching and learning was undertaken.

Audience response technology and the associated learning activities were analysed, using activity theory as an analytical basis. The study is framed within the pragmatic paradigm and uses Plowright's Framework for an Integrated Methodology (2011). Data capturing included observation of the lessons, interviews conducted with lecturers and completion of questionnaires by students. Five lecturers from five different disciplines took part in the study: Chemistry, Biochemistry, Logistics, Mathematics Education and English Education. The year groups consisted of one first year group, one second year group, two third year groups and one fourth year group. Class sizes ranged from 60 to 240 students per class.

The study highlights several important issues, inter alia the lack of a common understanding of terminology in educational technology, which impedes dialogue and progress in this field. The study attempts to address this by explaining and defining some of the concepts relevant to this study. Another finding is that, if lecturers do not give adequate consideration to their pedagogical approach, their lesson planning is generally poor when they attempt to integrate new technology.

Instructivism, constructivism and an integrated approach were examined and it was found that it is possible to follow an integrated approach in the design of audience response activities.

Several process models and design models were studied and consideration of these models culminated in the development of a framework to be used for the development of audience response activities as part of active learning. This framework consists of a

process model and a design model and includes factors like feedback and motivation, which are important aspects of active learning.

Another issue that was identified in this study is the lack of meta-level communication between lecturers and students, as far as the learning process is concerned. Explaining to learners how learning takes place and why a new pedagogical approach is being introduced is a crucial aspect of student motivation.

The conclusion of this study is that the effective integration of technology in education cannot be done haphazardly. It should be guided by well-informed strategies, accompanied by adequate pedagogical and technological support, as well as ongoing training.

Opsomming

Die doel van die studie was om die gebruik van die gehoorreaksie-aktiwiteite (*audience response activities*) as deel van aktiewe leer by Universiteit Stellenbosch, Suid-Afrika, te ontleed en om strategieë vir die doeltreffendste gebruik van gehoorreaksietegnologie te bepaal.

As ontwerper van die gehoorreaksietegnologie wat deur die dosente by Universiteit Stellenbosch gebruik is, moes ek voorlesings bywoon om tegnologiese probleme wat tydens die gebruik van die tegnologie ontstaan het, te identifiseer. Tydens hierdie voorlesings het ek ook 'n gebrek aan pedagogiese kennis van dosente waargeneem wat die effektiewe integrasie van gehoorreaksietegnologie gestrem het. Dit was dus nodig om 'n volledige navorsingstudie aan te pak met betrekking tot die pedagogiese aspekte rondom die gebruik van gehoorreaksietegnologie om 'n raamwerk daar te stel wat deur dosente gebruik kan word in die integrasie van gehoorreaksietegnolgoie as deel van onderrig en leer.

Gehoorreaksietegnologie en die gepaardgaande leeraktiwiteite is ontleed met behulp van die aktiwiteitsteorie as ’n analitiese basis. Die studie is benader vanuit ’n pragmatiese paradigma en gebruik Plowright se Raamwerk vir ’n Geïntegreerde Metodologie (2011). Data-insameling sluit waarneming van die lesse, onderhoude met dosente en vraelyste aan studente in. Vyf dosente van vyf verskillende dissiplines het aan die studie deelgeneem, naamlik Chemie, Biochemie, Logistiek, Wiskunde-Onderwys en Engels-Onderwys. Die jaargroepe het bestaan uit een eerstejaarsgroep, een tweedejaarsgroep, twee derdejaarsgroepe en een vierdejaarsgroep. Klasgroottes het gewissel van 60 tot 240 studente per klas.

Die studie dui op ’n aantal belangrike kwessies. Eerstens, dat daar ’n gebrek aan ’n gemeenskaplike verstaan van terminologie in opvoedkundige tegnologie is wat gesprekvoering en vooruitgang in hierdie studieveld belemmer. Konsepte in opvoedkundige tegnologie wat vir hierdie studie relevant is, word verduidelik en gedefinieer. ’n Tweede belangrike kwessie is dat swak lesbeplanning die gevolg is as dosente, in hul poging om nuwe tegnologie te integreer, nie hul pedagogiese benadering na behore in ag neem nie.

Instruktivisme, konstruktivisme en ’n geïntegreerde benadering is ondersoek en daar is bevind dat dit moontlik is om ’n geïntegreerde benadering in die ontwerp van gehoorreaksie-aktiwiteite te volg.

Verskeie proses- en ontwerpmodelle is bestudeer en het gelei tot die ontwikkeling van ’n raamwerk wat gebruik kan word in die ontwikkeling van gehoorreaksie-aktiwiteite as deel van aktiewe leer. Hierdie raamwerk bestaan uit ’n proses- en 'n ontwerpmodel en sluit belangrike aspekte van aktiewe leer soos terugvoering en motivering in.

’n Derde belangrike kwessie wat in hierdie studie geïdentifiseer is, is die gebrek aan metavlak-kommunikasie oor die leerproses tussen dosente en studente. Die verduideliking aan leerders oor hoe leer plaasvind en waarom ’n nuwe pedagogiese benadering gevolg word, is 'n kritieke aspek van studente-motivering.

Die gevolgtrekking van hierdie studie is dat die effektiewe integrasie van tegnologie in opvoedkunde nie lukraak gedoen kan word nie. Dit behoort gerig te word deur ingeligte strategieë saam met voldoende pedagogiese en tegnologiese ondersteuning sowel as deurlopende opleiding.

Acknowledgements

I would like to thank the following people for their contributions:

- My supervisors, Prof Magda Fourie-Malherbe and Prof Johannes Cronje for their input.
- Andrew Lewis for language editing and Alta for the Afrikaans summary.
- Stellenbosch University Library and Information Service for excellent service.
- Alta van Rensburg, Vernita Beukes, Elmien Strauss, Ronel Steyn and Melanie Havenga for unending support.
- Albert Marais from Moonstone whose threats and emotional support carried me through the last month.
- The lecturers who were willing to participate in this study.
- Lastly I am extremely thankful to God for continuous health and the ability to keep on working, even during difficult times.

Table of Contents

Declaration .... **i**

Summary .... **ii**

Opsomming .... **iv**

Acknowledgements .... **vi**

List of Figures .... **xiii**

List of Tables .... **xiv**

Glossary of terms .... **xv**

Chapter 1 Orientation to the study **1**

1.1 Introduction 1

1.2 Statement of the problem 3

1.3 Aim of the study 4

1.4 Theoretical underpinning 5

1.5 Research approach 7

1.6 Definition of terms 8

1.6.1 Process or design model 9

1.6.2 Instruction or learning 10

1.6.3 The TPACK framework 12

1.6.4 Audience response systems 15

1.7 The structure of the study 16

Chapter 2 Audience response technology against the background of a pedagogical approach and active learning **18**

2.1 Introduction 18

2.2 An overview of audience response technology 19

2.3 Barriers in the use of audience response technology 21

2.4 Current learning design models integrating the use of audience response technology 23

2.4.1 Peer instruction 23

2.4.2 Question-driven instruction 24

2.4.3 Technology enhanced formative assessment (TEFA) 25

2.5 Audience response technology at Stellenbosch University 27

2.6 Active learning 30

2.7 Pedagogical approaches 31

2.7.1 Instructivism 32

2.7.2 Social constructivism 34

2.7.3 An integrated approach 36

2.8 Assessment and feedback 37

2.9 Motivation 41

2.10 Design models 45

2.10.1 Gagné's events of instruction 45

2.10.2 Laurillard's conversational framework 46

2.10.3 ELSYE design model 49

2.10.4 ARCS design model 52

2.11 Summary of design models 55

2.12 Process models 56

2.12.1 ADDIE 56

2.12.2 ELSYE process model 59

2.12.3 ILDF for online learning 62

2.12.4 ARCS process model 65

2.13 The role of prototypes 66

2.14 Conclusion 66

Chapter 3 Activity Theory 71

3.1 Introduction 71

3.2 History of activity theory 71

3.3 Components of activity theory 75

3.3.1 The subject and the object 75
3.3.2 Activities, actions, motivation and goals 80
3.3.3 Tools and signs 84
3.3.4 Rules 87
3.3.5 Community 88
3.3.6 Division of labour 89
3.4 Five principles of activity theory 89
3.5 The cycle of expansive learning 92
3.6 Conclusion 94
Chapter 4 Research Methodology 97
4.1 Introduction 97
4.2 Mixed methods methodology 98
4.2.1 Pragmatism as a paradigmatic perspective 98
4.2.2 Designs in mixed methods methodology 99
4.3 The Framework for an Integrated Methodology (FraIM) 101
4.3.1 Professional context 101
4.3.2 Organisational context 102
4.3.3 Policy context 103
4.3.4 National context 104
4.3.5 Theoretical context 105
4.4 Components of research design 106
4.4.1 The research question 106
4.4.2 Case study design 107
4.4.3 Data collection 113
4.4.4 Data analysis 116
4.4.5 Warrantable research 116
4.5 Ethical considerations 117
4.6 Conclusion 118

Chapter 5 Data analysis 119
5.1 Introduction 119
5.2 The five principles of activity theory 119
5.2.1 The activity, actions and operations 120
5.2.2 Multi-voicedness 125
5.2.3 Historicity 126
5.2.4 Contradictions 126
5.2.5 Expansive transformations 127
5.3 Case study 1: Mathematics Education 127
5.3.1 Activity 127
5.3.2 Multi-voicedness 128
5.3.3 Historicity 128
5.3.4 Contradictions 129
5.3.5 Learning design 130
5.4 Case study 2: Logistics 132
5.4.1 Activity 132
5.4.2 Multi-voicedness 133
5.4.3 Historicity 133
5.4.4 Contradictions 133
5.4.5 Learning design 135
5.5 Case study 3: Chemistry 136
5.5.1 Activity 136
5.5.2 Multi-voicedness 137
5.5.3 Historicity 137
5.5.4 Contradictions 138
5.5.5 Learning design 139
5.6 Case study 4: Biochemistry 139
5.6.1 Activity 139

5.6.2 Multi-voicedness 140
5.6.3 Historicity 140
5.6.4 Contradictions...140
5.6.5 Learning design 142
5.7 Case study 5: English Education..144
5.7.1 Activity 144
5.7.2 Multi-voicedness 144
5.7.3 Historicity 144
5.7.4 Contradictions...145
5.7.5 Learning design 145
5.8 Comparison of the five cases 146
5.9 Artefact analysis..148
5.10 Expansive transformation...150
5.11 Student motivation 152
5.12 Conclusion 153
Chapter 6 A learning design framework: Conclusions and recommendations 155
6.1 Overview of the study...155
6.2 Contribution of this study...158
6.3 An integrated question-driven framework..159
6.3.1 Process model...159
6.3.2 Design model...162
6.4 Possible implications for practice 166
6.4.1 Technological Knowledge (TK)..167
6.4.2 Technological Content Knowledge (TCK)..167
6.4.3 Technological Pedagogical Knowledge (TPK)......................................168
6.4.4 Feasibility study 168
6.5 Limitations and further research..169

6.6 Concluding comments 170

List of references 172

List of addenda 188

Addendum A – Approval by Ethics Committee 188

Addendum B – Institutional permission 189

Addendum C – Lecturer consent 190

Addendum D – Lecturer Interview 193

Addendum E – Student consent and questionnaire 194

Addendum F – Observation schedule 197

List of Figures

Figure 1.1: The structure of a human activity system Source: Engeström, 1987:78 6
Figure 1.2: TPACK Framework Source: Koehler, 2012 13
Figure 2.1 An Integrated Approach Source: Cronjé, 2006:8 36
Figure 2.2: Conversational Framework Source: Laurillard 2012:92 47
Figure 2.3: Structure of an e-learning transaction Source: Gilbert & Gale, 2008:41......... 49
Figure 2.4: Alternative representation of an e-learning transaction Source: Gilbert & Gale, 2008:42... 50
Figure 2.5: Structure of a learning and teaching lesson. Source: Gilbert & Gale, 2008:45 .. 51
Figure 2.6: ELSYE project life cycle Source: Gilbert & Gale, 2008:22 60
Figure 2.7: The Integrative Learning Design Framework for Online Learning Source: Dabbagh & Bannan-Ritland, 2005:116.. 63
Figure 3.1: First generation activity theory Source: Engeström, 2001:134........................... 73
Figure 3.2 Second generation activity theory Source: Engeström, 1987:78 73
Figure 3.3: Third generation activity theory Source: Engeström, 2001:136 74
Figure 3.4: Third generation activity theory: objects & signs... 86
Figure 3.5 The cycle of expansive learning source: Engeström, 2001:152.......................... 92
Figure 3.6: Proposed spiral model for the cycle of expansive learning 94
Figure 4.1: The extended Framework for an Integrated Methodology. Source: Plowright, 2011:9 101
Figure 4.2 Basic types of designs for case studies Source: Yin, 2014:50.......................... 109
Figure 4.3: Context of this study 111
Figure 5.1 Audience response activity – Action 1.. 121
Figure 5.2: Audience response activity - Action 2.. 122
Figure 5.3: Audience response activity - Actions 3 & 4.. 123
Figure 5.4: Audience response activity - Action 5.. 124
Figure 5.5: Contradictions - Maths Education 130
Figure 5.6: Contradictions: Logistics 134
Figure 5.7: Contradictions: Biochemistry.. 141
Figure 5.8 Contradications: English Education... 146
Figure 5.9: Students' responses for the use of mobile devices as part of class activities.... 148
Figure 5.10: Students' response rate on the importance of marks for correct answers vs marks for participation.. 152
Figure 6.1: Process model for the creation of audience response activities 160
Figure 6.2: Audience response activity workflow.. 162
Figure 6.3: Components of the audience response activity 163
Figure 6.4: Active learning workflow.. 164

List of Tables

Table 2.1 Cycle Lengths For Formative Assessment 38
Table 2.2: Aspects of assessment for learning 38
Table 2.3: Events of Instruction.. 46
Table 2.4: Components and subcomponents of the ADDIE model 57
Table 2.5: Motivational design in relation to instructional design 65
Table 3.1: Two Perspectives on the Object of Activity 77
Table 4.1: Summary of case studies 112
Table 5.1: Biochemistry students' response rate on the importance of grades vs participation 143
Table 5.2: Comparison of the five cases 147

Glossary of terms

Audience response technology

The collection of techniques, processes and methods used in the production of audience response systems.

Audience response system

A system that allows an audience to submit data via a device, whether it is a mobile device or a dedicated response device. This data is then aggregated into histograms and other usable summarised informational structures, like word clouds.

Audience response activity

The activity associated with learners submitting responses via a handheld device, and the educator using the aggregated information provided by the audience response system to direct a lesson.

Design model

The actual design of a course, e.g. Gagne's instructional design model

Educational technology

The effective use of technology as part of education. It includes the delivery methods, e.g learning management systems or multimedia tools; as well as the underlying learning theories used as part of the educational activities.

Learning Management System

A software application for the administration, documentation and delivery of educational material.

Pedagogical approach

The pedagogical approach provides the rules according to which any learning activity is designed e.g. instructivism or constructivism.

Meta-level communication

Communicating to students the method involved in a teaching method and the subsequent learning process. The aim is to improve learning by developing the learner's beliefs, attitudes and behaviours towards the learning process.

Process model

A model which describes the process of developing a course, e.g. ADDIE

Chapter 1
Orientation to the study

1.1 Introduction

> *"People and organizations are all the time learning something that is not stable, not even defined or understood ahead of time. In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not yet there. They are literally learned as they are being created. There is no competent teacher. Standard learning theories have little to offer if one wants to understand these processes" (Engeström, 2001:138).*

Modern life is characterised by transformation. Many of the transformations are caused by the integration of technology in our lives. Technology also permeates education and enables pedagogical practices which have previously been impossible to achieve. Buzz words like MOOCs, gamification and digital storytelling are continuously being invented to define new practices that have become part of education.

As one of the three core functions of universities, undergraduate teaching and learning remains a major focus of higher education, particularly in the light of poor academic performance by undergraduate students worldwide and growing criticism of the general performance of university graduates in the workplace, expressed by employers. Studies focussed on improving the quality of undergraduate teaching and learning abound (Chickering & Gamson, 1987; Braxton, Eimers, & Bayer, 1996; Kuh, 2001, 2003; Pascarella, 2001; Zhao & Kuh, 2004; Rochester, Kilstoff & Scott, 2005; Zhao, Kuh & Carini, 2005; Fernandez, Simo & Sallan, 2009).

The processes of teaching and learning have been of interest to researchers long before the pervasion of modern digital technology. Early formal studies aimed at improving the quality of teaching date back several decades. One such study, conducted almost thirty years ago, by Chickering and Gamson, resulted in the development of the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamson, 1987). According to this study, good practice in undergraduate education encourages student-faculty contact, encourages cooperation among students, encourages active learning, gives prompt feedback, emphasizes time on task, communicates high expectations and respects diverse talents and ways of learning.

At the turn of the century, another researcher Kuh (2001; 2003) identified five benchmarks for effective educational practice, namely the level of academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences and effective campus support. It is worth noting that the importance of active learning was highlighted in both of these studies.

These standards are still relevant today and implementing them still poses challenges for many academics. Yet, new communication and information technologies have become useful resources for innovating and improving the quality of teaching and learning in higher education, including promoting active learning and student engagement.

The principles and benchmarks identified in the aforementioned studies are still relevant in today's learning environments and successful implementation continues to pose a challenge for many academics. New communication and information technologies have become useful resources for improving the quality of teaching and learning in higher education, promoting innovation, active learning and student engagement. One example of such a technology is audience response technology. The use of audience response technology can facilitate effective implementation of at least three features identified as characteristic of effective educational practice: prompt feedback, active learning and cooperation among students. The use of audience response technology in classroom instruction was initially made famous by Mazur, who used it as part of peer learning (Crouch & Mazur, 2001:970). Since 2001, several researchers have reported on successfully integrating audience response activities as part of active learning (McClanahan & McClanahan, 2002; Caldwell, 2007; Hoffman & Goodwin, 2006; Martyn, 2007; Debourgh, 2008; Harper, 2009; Oakes, 2013; Dori & Belcher, 2005).

In keeping with international trends, Stellenbosch University has adopted, as one of its educational strategies, increasing the use of technology in teaching and learning. The aim of this increased integration is to "blend information and communications technologies with a sound tertiary educational pedagogy, with a focus on learning and not just on teaching, which will contribute to easier, more effective and affordable learning opportunities" (SU Institutional Intent and Strategy, 2013 – 2018:16). As part of this integration, the use of audience response technology has been implemented at Stellenbosch University.

1.2 Statement of the problem

During 2011 a pilot study, involving the creation of audience response software (for mobile devices), which lecturers could use as part of classroom instruction, was conducted at Stellenbosch University. I was asked to develop the software, in collaboration with lecturers, in an attempt to ensure that it would satisfy their needs. I therefore attended lectures, during which the audience response technology was used to identify any technical problems associated with the use of the technology itself. Initially it was predominantly lecturers from the science faculty who participated in the study. They based their approach to integration of the audience response technology on Eric Mazur's method, which is discussed in more detail in Chapter two.

In subsequent years, several lecturers from other faculties piloted the audience response software, but most of them abandoned the trial after two or three attempts. I attended some of these lectures and I noticed that the lecturers generally appeared to lack a clear understanding of how to incorporate the use of audience response technology into their lectures, as part of their learning design. The lecturers struggled to modify their teaching methods to incorporate the use of audience response activities. Some lecturers appeared uncertain as to how they should utilise the feedback that was provided by the system. Many lecturers used audience response technology to award marks to students, as part of continuous assessment, which resulted in a significant shift in focus, from using it as a tool to promote interactivity in a learning activity, to using it as an assessment tool.

Draper and Brown (2004), Beatty and Gerace (2006; 2009) and Karaman (2011) highlight the fact that an effective pedagogical approach contributes to effective teaching and learning, rather than the use of audience response technology *per se*. However, most research on the use of audience response technology tends to place the emphasis on the object, namely audience response technology itself, and not on the learning design or the pedagogy. Beatty and Gerace (2009:147) also note that reports on the use of audience response technology which do identify some sort of pedagogical approach, generally fail to present their theoretical framework or position themselves within the larger body of educational research literature.

In the context of this study, it was clear that the lecturers did not understand how to integrate the use of audience response technology into their lessons. It appeared to me that inadequate lesson design was an obvious problem. I decided to review existing literature on the use of audience response activities in more detail, in order to identify any other factors that may have hindered the successful integration of audience response technology in this context.

Inadequate lesson design was an obvious problem, but I found it necessary to research the audience response activities in more detail to identify all factors that hindered the successful integration of audience response technology.

The literature I reviewed included several studies which demonstrate successful integration of audience response technology as part of active learning and present various frameworks which have been developed to guide lesson design and the creation of learning activities (see Chapter two for more detail). However, all of these frameworks were developed in mathematics and the natural sciences. I believed that other disciplines (social sciences and humanities) could also benefit from the use of audience response technology, so I wanted to develop a framework that can be used by all lecturers from all disciplines.

I therefore decided to conduct my own study on the use of audience response technology as part of active learning. This research included all the aspects of the activity: the role players (namely the lecturer, the students and the institution), the technology used and also the actions that formed part of the activity. The study also included research on pedagogical approaches and the design of lessons. It was my conviction that conducting research into all the aspects associated with the development and integration of audience response technology would enable me to develop a framework designed for use by lecturers from any discipline to ensure the effective integration of audience response activities as part of teaching and learning.

1.3 Aim of the study

Beatty and Gerace (2009:147) propose that researchers studying audience response technology should ask what pedagogical approaches an audience response system can support or enhance, and what impact such a system would have on those various approaches. With this in mind, I formulated the main aims of this study as follows:

- to analyse the use of audience response activities as part of active learning
- to study different pedagogical approaches and the associated design models

- to develop a theoretical framework for integrating the use of audience response technology as part of teaching and learning.

The primary research question which I hoped to answer through this study was thus:

- How should an audience response activity be implemented to ensure effective active learning?

A number of related sub-questions which were also taken into consideration are:

- What contradictions had an impact on the success of the implementation of the audience response activities?
- What are the critical elements that should be included in a design model intended to facilitate the successful implementation of audience response technology, as part of active learning?
- Which support structures should be in place to assist and support lecturers in the implementation of audience response technology?

1.4 Theoretical underpinning

In selecting the theoretical framework that would underpin my research, I followed a pragmatist approach. The reasons for this are discussed in more detail in Chapter four. In so doing, I considered John Dewey's pragmatism and activity theory, as two possible theoretical lenses. Both approaches study the problem of change and development in human activity and therefore both may have been relevant and applicable to this study. I selected activity theory for the following reasons:

As will be discussed in this study, any design model should consist of two components, namely the process and the actual design (product). The chosen theoretical framework should therefore enable the analysis of both components.

Activity theory allows the analysis of changing systems and the learning associated with them. Engeström discusses how "formative interventions may be characterized with the help of an argumentative grammar which proposes (a) the collective activity system as a unit of analysis, (b) contradictions as a source of change and development, (c) agency as a crucial layer of causality, and (d) transformation of practice as a form of expansive concept formation" (Engeström, 2011:598).

In this study, the goal-directed action of using audience response technology is the central activity. The audience response activity is therefore analysed in terms of the object, subject, mediating artefacts, rules, community, sense and meaning, and the outcome of the final activity (see Figure 1.1).

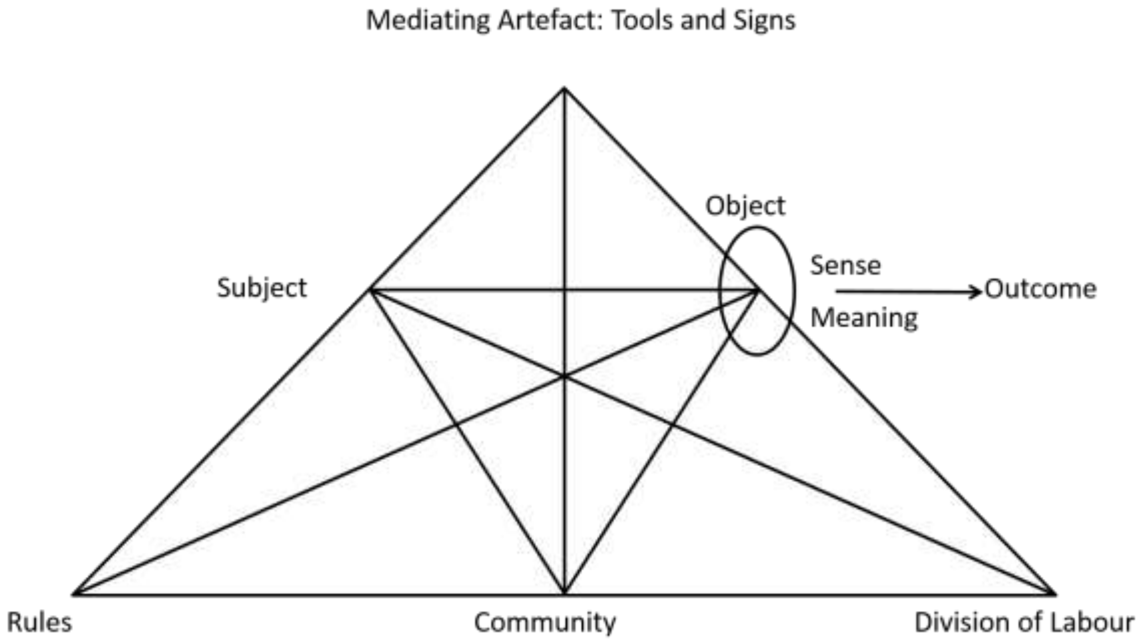

FIGURE 1.1: THE STRUCTURE OF A HUMAN ACTIVITY SYSTEM
SOURCE: ENGESTRÖM, 1987:78

This structure depicted in Figure 1.1 reflects all the components that make up the design of the audience response activity. Roughly defined, this will include the educator, the students, the technology used, the institution and its rules, any pedagogical approaches followed by the lecturer, and the object or objective of the activity. According to activity theory, the concept of motive is a very important aspect of any activity. Therefore, the role of motivation will also be studied.

This study focuses on three general views of the activity framework. The first is the importance of audience response technology as a mediated object, as part of active learning. Secondly, the study focuses on the role of systemic contradictions in the perceived cognition of audience response activities. The identification of contradictions in an activity system helps experts to focus their efforts on the root causes of problems. Such collaborative analysis and modelling is a crucial precondition for the creation of a shared vision for the solution of the contradictions (Engeström, 2000:966). Lastly, the study identifies the lecturer and student contradictions which prevent the successful implementation of audience response technology as part of the learning process.

As part of activity theory, Engeström developed the cycle of expansive learning within the framework of activity theory to map the different learning actions and the corresponding contradictions. This cycle allows one to answer *who, why, what* and *how* when researching learning. The cycle starts with individuals questioning current practice and culminates in a final new practice, but in order to do this it must go through a process. This is discussed in more detail in Chapter three.

This model corresponds with the process models discussed in Chapter two, but added to it are the possible contradictions that can arise during each stage. Therefore using activity theory makes it possible to model the different aspects of the audience response activity, to define contradictions and to develop a process model that can define the different steps that should be taken during each phase of the design process to prevent these contradictions from occurring.

1.5 Research approach

There are a number of components that influence the success of an audience response activity. These include the subjects, namely the educator and the students, the activity itself, the object or objectives, namely active learning, and the tool, the audience response technology used. Then there are also the rules according to which the activity is conducted, the pedagogical approach, and a number of other role players. Each of these had to be studied.

Following either a quantitative or a qualitative approach would not have been sufficient. I had to incorporate both methods. I therefore decided to follow a mixed methods approach. It was also necessary to place this study in context, because the context also influenced the success of the activity. Plowright's Framework for an Integrated Methodology included the study of the context as part of the framework (Plowright, 2011).

Therefore, I used the Framework for an Integrated Methodology, which does not only follow a mixed methods approach, but also looks at the study in context.

The ultimate aim of this study was to develop a framework that is not discipline specific. Therefore lecturers from three different faculties of the university were invited to participate in the study; one lecturer from the Faculty of Economic and Management Sciences, two from the Faculty of Sciences and two from the Faculty of Education.

As part of the data capturing process, I observed lessons facilitated by the participating lecturers, in order to identify the various activities associated with the use of audience response technology, which would inform the subsequent modelling process. I also identified and analysed disturbances that occurred during the lessons and thus constituted obstacles which ultimately played a role in preventing lecturers from adopting audience response technology and successfully integrating it into their lesson planning. I interviewed the participating lecturers, in order to determine what factors would serve as grounds for motivating lecturers to make use of audience response technology. I distributed questionnaires to students attending the lessons I observed, in an attempt to determine factors that may influence the extent to which students feel motivated to participate in audience response activities during lectures.

1.6 Definition of terms

A few years ago, during an interview for a position as an instructional designer, I was asked to explain which *design model* I follow. I started to explain Gagné's instructional design model, but it soon became clear that the interviewer had no idea what I was talking about. Eventually the interviewer asked if I knew ADDIE. I then realised that there was a communication gap: what the interviewer referred to as a *design* model, I understood to be a *process* model.

More recently, I was asked to discuss the integration of audience response technology, as part of teaching and learning, with several lecturers, who were participating in a blended learning course at Stellenbosch University. Once again I became aware of the fact that there was a lack of clarity, with respect to the differences between *process* modelling and *design* modelling. I only had fifteen minutes in which to conduct the discussion, which made it impossible to explain both concepts, as well as how to integrate audience response technology into lesson design. In the end, in my opinion, all we had managed to achieve was to conduct a very unsatisfactory discussion of how audience response technology works.

I reviewed the literature published on design models and process models, in an attempt to clarify how the two concepts are viewed in academic circles. The following quote illustrates the state of confusion very well:

> *"The terms instructional design, instructional technology, educational technology, curriculum design, and instructional systems design (ISD) are often used interchangeably" (What is Instructional Design?, 2012).*

Other concepts or terms which often lead to confusion in discussions are formative assessment and feedback. Ramaprasad (1983:4) has the following to say about the various definitions associated with the concept of feedback:

> *"Theoretically, each person and each discipline can independently define a concept as long as they adhere to the respective definitions consistently. But such a diversity of definitions hinders communication and, more importantly, the transfer of knowledge across individuals and disciplines."*

Numerous researchers (Ramaprasad, 1983; Czerniewicz, 2008, 2010; Reigeluth & Carr-Chelman, 2009) are concerned about the lack of a unified language associated with educational concepts, because this leads to confusion and therefore hampers communication. Since there is no common understanding of many of the concepts used in this study, I find it necessary to define very clearly the concepts that will be used.

1.6.1 Process or design model

The word design can either refer to the process of creating an object or to the actual design of an object. A number of design models and frameworks exist and they either refer to the process of creating a course or the actual design of the course. Examples of design models or frameworks which refer to the process of designing courses, are ADDIE (analysis, design, development, implementation, evaluation), the Integrated Learning Design Framework for Online Learning and the Dick and Carey model. Examples of frameworks or models which refer to the actual design are Gagné's instructional events, and Laurillard's Conversational Framework and the Learning Design Conceptual model. The e-learning systems engineering (ELSYE) approach and the ARCS model of motivational design both discuss the procedure followed when developing learning material and the actual design model of the learning material.

When the term instructional design is used, it is more often used to describe the process of designing courses than the actual design of courses. "In short, instructional design is the systematic process by which instructional materials are designed, developed, and delivered" (What is Instructional Design?, 2012*),* and; "The process by which instruction is improved through the analysis of learning needs and systematic development of learning materials" (Culatta, 2013a[1]).

ADDIE is described as an Instructional Design model (Culatta, 2013b; Summaries of Learning Theories and Models, 2014) and Dabbagh and Bannan-Ritland (2005) refer to their framework as a Learning Design Framework even though both ADDIE and the Integrated Learning Design Framework of Dabbagh and Bannan-Ritland indicate the process of design and not the product. However, when Pappas (2013) refers to design models in the context of learning theories, he has in mind the design model of courses and not the process followed to design a course.

Gagné (1992, 2005) calls a model which refers to the process of design an Instructional Systems model, but it seems that this term has not been widely adopted. With the above examples I have tried to illustrate that some people see the term instructional design as the process followed to develop learning material and some see it as the actual design of the learning material (product). This can cause confusion, since these are two very different aspects of design.

The term *process model* is already a well-established concept in the software engineering field (Pressman, 2005). Models used to describe the process followed to design learning material are all based on the same frameworks than those originating in software engineering. Therefore, for the purpose of this study, any model or framework that describes the process that needs to be followed to create learning and teaching material will be referred to as a process model or framework, and any model or framework that describes the actual design of the course (product) will be referred to as a design model or framework.

1.6.2 Instruction or learning

Both the terms *instructional* and *learning* are used in conjunction with the word *design* to basically describe the same concept.

Gagné, Briggs and Wager (1992:3), Ramsden (1992:5) and Laurillard (1993:13) state that the purpose of teaching or instruction is to help people to learn. Although learning may happen without any instruction, the effects of instruction on learning

[1] Direct quotation form electronic sources, therefore no page numbers included.

are often beneficial and usually easy to observe. Gagné, Wager, Golas and Keller (2005:194) define instruction as "a set of events external to the learner designed to support the internal processes of learning".

Where Gagné focussed on the design of *instruction* in earlier versions of his book *Principles of Instructional Design*, the fifth edition of the same book defines *instructional design* as: "aiding the process of learning rather than the process of teaching" (Gagné *et al*., 2005:2), shifting the focus from the instructor to the learner. MacLean and Scott (2011:557) state that both the terms *instructional design* and *learning design* refer to the creation of learning material. They found that it is not clear when the term *learning design* was used for the first time and at which stage it started to replace the term *instructional design* (MacLean & Scott, 2007:189). It is also not clear what was originally meant by the term *learning design* and how *learning design* differs from *instructional design.* MacLean and Scott (2007:190) concluded that the term *instructional design* refers to a more prescriptive set of events that should be followed when designing course material. They prefer to use the term *learning design* and they also suggest that *instructional designers* should rather refer to themselves as *learning designers*.

Laurillard (2012:66) prefers to use the term d*esigning for learning,* to *instructional design* because it places the focus on the learner and the learning.

The IMS Global Learning Consortium define the term *learning design* as:

> *"… a description of a method enabling learners to attain certain learning objectives by performing certain learning activities in a certain order in the context of a certain learning environment. A learning design is based on the pedagogical principles of the designer and on specific domain and context variables" (IMS Learning Design Information Model, 2003).*

Attendant to this statement, Laurillard (2012:66) describes *designing for learning* as creating "the environment and conditions within which the students find themselves motivated and enabled to learn".

Therefore, the IMS Global Learning Consortium, Laurillard and Gagné all describe design as an act of creating a learning environment that makes it possible for learners to learn, which is in essence *learning design* or *design for learning.* I therefore prefer to use the term *learning design* and *learning designer*, because I believe that design should focus on learning and how it will enable learning to take place.

1.6.3 The TPACK framework

The introduction of technology into education resulted in new fields of knowledge that now form part of education. Suddenly it is not enough to know the content and pedagogical practises. It is now necessary to include knowledge of technology. This also results in merged fields, and it has become necessary to define these fields, so that it can be clearly understood.

Educators are continuously confronted with new technologies that they can use as part of their teaching. Applying these technologies is not always straightforward. Most often these technologies are not designed for teaching in the first place, for example the Powerpoint presentation was designed for business presentations and audience response technology was originally designed to be used as part of game shows. When using these technologies educators need to understand the affordances and limitations of each tool, but more importantly how to integrate it as part of their teaching. They should not only be experts in content, pedagogy and technology, but also in the merged fields, which are described as part of the TPACK framework.

The Technological Pedagogical Content Knowledge (TPACK) framework was introduced by Mishra and Koehler in 2006. The framework describes the interaction among the three bodies of knowledge: content, pedagogy, and technology. "The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate technology use in teaching" (Koehler, Mishra & Cain, 2013:13).

The three components: content, pedagogy and technology form the core of the TPACK framework. Added to the three components are the interactions among them, represented as PCK (pedagogical content knowledge), TCK (technological content knowledge), PK (technological pedagogical knowledge), and TPACK (technology, pedagogy, and content knowledge).

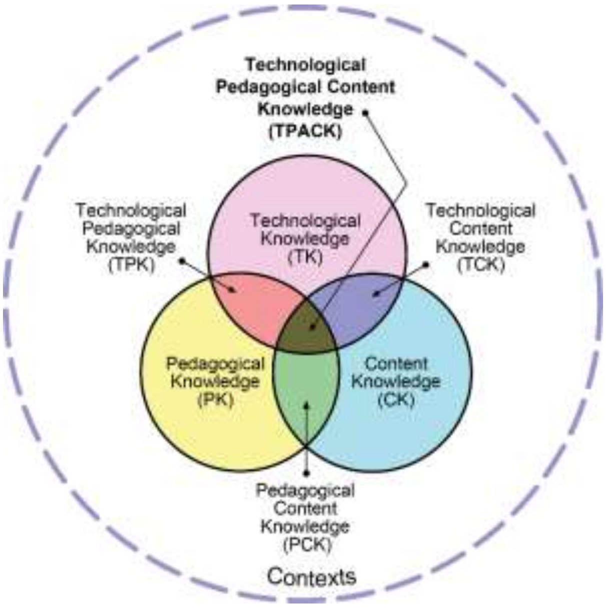

FIGURE 1.2: TPACK FRAMEWORK
SOURCE: KOEHLER, 2012

1.6.3.1 Content Knowledge (CK)

Content knowledge (CK) is knowledge about the subject matter to be learned or taught. The content taught in Logistics, for example, will differ from the content taught in Chemistry. According to Shulman (1986:5) content knowledge will include the knowledge of theories, concepts, frameworks and established practices.

1.6.3.2 Pedagogical Knowledge (PK)

Pedagogical knowledge defines knowledge about teaching and learning. This includes understanding how students learn, how to manage a classroom, how to develop lessons and how to assess. As described by Koehler and others (2013:15): "Pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in the classroom."

1.6.3.3 Technological Knowledge (TK)

Defining technological knowledge (TK) is very difficult, because of the rapid changes in this field. That said, a certain 'understanding' of technology can apply to all technological tools and resources. Technological knowledge is more than just computer literacy. It can be linked to the definition proposed by the

Committee of Information Technology Literacy of the National Research Council (NRC, 1999), called Fluency of Information Technology (FITness). FITness consists of three kinds of knowledge; contemporary skills, foundational concepts and intellectual capabilities. Contemporary skills require that a person can use current technology efficiently. Foundational concepts include the understanding of the structure of the technology used, including the understanding of the affordances and limitations. Intellectual capabilities are the ability to apply this technological knowledge in new and complex situations. FITness requires a lifelong learning process in which an individual is able to adapt to changes in technology.

1.6.3.4 Pedagogical Content Knowledge (PCK)

When the knowledge of pedagogy is applied to the teaching of specific content, i.e. the educator must understand how to transfer knowledge of content to a learner and which learning materials to use in the process, it is called Pedagogical Content Knowledge (PCK). "PCK covers the core business of teaching, learning, curriculum, assessment, and reporting, such as the conditions that promote learning and the links among curriculum, assessment, and pedagogy" (Koehler, *et al*., 2013:15).

1.6.3.5 Technological Content Knowledge (TCK)

The type of content taught has an influence on the technology that can be used and understanding this concept is critical for effectively applying technology for educational purposes. Likewise, the available technology has an influence on the type of content ideas that can be taught. "Technological Content Knowledge (TCK), then, is an understanding of the manner in which technology and content influence and constrain one another" (Koehler, *et al*., 2013:16).

1.6.3.6 Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) is an understanding of how certain technologies can be used to change current practices in teaching and learning. For example, in the past when a teacher asked a question in class, the students responded with a show of hands, and the teacher had to guess the outcome by quickly calculating the number of raised hands. Audience response technology allows a teacher to ask a question and to receive an immediate and accurate summary of what the students selected. A constraint of such a system might be that it only allows for multiple-choice questions to be asked. Therefore TPK means that an educator understands how technology can be integrated into pedagogy.

1.6.3.7 Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge (TPACK) is an emergent form of knowledge, merging all three core components, namely content, pedagogy and technology.

Even though there are various criticisms against the TPACK framework, for example that the different areas are not always clearly defined (Archambault & Barnett, 2010:1659) it is a useful framework to pinpoint the problem areas when a particular activity did not work out as planned.

1.6.4 Audience response systems

Audience response systems are also referred to as Student response systems, or Learner response systems, or more commonly as clickers.

Originally, Audience response (AR) systems were based on infrared (IR) technology, but low-cost radio-frequency (RF) audience response systems were introduced in 2005 (Barber & Njus, 2007:1). They were cheaper than IR audience response systems and started to replace IR audience response systems. The devices that the audience used to submit their answers were referred to as clickers, and the word 'clickers' started to become the most common term used to refer to audience response systems.

Recently, developers also started to develop software for mobile devices that connect to a server via the web using relevant software, which perform the same function as audience response systems.

Due to the fact that clickers refer to the actual devices as part of traditional audience response systems and can also refer to devices that make click sounds and which are used to train animal behaviour, I decided not the use the term clicker for this study.

I also preferred to use the term audience, instead of learner or student, because the device can be used in any educational situation, whether the audience referred to consist of learners or students or scholars.

The word system cannot be used in any context, because it might refer to the technology, or the activity or the software. Therefore, the term audience response will be used combined with other relevant terms such as technology, activity or software.

1.7 The structure of the study

In order to develop a framework for the integration of audience response technology in education, it was necessary to research current practices and learning design models found in the use of audience response technology. This is discussed in Chapter two.

All of the described learning design models used in connection with audience response technology originated in sciences. In order for me to design a framework around the use of audience response technology as part of active learning that can be used by any lecturer in any discipline, it was necessary to look at other learning design models. The blueprint of the design model is influenced by the chosen pedagogical approach. Since the study researches the use of audience response technology as part of active learning, the concept of active learning will also be an integral part of the lesson design. Therefore, active learning and three pedagogical approaches, instructivism and constructivism, and an integrated approach are discussed in Chapter two. Any audience response activity will follow a question-answer-sequence; therefore assessment and feedback will also form an aspect of the audience response activity and is also discussed in Chapter two. The data analysis (see Chapter five) showed that motivation is a crucial aspect of the audience response activity. Chapter two therefore includes a section on motivation. The aim of this chapter is to give the background to the theoretical frame of the intended framework and to situate this framework in current pedagogical approaches.

The design of any educational activity consists of two components, namely the process followed and the design of the activity. Current process and design models used in education are discussed in Chapter two. The strengths and weaknesses of each model is also discussed and how each of them can possibly be applied to audience response activities.

Activity theory used as theoretical lens to analyse the data is discussed in Chapter three. The chapter looks at all the different components of activities in general and then more specifically at the composition of each of these components as part of an audience response activity.

This is followed by the chosen research approach in Chapter four. The paradigm perspective, namely pragmatism, is discussed, and the reason for the chosen research approach is argued. This is followed by a discussion of the design and different components of the study. This includes the context in which the study was undertaken, the selection of cases, the methods of data collection and how the data was analysed.

Chapter five starts with a general analysis of the audience response activity using the five principles of activity theory as lens. Each case study is then analysed using these five principles. Each section concludes with a discussion on the learning design of each case and looks at the different aspects which had an influence on the success or failure of the integration of audience response technology.

Chapter six introduces the framework consisting of a process and a design model and provides the conclusion to this study. The contribution and limitations of this study is also discussed and recommendations are made for possible future studies.

Chapter 2

Audience response technology against the background of a pedagogical approach and active learning

2.1 Introduction

Seeing that this is a study into ways of effectively integrating audience response technology into learning design in order to promote active learning, some background on the history and development, as well as the current utilisation of audience response technology is required. This chapter presents a brief history of audience response technology, followed by an overview of current use of this technology. It continues with a discussion of the barriers which have been identified as obstacles that prevent effective use of audience response technology. Thereafter, various design models currently associated with audience response technology are presented. The components of each model are discussed and elements that should ideally form part of a comprehensive design model are identified.

The chapter then continues to give a background on the introduction of audience response technology at Stellenbosch University.

Cambell and Monk (2015:27) found that there are very few resources available for lecturers which clarify how to integrate audience response activities in a meaningful way, but which also complement their pedagogical approach and help them to effectively use audience response technology as part of their teaching. This lack of the linking of the learning design model to a pedagogical approach is explored.

Dillon (2004), Czerniewicz (2010) and Jaffer (2010) identify the two most prevalent pedagogical approaches included in educational technology as instructivism and constructivism. Cronjé (2006) also identifies an integrated approach. These two pedagogical approaches, and the integrated approach, are also discussed.

The pedagogical approach provides the rules according to which any learning activity is designed. These rules define the design model that determines the design of the learning activity. This chapter will describe how these pedagogical approaches are integrated in learning design models. A number of design models or frameworks are discussed that are specifically linked to either one or both pedagogical approaches.

Throughout the discussion the role that audience response technology can play to promote effective active learning, is highlighted. This chapter therefore continues to explore active learning in more depth.

Key concepts that are also associated with active learning are feedback (Gibbs & Simpson, 2004; Dyson, 2008; Efstathiou & Bailey, 2012) and motivation (Crouch & Mazur, 2001; Cherney, 2008; Heaslip, Donovan & Cullen, 2013) and therefore this chapter will also include discussions on assessment and feedback, and motivation.

Van Rooij states that learning designers should possess both learning design knowledge and solid project management skills. She calls for a more formal approach to the development of learning material. She found however that courses in learning design at higher education institutions often do not include project management, creating a gap between learning design programmes and real-world practice (Van Rooij, 2010:852). Other authors who also advocate a more formal approach to learning design are Lester Gilbert and Veronica Gale (Gilbert & Gale, 2008:11). Their process model includes a strong project management component.

Four process models that are used in the design of learning activities are discussed. The strengths and weaknesses of each model is highlighted and components are identified that are important in the design of audience response activities.

This chapter will now continue with an overview of audience response technology.

2.2 An overview of audience response technology

As the name suggests, audience response systems were originally created to provide interaction with an audience, typically on a television show. Such a system provides the opportunity for each member of an audience to submit a response to a given question. The responses are then aggregated, analysed and summarised, thus allowing the presenter (or organiser of the show) to respond to input from the audience.

According to Kay and LeSage (2009), audience response technology was introduced at Stanford University in 1966. However, extensive use of audience response systems only began in 2003 and, since then, the use of audience response systems has steadily increased at educational institutions.

Perhaps the most significant characteristic of this technology, which gives it the potential to enhance lessons significantly, is its ability to provide the lecturer with instantaneous, potentially detailed analysis of the level of comprehension of students, so that the lecturer may tailor the lecture to the audience, in real time. Several researchers (Duncan, 2006; Caldwell, 2007; Twetten, Smith, Julius & Murphy-Boyer, 2007; Smith, Annis, Kaplan & Drummond, 2012) have reported on the value added by the use of audience response systems as an aid to enhance active learning in the classroom.

One of the major advantages of the use of audience response technology, identified by researchers, is the identification of misconceptions held by members of an audience (Barnett, 2006; Lundeberg, Kang, Wolter, delMas, Armstrong, Borsari, Boury, Brickman, Hannam, Heinz, Horvath, Knabb, Platt, Rice, Rogers, Sharp, Ribbens, Maier, Deschryver, Hagley, Goulet & Herreid, 2011; Anderson, Healy, Kole & Bourne, 2013). The technology is especially effective in identifying individual learning needs in larger groups of learners (Cutts, Kennedy, Mitchell & Draper, 2004; Draper & Brown, 2004; Barnett, 2006). Effective use of audience response technology, during question and answer sessions, improves an educator's ability to determine whether or not the majority of learners understand the material being presented, thus allowing the educator to avoid spending unnecessary time on content that is already understood. Researchers have also highlighted the benefit of using the audience response technology as part of formative assessment, finding it to be a very effective teaching technique for the mastering of new material (Simelane & Skhosana, 2012; Anderson *et al*., 2013; Han & Finkelstein, 2013). Graham, Tripp, Seawright & Joeckel (2007:251) found that students preferred the use of audience response technology as part of formative assessment rather than summative assessment.

Beatty (2004:3-4) notes that the full potential of audience response technology is seldom realised in learning situations, with educators generally using it only intermittently, whether it be to gather answers to a question, quiz students for comprehension or simply keep the students awake. I experienced this apparent waste of the potential of this technology during lesson observations at Stellenbosch University. Very often the aggregated feedback, which is essentially the most important feature of audience response technology, was not used by the lecturers. It was evident that the lecturers were uncertain as to how they should make effective use of the aggregated feedback they were receiving.

As early as 2006, Roschelle stated that audience response technology has achieved "impressive scale and produced large learning gains and transformations in pedagogical practice" (Roschelle, 2006:2) in schools. He attributes this to the fact that it is relatively simple technology, reasonably cheap and "there is a deep scientific linkage between the capabilities of the technology and how people learn. Students learn best when classrooms are learner-centred, knowledge-centred, assessment-centred and community-centred" (Roschelle, 2006:11).

This was also noted by Abrahamson, when he reported the following in 2006:

> *"Today, at almost every university in the USA, somewhere a faculty member in at least one discipline is using a response system in their teaching … Amazingly, these generally somewhat primitive tools are used in just about every discipline taught … Arguably, not since the overhead projector, has a piece of technology received such widespread acceptance as an aid to classroom teaching" (Abrahamson, 2006:2).*

The adoption of this technology in South Africa has not been as widespread and, even now in 2015, very few educators use audience response technology as part of instruction. This is somewhat disappointing, given the extent of the successful integration and effective use of audience response technology reported in studies conducted in higher educational institutions in South Africa (Gachago, Morris & Simon, 2011; Simelane & Skhosana, 2012).

2.3 Barriers in the use of audience response technology

Research suggests that educators may be reluctant to embrace the use of audience response technology because effective integration of this technology necessitates that they learn new skills and assume different roles in the teaching-learning situation (Burnstein & Lederman, 2001; Beatty, 2004). Not only are the educators required to learn new technical skills, but they are expected to implement these in front of learners, often without assistance and technical support. Integration of audience response technology may involve educators adopting a new way of teaching, recreating their lesson plans in order to build lessons around questions. This can be extremely time consuming at the beginning of the process. Abrahamson (2006:10) found that limited subject knowledge also deterred educators from attempting to incorporate audience response technology into their lessons, because such an interactive approach might require that they answer questions (from students), which they have not anticipated, and which they may not feel confident answering.

It is not only the lecturers, but also the students who find it difficult to adjust to changes resulting from the introduction of audience response technology. Students who are accustomed to performing well with the old teaching style find it difficult to adapt, especially if they cannot see the reason for the change. Students who are generally passive during lessons, accustomed to sitting and doing nothing during lectures, do not like the idea of being forced to engage in class activities (Beatty, 2004:7).

Beatty (2004:7) also found that institutions are not adequately prepared to support the use of audience response technology as part of teaching and recommends not only technical support, but more importantly instructional support for educators. Lecturers at universities are often content experts, but they do not have formal educational training. Such lecturers need support from educational experts in pedagogy and technology to aid them in the transformation of lesson design.

The literature on audience response technology use falls into three categories:

- introducing audience response technology (e.g., Johnson & McLeod, 2004; Duncan, 2006; Herreid, 2006; Caldwell, 2007);
- individual reports on teaching with audience response technology, often supported with very limited data (e.g., Burnstein & Lederman, 2001; Draper & Brown, 2004; Barnett, 2006; Herreid, 2006); and
- best practices and recommendations (e.g., Caldwell, 2007).

Fies and Marshall (2006:106) note the dearth of studies which combine audience response technology use with pedagogical approaches. It may be argued that it is not the use of audience response technology *per se* that improves learning, but rather the pedagogical approach underlying the use of audience response technology, which appears to have a positive impact. So, even though there are very few studies that investigated the pedagogical approach underlying the use of audience response technology, three current learning design models were identified.

In the following section these three learning design models associated with the use of audience response technology are presented, together with an outline of the strengths and weaknesses of each approach.

2.4 Current learning design models integrating the use of audience response technology

2.4.1 Peer instruction

The use of audience response technology, as part of education, was made famous by Eric Mazur, whose design model is called *peer instruction*. He discovered that his students had difficulty with understanding conceptual questions. According to Mazur, the traditional way of information transfer did not allow students to develop models of how science works, and this led to him changing his approach from lecturing to questioning (Crouch & Mazur, 2001; Mazur, 2009).

The method advocated by Mazur involves a short presentation on a given topic, followed by a conceptual question, called a *concepTest*, which tests the students' understanding of the work discussed during the presentation. The *concepTest* takes the form of a multiple-choice question and the feedback is given in the form of a histogram. The students discuss the answers amongst themselves, and then answer the same or a similar question again (Crouch & Mazur, 2001; Mazur, 2009).

Crouch and Mazur (2001:974) say that peer instruction requires students to be significantly more involved, and that some students are initially very sceptical about this new form of learning. They find that this requires adding forms of motivation. The forms of motivation that they add is the grading of the students on their conceptual understanding and to include meta-level communication at the start, by explaining to their students the reason for changing the teaching method.

Mazur's peer instruction method focuses on explaining concept questions (Crouch & Mazur, 2001). I would argue here that audience response questions can comprise more than just the asking of concept questions. The peer instruction itself is also not clearly grounded in a theoretical framework.

The inclusion of meta-level communication, which involves explaining to students the reason behind any new teaching method, is a very important aspect of the integration of new technology into teaching and can contribute to motivating students to participate in the new teaching method.

The peer instruction model provides a solid foundation to use as a framework, but this model has mostly been used in natural sciences and and the pedaogigical approach is not clearly defined. It still mirrors the traditional teaching method of explaining the content first and then introducing questions, which means that students are still passive during the first part of the lesson when they do not actively participate.

2.4.2 Question-driven instruction

Beatty, Gerace, Leonard and Dufresne (2006:31) note that designing effective audience response questions is particularly challenging to educators, because audience response questions differ considerably from the type of questions generally asked as part of homework exercises or in examinations. Even though these authors found Mazur's peer instruction method, involving conceptTests to be worthwhile, they found that more dramatic improvements in teaching and learning can occur by "inverting the paradigm" (Beatty *et al*., 2006:31). They use a "'question cycle' as the core of in-class instruction, making question posing, pondering, answering, and discussing the vehicle of learning" (Beatty *et al*., 2006:31). They call their approach q*uestion-driven instruction*. This method does not use traditional lecture formats, such as the presentation of material, but rather seeks to help "students explore, organize, integrate, and extend their knowledge" (Beatty *et al*., 2006:32). A lesson begins with a question, which students discuss in small groups. Students then submit their answers via the audience response system. The results are presented to the students, but the correct answer is not revealed. Students are then given the opportunity to justify their answers and defend their points of view, during a class discussion. This is followed by general comments, a short lecture, a related audience-response question or whatever else is necessary to conclude the discussion of the answer to this question. This cycle is repeated three or four times during a 50-minute class period.

Beatty and others believe that each audience response question should consist of a content goal, a process goal and a metacognitive goal. The content goal covers the content to be learned, the process goal covers the cognitive skills that should be developed; and the metacognitive goal covers the beliefs about learning that should be reinforced by answering the question (Beatty *et al*., 2006:32). The authors conclude that designing questions like these is difficult and time consuming, but essential to the success of question-driven instruction (Beatty *et al*., 2006:39).

This method by Beatty and others focuses on the type of question that should be asked and gives detailed information on how the question should be developed. This I consider to be an improvement on the peer instruction method. It also broadens the scope and makes it more usable for other disciplines.

One feature of question-driven instruction, which may be criticised, is the presentation of the answers to the students, prior to the class discussion. Researchers have found that this may lead to the students being influenced, in the subsequent discussion, by the majority vote, rather than basing their comments on their own answers (Labov, Reid, & Yamamoto, 2010; Knight, Wise & Southard, 2013).

Even though this model leans more towards a constructivist learning design, the actual lesson design is not clearly defined, except for the requirement that a 50 minute lesson should consist of three to four question cycles. And although question-driven instruction advocates that the question should include a meta-cognitive goal, it does not require meta-level communication with students.

2.4.3 Technology enhanced formative assessment (TEFA)

Beatty and Gerace (2009) developed a design model, called *technology-enhanced formative assessment* (TEFA), for teaching science and mathematics.

They define the four principles of TEFA as:

> *"1) Motivate and focus student learning with question-driven instruction; 2) Develop students' understanding of scientific fluency with dialogical discourse; 3) Inform and adjust teaching and learning decisions with formative assessment; and 4) Help students develop metacognitive skills and cooperate in the learning process with meta-level communication" (Beatty & Gerace, 2009:153).*

The first principle of 'motivate and focus student learning with *question-driven instruction* (QDI)' is the setting of questions or problems to create opportunities for learning i.e. not limited to assessing previous instruction. The instruction is driven by questions and this results in assessment *as* learning, distinguishing it from summative assessment; also called assessment *of* learning; and formative assessment; or assessment *for* learning (Wiliam, 2007:1053). Carefully constructed questions can make learners attentive to gaps in their understanding, "raise dilemmas for them to wrestle with, and challenge the limits of their context-dependent knowledge" (Beatty & Gerace, 2009:153). The question-answering context helps learners to realise that knowledge is there to aid the answering of questions, and not something to memorise, simply so that it can be recalled at a later stage (Beatty & Gerace, 2009:153).

The use of questions also supports the development of learners' intrinsic motivation. In addition, Beatty and Gerace (2009:154) posit that "it supports the development of self-efficacy by allowing students to wrestle with a task they do not initially know how to complete, but can eventually succeed at".

The sociocultural view of learning strongly promotes dialogue as critical to the learning process. Constructivism further argues that learning starts with addressing the beliefs and knowledge already in learners' minds. This knowledge should be drawn out and learners should be encouraged to explore and articulate it.

The second TEFA principle is *dialogical discourse* (DD), which refers to the arrangement of students in whole-class and small-group discussion groups where they get the opportunity to discuss different perceptions. Dialogical discourse has several effects: "to clarify thought through the process of articulation and externalization; to expose students to different points of view and lines of thinking; to promote analysis and resolution of disagreements; to supply stimuli, context, and tools for individual sense-making; and to provide practice speaking the social language of science" (Beatty & Gerace, 2009:154).

The third TEFA principle is inform and adjust teaching and learning decisions with formative assessment (FA). FA's main purpose is to improve learning. The results of this assessment are used to adapt teaching methods and to meet learning needs.

The fourth TEFA principle is to help students develop metacognitive skills and cooperate in the learning process with meta-level communication (MLC). Three categories of meta-level communication are important: meta-narrative, meta-cognitive talk, and meta-communication. The aim of meta-level communication is two-fold: to improve learning by increasing the effectiveness of instruction; and to improve learning by developing the learner's beliefs, attitudes and behaviours towards the learning process. Meta-narrative is communication about the design of the course. Its purpose is to inform learners about what is happening in class and why it is happening, so that learners can focus on important aspects and also understand the purpose behind lesson design and how it contributes to improved learning. Meta-cognitive talk is communication about how learning takes place, the thinking process and how knowledge is gained. If students understand these processes, they can become more aware of their own learning processes and can make more insightful decisions about their own learning. Meta-communication is communication about communication. Its purpose is to improve communication in the classroom and help learners to participate more efficiently (Beatty & Gerace, 2009:156).

TEFA is, to date, the most comprehensive design model created for guiding the use of audience response technology. The authors of the TEFA approach acknowledge that the development of TEFA is far from complete and that they need to review a lot more empirical evidence (for example, on the efficacy of meta-level communication), in order to determine whether or not it is really effective (Beatty & Gerace, 2009:160).

This design model includes all the important elements of the lesson design, namely the assessment cycle, how the feedback is used to adapt the teaching method and motivation. It is also situated in a pedagogical approach, namely constructivism.

A short background on how audience response technology was introduced at Stellenbosch University now follows.

2.5 Audience response technology at Stellenbosch University

In December 2010, several lecturers at Stellenbosch University, in South Africa, requested that the institutional Centre for Teaching and Learning (CTL) assist them in buying audience response systems which they wanted to use as part of their teaching. CTL approached the Division of Information Technology (IT) to investigate different types of audience response systems, since IT would have been responsible for the overall support.

The typical audience response system "consists of transmitters that students use to send responses, receivers that collect these inputs, and a computer that runs software designed to interpret and aggregate these responses in real time" (Fies & Marshall, 2006:101). Most audience response systems only allow multiple-choice questions, but some also include short answer, numeric or free-text answers. As an alternative to using an audience response system that includes its own, dedicated audience response devices, mobile devices may be incorporated in an audience response system. Numerous audience response software programmes for mobile devices exist. Mobile devices replace the actual audience response device and responses are sent, using the audience response software, via the web, to a computer that acts as a server, where the responses are interpreted and aggregated. Either the customised, dedicated audience response devices or the mobile devices can be used to engage the audience, obtain feedback and track performance.

IT investigated various options and compared systems that included dedicated audience response devices with those employing mobile devices to capture responses. Several problems were envisaged with the use of dedicated, customised audience response devices. Firstly, if the university purchased the audience response devices, it would be tedious and time consuming to distribute the devices at the start of each lesson, especially in large classes. Secondly, the audience response devices could not be linked to specific users, unless the students were asked to buy the devices, in which case they would be required to carry the cost. Linking each response device to its user would result in an inordinate amount of extra administrative work. This would also mean that students would have an extra device to carry around. Extra IT staff would have to be appointed to support the audience response devices. This was therefore not considered to be a viable solution.

Various systems incorporating the use of the students' personal mobile devices were considered. Given that the students were using a wide variety of mobile devices, a BYOD (bring your own device) approach had to be followed. Any software that was developed had to work on any mobile device. Most of the available audience response software concentrated on iPhones and Android devices such as Samsung, HTC and LG. Buying available software would mean that students who did not own iPhones or Android devices would not be able to use the system.

Since the available software did not satisfy the needs of Stellenbosch University, it was decided to design in-house software. The students used such a wide variety of mobile devices, that it was decided that it would not be feasible to develop applications for each mobile type and that the university would rather concentrate on a mobile web interface, which would allow any web-enabled mobile device to access the audience response system. I was asked to develop audience response software that would integrate with Moodle, the learning management system used by the university. This audience response software was used by all the lecturers who participated in this study.

The audience response technology was made available to the whole university in 2012. Training was provided in the use of the audience response technology, but this mostly consisted of how to work with the technology itself.

A number of lecturers started using the system without adequately understanding the affordances and the shortcomings of the tool. The result of this was that they did not know how to integrate the audience response technology into their lesson design. I felt that the use of audience response technology could make a significant contribution to improving the learning process and it was discouraging to see how lecturers repeatedly failed to integrate the audience response technology successfully as part of active learning.

From my review of the literature published on the use of audience response technology, I concluded that most of the research, to date, was conducted on the use of audience response technology in the teaching of mathematics and the natural sciences. The question was if only these scientific disciplines could benefit from the use of audience response technology and as suggested by Kay and LeSage (2009), and Campbell and Monk (2015), I realised that there is a need for research on the use of audience response technology to be expanded to social sciences as well. This study reflects an effort to fill this gap by expanding the research on audience response technology to the social sciences, with case studies from the Faculty of Education and the Faculty of Economics and Management Sciences included.

In theory, any discipline could use audience response technology as an assessment tool, but, for me, the key issue was whether or not all disciplines could potentially benefit from using this technology as part of active learning, which will now be discussed in detail.

2.6 Active learning

Active learning is defined as engaging learners in the learning process, therefore requiring them to actively participate during classroom hours. It goes beyond traditional activities, such as homework, and requires learners to actively construct knowledge. It involves more than merely listening to a formal presentation, and includes higher-order thinking activities like analysis, synthesis, and evaluation (Bonwell & Eison, 1991:1). It requires activities to be introduced in the classroom, and learners are no longer passively receiving information, but rather actively engaged.

Laurillard (2012:59) describes the learning process as an active process, triggered by a personal goal, which is partly individually and partly socially determined. The learner has access to a model of required actions and an outcome and the means of acquiring this goal is within the learner's capability. The learner's current conceptual organisation is formed by having access to another's articulated conceptual organisation, either in the form of feedback from previous actions or articulations, or by receiving feedback from someone else. This feedback is used to modify future actions.

The importance of engaging learners actively is widely acknowledged and there is considerable evidence to support the effectiveness of active learning. For example Dori and Belcher (2005:274) found that technology-enabled active learning improved the pass rate considerably. They enhanced their teaching with experiments, web-based assignments, audience response activities and peer discussions. McClanahan & McClanahan (2002:95) found that, not only did active learning contribute to students asking more questions, but the quality of the questions after an active learning activity also improved. Their choice of active learning activities included group discussions, reflection activities, brainstorming and debriefing sessions. Ada (2009:145) introduced online discussions groups and found that there is a positive correlation between active participation in online discussion groups and the quality of cognitive skills fostered. In addition, Pundak, Hersocovitz and Shacham (2010:2) established that most researchers investigating active learning find improvements in conceptual understanding, grades, student satisfaction, collaboration and problem solving.

Bonwell and Eison (1991:2) describe several barriers which prevent the use of active learning in classes. These include limited class time, limited preparation time, large classes and lack of resources. The most significant barrier however, is the fear that learners will not participate, or that meaningful learning will not take place. This is confirmed by Niemi (2002:773), who also found that factors which made educators resistant to the use of active learning included large groups of learners, limited class time, and the fact that learners lacked motivation and did not want to participate in the active learning activities. The same author (Niemi, 2002:775) found that learners claimed that educators did not know how to apply active learning methods effectively and posits that, if educators actually knew what they were doing, learners would be more motivated and willing to take part in these activities. Problems like these can be overcome by careful planning of the learning process, as discussed in section 2.11.

McClanahan and McClanahan (2002:92) caution that when a lecturer decides to integrate active learning into his or her teaching, it is important for the lecturer to find a strategy that is compatible with his or her current pedagogical approach. This implies that active learning is not necessarily restricted to a single pedagogical approach or theory. This is confirmed by Jaffer (2010:283) who believes that pedagogies themselves are neither good nor bad; the impact of any given pedagogy depends on how it is used by educators. A background on current pedagogical approaches will now be given and then each approach will be discussed in more detail.

2.7 Pedagogical approaches

Bigge (1982:48) considers the two most influential families of contemporary learning theory to be the *behaviouristic* family of *stimulus-response conditioning theories* and the *Gestalt-field* family of *cognitive theories*. He lists the main differences between these two families of theories as follows: the behaviouristic approach believes human beings to be *passive* or *reactive* and cognitive theories believe human beings to be *interactive* in relationship with their environments (Bigge, 1982:49). Two leading figures of contemporary learning theory, during the first third of the twentieth century, were John. B. Watson and Edward L. Thorndike. Thorndike's psychology, even though in essence behaviouristic, was known as connectionism. Although neither behaviourism nor connectionism are still being advocated, from them a new field of behaviourism developed, called neo-behaviourism. Bigge calls Gagné, among others, one of the leading contemporary neo-behaviourists (Bigge, 1982:50). Gagné's instructional design theory, referred to as an instructivist design approach and based on the behaviourist learning theory, emerged as a leading design theory over the last century.

An equally influential contemporary learning theory, is social constructivism, a theory grounded in the theory of Lev Vygotsky (1896 – 1934). Social constructivism has become instructivism's strongest adversary and there are those who believe that instructivism should be abandoned all together. In essence, instructivism is based on traditional teaching methods, where the teacher is the primary source of information and directs the learning process. Constructivism and, in particular, social constructivism, defines the acquisition of knowledge as a social and cultural process, which does not happen in isolation. The focus is on the learner, and the learning process is directed by the learner.

Different learning situations may call for different instructional methods. A good educator should be able to analyse a learning situation and decide which method will be the most appropriate to apply in any given situation. Gilbert and Gale (2008), for example, combined these two theories in their design model which is explained in more detail in section 2.10.

Two leading figures in the field of learning design are Robert Gagné and Diana Laurillard. Gagné's approach to design is instructivism, whereas Laurillard favours social constructivism. Gilbert and Gale provide a design model in which both of these pedagogical approaches are combined. This is discussed in section 2.10.

Therefore, even though there are a large number of very influential learning theories, I will focus on instructivism and constructivism and how audience response activities can be applied in learning activities based on an instructivist approach, activities based on a constructivist approach and activities based on a combination of these two approaches.

2.7.1 Instructivism

Instructivism finds its roots in behaviourism, which explains learning as a system of behavioural responses to physical stimuli. Psychologists in this field study the influence of reinforcement, practice and external motivation. Educators develop well-structured curriculum and determine, beforehand, how learners will be assessed and motivated. Learners are seen as passive, needing external motivation. "Assumptions are made that observation, listening to explanations from teachers who communicate clearly, or engaging in experiences, activities, or practice sessions with feedback will result in learning" (Fosnot & Perry, 2005:9).

Skills are seen as the outcome of learning as also defined by Gagné. He distinguishes five different varieties of skills, namely intellectual skills, verbal information, cognitive strategies, motor skills and attitudes (Gagné, 1985:47).

Gagné sees a single learning act as a set of processes that takes place. These processes may take place in sequence or some of them may occur simultaneously. The learning act starts with the learner, who receives stimulation from the environment. This information is entered into the *sensory register*, where it is transformed into patterns, where some stimuli are discarded and some are retained and re-ordered. This transformed information is then entered into the short-term memory where it exists for a very limited period. This information then needs to be transferred to the long-term memory. This process is called encoding, whereby the information is stored as concepts whose meaning can be correctly organised. For information to be verified as learned, the learner must be able to retrieve it from long-term memory. This process requires that certain *cues* should be provided, either externally or internally. The retrieved information is then transferred to the short-term memory, also known as the working-memory. This information can then be combined with other inputs to form new encodings. The next stage is that of *response generation*. This is where the type of response is being determined, i.e. whether it will involve speech, or some reaction. This is known as performance, an action that is externally observable. The process is concluded with the feedback event, which originates externally. Feedback can be automatic, when it is provided by the performance itself, e.g. the successful riding of a bike. During a formal lesson this feedback is provided by the teacher (Gagné, 1985).

Audience response activities can be used during any of these stages to aid in the learning process. They can, for example be used as external stimulation to start the learning event. They can be used to generate cues to help retrieve information from the long-term memory. They are also beneficial as feedback tools, providing confirmation of successful or unsuccessful learning. This is where the instructional process comes into play. The role of the teacher is to decide during which of these events the audience response activity will be introduced.

According to Laurillard (2012:45), instructivism cannot be regarded as completely irrelevant, because the educational system makes use of grades, credits and qualifications as rewards intended to motivate learners. This results in learners being passive recipients of learning material and passing exams by memorising and repeating learned content. However, if one of the aims of education is to help learners to become independent learners, responsible for their own learning process, then instructivism is not sufficient.

2.7.2 Social constructivism

Cognitive development and deep understanding, rather than modified behaviour or the acquisition of skills, are the foci of constructivism. Learning is not seen as a linear process, but as complex in nature (Fosnot & Perry, 2005:11). Another characteristic of constructivism or, more specifically, social constructivism, is that learning is seen as a social process and does not occur in isolation.

Dewey and Vygotsky were two of the first educational theorists who emphasised the role of language and social interaction in the learning process. Vygotsky argued that learning through discussion is important and differs from learning through practice, because articulating an idea is the final step required to prove that one knows and understands an idea. Discussion of ideas results in the development of new ideas, which are different from learning through practice and experience. The less experienced learner learns from the more experienced learner and is then able to move into his or her "zone of proximal development", i.e. a level which he or she would not have been able to achieve alone (Vygotsky, 1978). In this way, we not only construct our own models of the world, but through communication we are able to share our models with others, thereby learning from one another. As Frith (2007:181) puts it: "Some people are experts who clearly have better models of some aspects of the world. By putting together the models of many people, we can construct a new model that is better than any model produced by a single individual. And our knowledge of the world is no longer derived from a single lifetime – knowledge passes from one generation to the next."

The ideal learning situation, when it comes to communication between an educator and a learner, is described by Laurillard (2012:49) as follows: "In communication person A's brain constructs a model of person B's idea, compares it with what B should do as a result, and uses any error in that prediction to see where the difference lies between the two models, and adapt their communication accordingly." However, in formal education it is seldom possible for the educator to adapt his or her explanation to a single learner's interpretation, because class sizes make it impossible to focus on single learners. The use of an audience response activity can bridge this gap by making two-way communication possible. The educator immediately gets access to the learner's interpretation of his or her explanation and can therefore adapt his or her communication accordingly. Introducing peer activities as part of the process also exposes learners to peers' models and by communicating with their peers, they can construct new models.

This concept of effective collaborative learning is described by Black and Wiliam as follows:

> *"To varying degrees, learning happens through, and in association with, social interactions. Thus the learning of students develops in several communities — notably the family, the peer group, and the classroom. The idea that the nature of the classroom as a learning community is an important determinant of school learning is now well established. For example, development of peer learning and peer assessment has been shown to lead to significant improvements in learning" (Black & Wiliam, 2007:45).*

Vygotsky believed that development flowed from the social to the individual. He regarded collective learning as primary, and individual learning as secondary (Vygotsky, 1962:133). Meacham (2001:190) supports the implications of Vygotsky's writings and broadens them to include the aspect of diversity by positing that "a culturally diverse learning environment, in contrast to the tradition of deficit, may embody important advantages in higher-order conceptual development."

Another aspect of constructivism is the ability to think critically and not just consume information. Powell and Kalina (2009:245) stress the importance of critical thinking, and that educators should give ample opportunity for critical thinking, because in that way learners will be able to construct personal meaning. They suggest that educators introduce question-and-answer periods which will give learners the opportunity to discover knowledge on their own (Powell & Kalina, 2009:247). Again this is the ideal situation for the introduction of an audience response activity.

It is therefore clear that the use of audience response technology is worth considering in the social constructivist classroom, giving ample opportunity for collaboration, critical thinking and peer learning. I have already indicated how audience response technology can be used as part of an instructivist approach, so it therefore makes sense to combine these two approaches, to create an integrated approach, which will now be discussed.

2.7.3 An integrated approach

Even though instructivism still features very strongly in many institutions, a more constructivist approach is slowly emerging. In general, educators will follow either an instructivist approach or a constructivist approach. Cronjé and Brittz (2005:158) found that it is possible to integrate both educational approaches into a single learning experience that is both meaningful and effective. The instructivist elements bring order to the learning process and the constructivist elements allow educators to address higher levels of Bloom's taxonomy, contributing to establishing a feeling of ownership and stimulating enthusiasm amongst the learners.

Cronjé (2006) developed a model that plots the two approaches, showing how learning activities from both approaches can be combined. He refers to instructivism as objectivism.

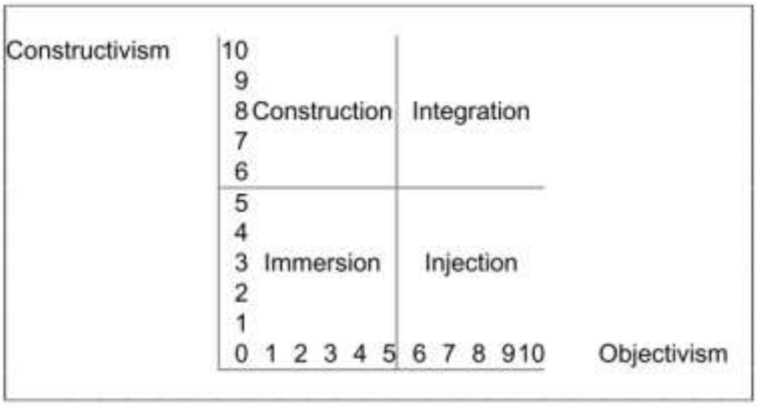

FIGURE 2.1 AN INTEGRATED APPROACH
SOURCE: CRONJÉ, 2006:8

The model is divided into four quadrants, namely injection, construction, integration and immersion. Learning activities in the injection quadrant consist of tutorials, lectures and drill-and-practice. This quadrant describes direct instruction, i.e. an instructivist approach. Learning activities which fall in the construction quadrant are examples of activities in which learners construct their own knowledge (Cronjé, 2006:8), and represent a constructivist approach.

Learning activities which fall in the immersion quadrant are examples of activities which are both low in instructivist and constructivist elements. There is no planning of learning activities, no instructor present, nor any facilitation of learning. He calls these learning experiences opportunistic and gives the example of a toddler who picks up a bug and gets stung. In this way the toddler learns to avoid bugs (Cronjé, 2006:8).

In the integration quadrant, learning activities are both high in instructivist and constructivist elements (Cronjé, 2006:8). Audience response activities will typically fall into this quadrant.

For example, the educator decides to use an audience response activity to generate cues to help retrieve information from the long-term memory, introducing the instructivist element. He or she therefore asks a question, which is answered by the learners. The aggregated feedback provided by the audience response software will give an indication of how much the learners remember. This is followed by a peer discussion, introducing the constructivist element. Therefore the learners articulate their thoughts, learn from one another and each one can reach his or her "zone of proximal development".

Irrespective of the educational approach that is followed, an audience response activity will always include a question-and-answer sequence, which implies that there should be feedback involved in order to make it a meaningful activity. The role of assessment as part of an audience response activity will now be discussed.

2.8 Assessment and feedback

In a study that was conducted by Efstathiou and Bailey (2012:94), the majority of students valued the use of audience response technology as part of formative assessment and wanted the use of audience response technology to be extended to other modules.

Black and Wiliam (2007:4-5) identify the main characteristics of formative assessment as that it is interactive and adaptive, uses a variety of inputs, can be a short dialogue or a review, promotes active involvement of learners and is a central feature of an educator's practice of instruction.

These are all characteristics of an audience response activity. The activity is interactive and adaptive, consists of a variety of inputs; can promote dialogue and involve learners actively. It is also an activity that can become a central feature of classroom practice.

The cycle lengths for Formative Assessment are described by Wiliam as follows:

TABLE 2.1 CYCLE LENGTHS FOR FORMATIVE ASSESSMENT

Type	**Focus**	**Length**
Long-cycle	Across marking periods, quarters, semester, years	4 weeks to 1 year
Medium-cycle	Within and between instructional units	1 to 4 weeks
Short-cycle day-by-day minute-by-minute	Within and between lessons	24 to 48 hours 5 seconds to 2 hours

Source: Wiliam, 2007:1064

The audience response activity is therefore a short-cycle formative assessment, or assessment *as* learning, as described by Wiliam (2007:1064).

An assessment can only be seen as formative if the information from the assessment is used to adjust instruction to better meet student learning needs. Ramaprasad (1983:5) also identifies three important functions of feedback as part of formative assessment: 1) it establishes where the learners are in their learning; 2) where they are going; and 3) what needs to be done to get them there. This idea and how it can be played out in the classroom is summed up by Wiliam in the following table:

TABLE 2.2: ASPECTS OF ASSESSMENT FOR LEARNING

<table>
<tr><th colspan="2">Where the learner is going</th><th>Where the learner is right now</th><th>How to get there</th></tr>
<tr><td>Teacher</td><td>Clarifying learning intentions and sharing and criteria for success</td><td>Engineering effective classroom discussions and tasks that elicit evidence of learning</td><td>Providing feedback that moves learners forward</td></tr>
<tr><td>Peer</td><td>Understanding and sharing learning intentions and criteria for success</td><td colspan="2">Activating students as instructional resources for one another</td></tr>
<tr><td>Learner</td><td>Understanding learning intentions and criteria for success</td><td colspan="2">Activating students as the owners of their own learning</td></tr>
</table>

Source: Wiliam, 2007:1064

Commenting on Ramaprasad's definition of feedback (see above), Sadler(1989:121) noted:

> *"An important feature of Ramaprasad's definition is that information about the gap between actual and reference levels, is considered as feedback only when it is used to alter the gap. If the information is simply recorded, passed to a third party who lacks either the knowledge or the power to change the outcome, or is too deeply coded (for example, as a summary grade given by the teacher) to lead to appropriate action, the control loop cannot be closed, and 'dangling data' substituted for effective feedback."*

Therefore, if the output given by the audience response activity is not used to improve the learning process, it can neither be seen as formative assessment, nor active learning. For any activity to be considered formative or active, feedback should be generated and should be used to improve the learning process.

Feedback that was given by students as part of this study, (see Chapter five), clearly indicated that the fact that lecturers did not use the feedback to improve the learning process, led to demotivation and eventually resulted in a very low participation rate in the audience response activities.

Relating to Sadler's quote on feedback, Black and Wiliam (1998:83), identify three problematic issues relating to assessment. The first concerns the effectiveness of the learning process. They found that the tests used by educators encourage rote and superficial learning.

The second problem that they identified is the negative impact of the assessments on learners. Marks and grading are overemphasized, and advice on how to improve is underemphasized. Learners are compared to one another and competition rather than personal improvement is encouraged. This kind of feedback makes low-achieving learners believe that they are unable to learn.

The third issue is the administrative load that assessments impose upon educators. Due to the fact that educators are forced to accumulate grades, grades become the driving force around assessments and constructive feedback that improves the learning process is often ignored.

Black and Wiliam (2007:44) caution that feedback which emphasises grades can lead to demotivation and poor performance amongst learners. Because the emphasis in education is usually placed on grading, learners seldom bother questioning the feedback, unless it can enhance their marks.

Educators should provide ideally high quality feedback, that is unrelated to grades and ensure that learners actually engage with this feedback. Only then can feedback be beneficial to the learning process (Hatziapostolou & Paraskakis, 2010:121).

Feedback can be either intrinsic or extrinsic. Intrinsic feedback is effectively internal with respect to the action: the consequences of actions experienced by the learner. By comparing resultant outcomes to the intended goal, the learner can determine if the goal was reached and what to do to improve. This is done without the teacher. Intrinsic feedback is a very important aspect of learning, because it enables the learner to make progress without aid and is "fundamental to the idea of constructionist, situated and experiential learning" (Laurillard, 2012:56). External feedback is feedback given by a teacher or a peer: comments or guidance that the learner can follow to improve on an action.

Researchers agree that feedback should be frequent and timely (Nicol & Macfarlene-Dick, 2006; Ecclestone, 2007; Fluckiger, Vigil, Pasco & Danielson, 2010; Halverson, 2010). Black, Harrison, Lee, Marshal and Wiliam (2004:17) also state that feedback should help students to become critical about the quality of their arguments, while Ecclestone (2007), Cauley and McMillan (2010), and Fluckiger and others (2010), call for feedback that is specific, focused and shows students how to improve.

For adequate learning to take place, it is vital that the student actually engages with the feedback as soon as possible after the assessment has taken place (Black *et al*., 2004:13). An audience response activity can solve the timing issue of feedback, because the marking is immediately completed by the system. The educator can therefore give immediate feedback.

This feedback to students should focus on developing skills, understanding, and mastery, and treats mistakes as opportunities to learn. By showing students specific misunderstandings or errors that frequently occur in a content area or a skill set, and showing them how they can adjust their approach to the task, students can see what they need to do to maximize their performance (Cauley & Mcmillan, 2010:3).

The student has to believe that it will be beneficial for their own learning process to participate in the audience response activities. The student should therefore be intrinsically motivated. However, if the student is not intrinsically motivated, and the lecturer cannot convince the student that these activities are beneficial, some form of extrinsic motivation should be provided. As has been seen in this chapter, this is a complicated process, because the ultimate goal of adding audience response activities is to promote active learning and the adding of extrinsic motivation should not hinder this process.

There is a direct link between receiving feedback, emotion and motivation. Therefore, in order to engage students in the feedback process, it is important to stimulate motivation (Hatziapostolou & Paraskakis, 2010:116; Black *et al*., 2004:18).

2.9 Motivation

Early theories of motivation included theories of drive or action and it was believed that people seek achievement because they have a desire for it, or a need. It was believed that people's motivation came from two sources, namely a "need to achieve" and a "fear of failure". Eventually it became apparent that this picture was incomplete. Other theories followed like Weiner's attributional theory of motivation and the Goal Theory, all of which attempted to create a more complete picture.

The Goal Theory stated that individuals entered situations for different reasons, with different ideas as to what was meant by success and failure, and what was required to achieve their desired outcome. Therefore it was believed that a person's goal was the motivational factor (Molden & Dweck, 2000:133). Two categories of goals were identified, namely "a *performance goal* involving demonstration of ability (also referred to in some literatures as an *ego* or *ability* goal) and a *learning goal* involving the development of ability (also called a *mastery* or *task* goal)[2]" (Molden & Dweck, 2000:133).

It was found that, when people were focused on demonstrating their level of ability, they saw failure as a measurement of themselves and were more likely to become demotivated. When people were focused on increasing their level of ability, setbacks

[2] Italics as in original document

were seen as a part of learning, and they were therefore motivated to try harder (Diener & Dweck, 1978, 1980; Molden & Dweck, 2000).

In education, a performance-goal orientation, also called an ego-involved orientation by Cauley & Mcmillan (2010:3), focuses on the assessment of learners' abilities. Learners' marks are made public and their performance is linked to their individual ability. Learners who under-perform are not rewarded.

The opposite of performance-goal orientation is called mastery-goal orientation by Cauley and McMillan. "A mastery-goal orientation emphasizes learning, understanding, improving, mastering new skills, and taking on challenges" (Cauley & McMillan, 2010:3). Instead of evaluating a learner's performance, educators evaluate a learner's progress. Learners have the opportunity to improve and mistakes are seen as part of the learning process. Evaluation is private and is not made public.

According to Cauley and Mcmillan (2010:3) learners who pursue mastery goals show positive characteristics. They use higher intellectual thought. They can more easily relate new learning to prior knowledge and they are also more persistent when facing difficult tasks. In contrast to this, learners who pursue performance goals display more negative characteristics. They are more likely to procrastinate, study superficially and sometimes display cheating behaviours. Recognition is very important to these learners (Cauley & Mcmillan, 2010:3).

Recent research on goal theory however found that, in some cases, individuals who are focused on demonstrating their level of ability may see failure as motivation to work harder. This is not a black-and-white situation. There are many variables that influence intrinsic motivation such as "someone's implicit theory of intelligence, or situational factors, such as the nature of the feedback that is provided" (Molden & Dweck, 2000:154).

Ryan and Deci (2000) completed a study on the undermining effect of the giving of rewards on intrinsic motivation. The use of rewards is pervasive in all areas of society. According to Ryan and Deci (2000:15) this strong focus on rewards is a recent phenomenon. They say that "although reward contingencies and natural consequences have always been an implicit feature of life, the difference today is that we now have a highly developed technology of rewards and a self-conscious use of rewards to harness human capital" (Ryan & Deci 2000:16). Athletes are rewarded for performing well, artists for excelling. Children are rewarded for doing well at school. We are even rewarded for spending money. These rewards are usually monetary, because money drives many people and it has been found to be the most effective method of providing extrinsic motivation.

Ryan, Mims and Koestner (1983:736), introduce the following terms to describe the different rewards contingencies: *task-noncontingent* rewards which are given for simply participating, but not engaging, in an activity; *task-contingent* rewards, which are given for completing an activity; and *performance-contingent* rewards which are given for doing well, matching a given standard of excellence, or meeting a specific set of criteria.

Tangible rewards, like grades, money and prizes, are often given in order to get people to do things they might not otherwise do. Even though these type of rewards are effective for providing extrinsic motivation, it was found that they have a very negative effect on intrinsic motivation, especially in children. Ryan and Deci (2000:25) conclude that:

> *"There is great concern about children's motivation for schoolwork, as well as for other behaviours such as sports, art, and prosocial activities. Using rewards to motivate children may indeed control their behaviour in some immediate sense, but these findings suggest that they are likely to have negative consequences in terms of the children's subsequent interest, persistence, and preferences for challenge."*

These children go to school and to higher education still expecting extrinsic rewards, and ever better extrinsic rewards, which makes it increasingly difficult for educators to keep them motivated to participate in learning activities.

The giving of performance-contingent rewards can have a positive effect, if the rewards are interpreted as an affirmation of competence, but has a negative effect if the rewards are seen as controlling. The administration of grades, another example of performance-contingent rewards, can have a highly harmful effect on both self-motivation and the quality of learning. Harackiewicz, Manderlink and Sansone (1984:293) demonstrated that participants, who were told that they would be evaluated, showed significant less intrinsic motivation after having been given positive feedback after the evaluation than those who were not told that they would be evaluated, but were given the same positive feedback.

Sansone and Harackiewicz (2000:444) conclude that there is general consensus that rewards can have different effects on intrinsic motivation and performance. These reward effects "depend on the nature of the activity, the reward contingency, the feedback obtained, the more general context for reward administration, and the people offering and receiving the reward."

A study was conducted in which three different types of feedback were given to three different groups of students. The first type of feedback consisted of marks/grades, the second consisted of comments and the third consisted of a combination of marks/grades and comments. The study indicated that the group who received comments only (no marks/grades) performed better in examinations than the other two groups, who showed very little or no gains. The group who received positive comments and grades ignored the comments and only concentrated on the grades (Clarke & Fisher, 2005:69). Positive feedback encourages and enables learners to improve. Clarke and Fisher (2005:69) mention that "many studies have shown that work marked by 'comment-only', with grades given only at the end of units, increases motivation and achievement."

A number of studies indicated that the use of technology can enhance students' motivation in the learning process. Chang and Lehman (2002:95) found that appropriately designed instructional material had a positive influence on students' learning, but that the combination of the instructional material and a higher level of intrinsic motivation benefited students' learning the most.

In a study that was conducted by Harper (2009), written feedback was compared to digitised oral feedback. The results indicated that digitised oral feedback had a more constructive influence on student autonomy and intrinsic motivation than written feedback (Harper, 2009:4). The researcher states that "the use of these technologies contributed to increased perceptions of competence, intrinsic motivation, autonomy while promoting pro-achievement behaviors like regular attendance, careful reading and engaged learning that will increase the likelihood of academic success" (Harper, 2009:7).

As has been seen in activity theory, the objective or motivation of any activity is crucial to the success of any activity. The above section on motivation is limited in its coverage of the whole motivational debate and was included in order to give the reader a picture of the sheer complexity of the issues relating to motivation. The fact that one of the learning design theories discussed in the next section is based largely on the theory of motivation, should give an indication of the importance of this factor when designing lessons.

The next section discusses a selection of design models that are currently used in the design of learning activities.

2.10 Design models

As stated earlier, Gagné developed a set of events of instruction following an instructivist approach and Laurillard followed later with the conversational framework which favoured a constructivist approach, because she believed that Gagné is too rigid in his approach. The ELSYE approach combines both instructivism and constructivism into one design. The ARCS model of Motivational Design can also be used, following either pedagogical approach, instructivist or constructivist. These models will now be discussed in more detail.

2.10.1 Gagné's events of instruction

Instructivism as a pedagogical approach was discussed in section 2.7.1. The rationale for instructional design proposed by Gagné and others (2005) relates to the conditions under which learning occurs. These conditions can be both internal and external and are also dependent on the desired learning outcomes. This approach results in the following design model, which lists the events of instruction and their relation to learning processes, as described by Gagné and others (2005).

TABLE 2.3: EVENTS OF INSTRUCTION

Instructional event	**Relation to Learning process**
Gaining attention	Reception of patterns of neural impulses
Informing the learner of the objective	Activating a process of executive control
Stimulating recall of prerequisite learned capabilities	Retrieval of prior learning to working memory.
Presenting the stimulus material	Emphasizing features for selective perception
Providing learning guidance	Semantic encoding: cues for retrieval
Eliciting performance	Activating response organization
Providing feedback about performance correctness	Establishing reinforcement
Assessing the performance	Activating retrieval; making reinforcement possible
Enhancing retention and transfer	Providing cues and strategies for retrieval

Source: Gagné *et al*., 2005:195

Instruction takes place in a certain sequence and the rationale for this sequence was discussed in section 2.7.1. Gagné and others (2005:195) believe that these events should serve as guidelines. They do not all necessarily have to be present in a lesson, and the order in which they occur may vary. The authors also differentiate between instructional activities (i.e. what the instructor does) and learning activities (i.e. what the learners will do).

Designers often favour either the constructivist approach or the instructivist approach, while completely rejecting the other. While Gagné and his co-authors do not reject either perspective, they focus on an instructivist approach, because they believe that learning is best done when learning objectives are stated before designing learning activities. When a constructivist approach is followed, the learner can often set the goals and directions of learning, which results in a less linear process (Gagné *et al*., 2005:133).

2.10.2 Laurillard's conversational framework

According to Laurillard, teachers should regard the teaching process as a complicated and difficult process, but that it is iterative and there is always scope for improvement. Teaching should be seen as a design science and cannot be theorised like a natural science (Laurillard, 2012:82). She further declares that there is a "gulf of uncertainty between knowing what it takes to learn and knowing what it takes to teach, and the educational design world has not yet bridged it" (Laurillard, 2012:82). This is further complicated by the addition of technologies to the educational process. Teachers and lecturers should learn how to use technology more effectively in the classroom, but they need a lot more support if they want to do it successfully (Laurillard, 2012:84).

Laurillard (2012:67), and Entwistle and Smith (2002:322) found that there is a plethora of learning theories and learning designs, some of which are very unrealistic and some which contradict each other in what they advocate. Lecturers do not always know which route to take. In response to this, Laurillard developed the conversational framework:

> *"to represent, as simply as possible, the different kinds of roles played by teachers and learners in terms of the requirements derived from conceptual learning, experiential learning, social constructivism, constructionism, and collaborative learning, and the corresponding principles of designing teaching and learning activities in the instructional design literature" (Laurillard, 2012:93).*

The following figure is a representation of the Conversational Framework as designed by Laurillard.

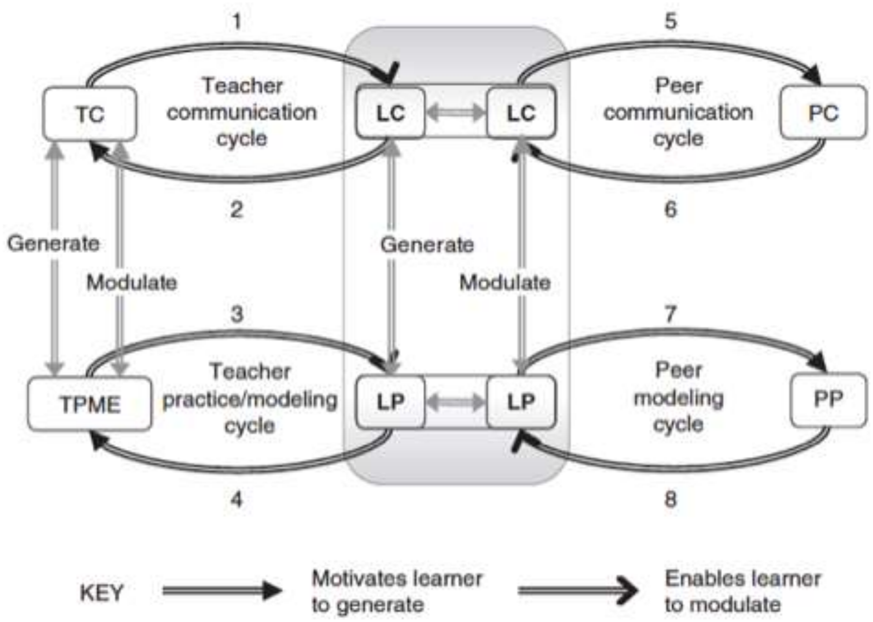

FIGURE 2.2: CONVERSATIONAL FRAMEWORK
SOURCE: LAURILLARD 2012:92

The representation shows the different iterations in the internal learning cycle as initiated by the teacher and the learners. A short explanation of each follows:

The teacher communication cycle (TCC)

(1) The learner is given access to the teacher's concept thereby allowing them to modulate their own concept. **(2, 1)** the learner is motivated to build on this concept, because of extrinsic feedback provided by the teacher.

The teacher practice cycle (TPC)

(4, 1) the learner is motivated to modify his or her practice by generating actions that result in extrinsic feedback from the teacher.

The teacher modelling cycle (TMC)

(4, 3) the learner is motivated to modify his or her practice by generating actions that result in intrinsic feedback from the modelling environment.

The peer communication cycle (PCC)

(6) a learner is given access to a peer's concepts, thereby enabling the learner to modify his or her own concepts. **(5, 6)** Due to extrinsic feedback given by peers, a learner can generate his or her own articulations.

The peer modelling cycle (PMC)

(4, 7) a learner is motivated to share their practice. **(8)** a learner can modify their own practice by using the model of a peer's output.

Therefore, a teacher's design aims to motivate or enable the learner, to generate articulations and actions, in order to modify concepts and practice.

Different combinations of these design elements can be used as part of a teaching-learning activity, but as many design elements as possible should be used to motivate the iterative internal learning cycle (Laurillard, 2012:94).

Laurillard (2012:96) lists a number of common teaching-learning activities, including learning through acquisition, inquiry, practice, production, discussion, and collaboration. The first four types describe individual learning, while social learning is described by discussion and collaboration. Several different technologies can be used for each of these activities. For example, acquisition can be completed via reading multimedia, websites or watching videos, while practice can be facilitated with the aid of simulations, online role-play and virtual labs.

A study of the use of audience response technology conducted by Cutts and others (2004) show how this dialogue between teacher and learner can also be enabled in large classes. Using audience response technology in a large classroom enables learners to articulate their own concepts, get access to peers' concepts and modify their own concepts based on their peers' concepts and feedback by the lecturer.

2.10.3 ELSYE design model

Gilbert and Gale base their design model on Laurillard's conversational framework. They describe the system as follows. The teacher operates in the environment and receives feedback as a result of these operations. The student similarly operates in the environment and receives feedback as a result. They call the operating and feedback operations 'reflective' and 'adaptive' (Gilbert & Gale, 2008:35).

Four activities are identified by these authors, namely guidance by the educator, response by the learner, feedback by educator and lastly, response by the learner using the feedback given by the educator (Gilbert & Gale, 2008:35). They simplify this system into a system they call the *e-learning transaction*.

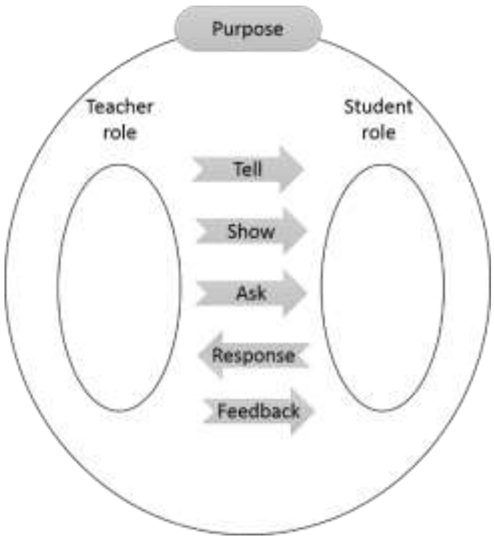

FIGURE 2.3: STRUCTURE OF AN E-LEARNING TRANSACTION
SOURCE: GILBERT & GALE, 2008:41

They describe this representation as a simplistic model which only captures the relevant features of a situation and they admit that a learning and teaching situation is far richer than depicted by the model. The *purpose* element of the model emphasises the point that the development of any learning material should be aligned with the overall purpose of a transaction. The second elements are the two roles which exist in any teaching and learning situation. The two roles are interchangeable and can be played by anyone at any given point during the transaction. The role of the teacher can, for example, be played by a peer. The five key exchanges in the transaction are tell, show, ask, response and feedback. They state that this simply emphasises that all these exchanges should ideally take place at some point in a learning and teaching situation, but that they do not necessarily have to occur in this order. They also propose an alternative situation, which they call the Socratic dialogue, where teaching and learning is initiated by the asking of a question as depicted in the following diagram.

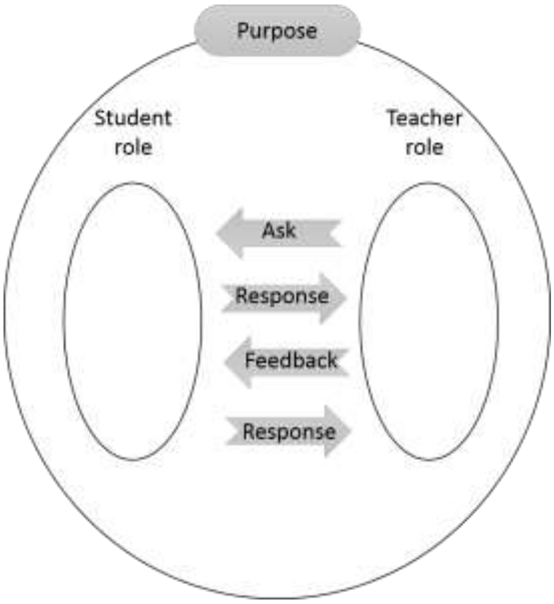

FIGURE 2.4: ALTERNATIVE REPRESENTATION OF AN E-LEARNING TRANSACTION
SOURCE: GILBERT & GALE, 2008:42

Each lesson is made up of a number of transactions, as depicted in the following diagram. Gilbert and Gale use Gagné's events of instructions to structure the lesson and the following diagram is a possible representation of how the transactions can be used during a lesson. Two events are added to Gagné's list of nine, the first of which is assessing prior learning to guide the learner through the lesson or to help the learner to follow his or her own route through the lesson. The second additional event is evaluating the lesson (Gilbert & Gale, 2008:51).

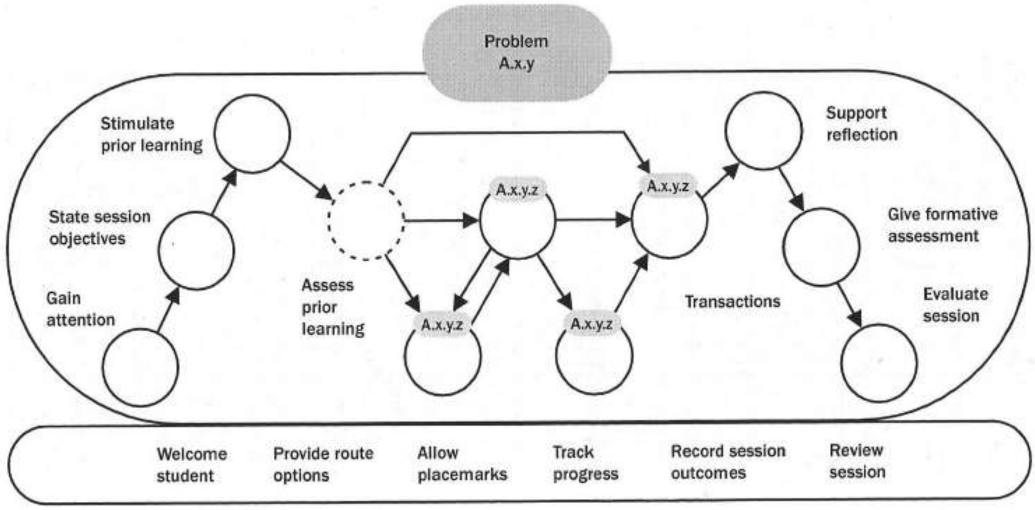

FIGURE 2.5: STRUCTURE OF A LEARNING AND TEACHING LESSON.
SOURCE: GILBERT & GALE, 2008:45

A lesson's purpose is to address 'problem A.x.y'. The various transactions, 'z', are small aspects of the lesson. Several of these transactions are therefore put together to form a lesson.

These events described by Gilbert and Gale refer to e-learning specifically, but can very easily be used as part of any audience response transaction in a face-to-face environment. During a face-to-face lesson the 'tell, show, ask, response and feedback' sequence usually has to be broken up into two lessons, where the 'tell, show, ask and response' steps take place during the first lesson and, once the responses have been marked (between lessons), the feedback step takes place during the second lesson. This can now become one event, with the immediate marking and summarizing of responses by the audience response technology, making immediate feedback possible. Therefore, an event of instruction can be completed before moving on to the next event of instruction. This diagram also shows that it is possible to use the audience response transaction during any of the events of instruction.

2.10.4 ARCS design model

The ARCS model has been used by a number of researchers to improve learner motivation in learning activities (Shellnut & Knowltion, 1999; Wongwiwatthananukit & Popovich, 2000; Hodges, 2004).

According to Wongwiwatthananukit and Popovich the model helps the educator to identify the components of instruction that are responsible for student motivation or demotivation and to develop motivational strategies which an educator can use make learning material interesting and which will cater for the students' needs (Wongwiwatthananukit & Popovich, 2000:190).

The ARCS model of motivational design provides "guidance in the form of a motivational design process; that is, it consists of a general model of design that is grounded in motivational theory but also incorporates systematic audience analysis based on the primary components of human motivation to diagnose specific motivational problems that exist in a given situation" (Keller, 2010:3). The four categories of the ARCS model are attention, relevance, confidence and satisfaction.

2.10.4.1 Attention

The first category relates to the stimulation and sustainment of students' curiosity and interest; in other words, how to grab a student's attention and keep it. This includes human characteristics such as the "orienting reflex, curiosity, and sensation seeking" (Keller, 2010:47). Specific kinds of activities are clustered into three groups, according to the role they fulfil, namely:

- Perceptual arousal: How to capture interest
- Inquiry arousal: How to stimulate an attitude of inquiry
- Variability: How to maintain attention (Keller, 2010:47)

Perceptual arousal refers to one's reaction to stimuli, e.g. an eye-catching headline or a humorous picture presented at the start of a lesson. This step is the first step in the attention process, but must soon be followed up by the next stage, with an activity stimulating inquiry arousal. This can be done by asking the students a thought provoking question, as part of an audience response exercise and displaying the answers on a screen, after which the question and answers can be discussed in groups. It is important to add variety to any lesson. If the same sequence is followed for every lesson, it becomes tedious and students lose interest. Instead of giving the audience response exercise at the start of every lesson, variability can be attained by doing it at the end of the lesson, on content covered during the lesson, and by changing the question into a poll. Displaying the results to the students and having a follow-up discussion as a homework exercise, will further stimulate an attitude of inquiry.

2.10.4.2 Relevance

A number of studies which incorporated the ARCS model identify the importance of the second element (Chang & Lehman, 2002; Wongwiwatthananukit & Popovich, 2000). A student will be motivated if he or she believes that the content is relevant. The content should therefore relate to the student's personal goals and motives. In the Wongwiwatthananukit and Popovich study, the lecturer shared the story of a former pharmacy student who was now a practising pharmacist. He demonstrated how the pharmacist applied the skills she learnt (as a student), in the real world where she was practising. (Wongwiwatthananukit & Popovich, 2000:192).

Keller defines three subcategories of relevance:

- Goal orientation: What are my students' needs and how can I meet them?
- Motive matching: How and when can my students be provided with appropriate choices, responsibilities and influences?
- Familiarity: How can the instruction be connected to the students' experience? (Keller, 2010:48)

Goal orientation includes the setting of goals and working towards achieving them. Goals can include gaining admission to university or getting a job or a promotion. Motive matching includes the understanding of the students' personal motive structures. Some students define goals and set standards for themselves and enjoy working on their own. They dislike group activities and perform best when working on their own. Other students enjoy collaboration and dialogue and perform well in groups. The lecturer should include activities that will motivate both types of student. Familiarity can be achieved by personalising text, for example using personal pronouns and people's names, or by using concrete examples familiar to the learner.

Goal orientation, when designing the question as part of an audience response activity, is also mirrored by Beatty and others (2006), who advocate that the question should be goal orientated and therefore relevant.

2.10.4.3 Confidence

Keller indicates that, even if students believe the content to be relevant and they are motivated to learn it, they "still might not be appropriately motivated due to too little or too much confidence, or expectancy for success" (Keller, 2010:45). They might for example be scared of learning Mathematics, which they perceive as a difficult subject or, if it is the first time that they are doing an online course, they might be scared of the unfamiliar environment. At the other extreme, they might believe that they already know the content and then overlook important learning activities. Therefore, the learning material and the learning environment should be designed in such a way that students will be convinced that they need to complete the activities and that they can learn successfully.

Keller (2010:50) divides the building of confidence into three categories:

- Learning requirements: How can positive expectations for success be built?
- Success opportunities: How can the learning experience support or enhance the students' beliefs in their competence?
- Personal control: How can personal control of the learning experience be given to the student?

Audience response questions should never be so difficult that learners never answer the question successfully. There is a fine line between challenging the learners to give their best and making questions so challenging that the learners can never succeed. The educator should always keep the above guidelines in mind when developing audience response activities.

2.10.4.4 Satisfaction

For continued motivation, students must experience feelings of satisfaction with both the learning process and with the results. Satisfaction can be derived from both intrinsic and extrinsic factors. Extrinsic factors are for example grades, certificates, and opportunities to advance to a next level. Intrinsic factors include experiencing accomplishments that enhance their feelings of self-esteem, experiencing positive interactions with other people, having their views heard and respected, and mastering challenges that enhance their feelings of competence (Keller, 2010:46).

The ARCS design model can follow either a constructivist or instructivist approach. It does not specify the sequence of learning, but focusses on motivational factors, which play a critical role in determining the success of any learning design.

Despite the fact that the ARCS model was developed before the boom of e-learning, Hodges (2004:6) believes that this model is still very relevant and can be used in any learning environment.

2.11 Summary of design models

This concludes the discussion on design models, which has presented a design model that advocates an exclusively instructivist approach, and another which advocates an exclusively constructivist approach. The ELSYE model demonstrates how it is possible to combine both of these approaches in the design of learning activities by following an integrated approach. The conversational framework highlights the importance of motivation, around which the entire ARCS model is centred, with its focus on developing learning material around the concept of motivation. Each of these models incorporates important features and considerations that can contribute to a comprehensive design model that can be used in the design of audience response activities. Gagné's events of instruction determines the sequence of the learning events. Laurillard's conversational framework introduces the constructivist elements, which includes the learner in the learning process and adds aspects of active learning, ensuring that the learner is not just a passive onlooker in the learning process. The ELSYE model provides a framework, combining instructivist and constructivist elements, which can be used as a foundation for the development of a learning design framework used as part of audience response activities. The ARCS model highlights the motivational aspects that should be taken into consideration when designing the audience response activity.

Different aspects of each of these models can therefore be used to develop a design model for the development of audience response activities. However, the process of development is equally important and should be well structured. The next section provides an analysis of four process models and determines the strengths and weaknesses of each, as well as which aspects can be used in the design of audience response activities.

2.12 Process models

ADDIE is the most popular process model, used by a large number of private instructional design companies and other institutions. It is also used by Gagné and others in their book *Principles of Instructional Design* (Fifth Edition). The Integrated Learning Design Framework for Online Learning is the preferred process model used by the Centre for Learning Technologies at Stellenbosch University and is therefore also included in this discussion. The e-learning systems engineering process model is described here as well, because it is the most comprehensive model to date, including project management and quality management. Lastly, the ARCS model for Motivational Design is also included in this section, because this model focuses on designing for motivation, which, as has been seen in the previous section, plays a vital role in determining whether or not learning activities are successful.

2.12.1 ADDIE

ADDIE is an acronym that refers to the steps that comprise a generic process model: analysis, design, development, implementation, and evaluation. The tendency amongst researchers and designers appears to be that they accept ADDIE as an umbrella term and then create their own models and descriptions. Molenda (2003:36) stresses the point that, in reality, authors who do this are essentially creating their own models, "as there does not appear to be an original, authoritative version of the ADDIE model to be revealed and interpreted".

This finding is quite interesting, considering the fact that ADDIE seems to be the most widely used model in learning design. The question then arises: when someone claims to be using the ADDIE model, whose principles and procedures are they actually using to guide their design process?

Since Gagné can be considered a trustworthy source, I add a summary of the ADDIE model as provided in the book *Principles of Instructional Design* (Fifth Edition). Gagné and others (2005:21) recognise that there are different interpretations of each of the five components of the ADDIE model. They also concede that the model is not always followed in a linear fashion and that much depends on the circumstances. The redesign of a course might, for example, start with the evaluation of existing course material and not with the analysis phase (Gagné *et al*., 2005:22). The following table is their interpretation of the model.

TABLE 2.4: COMPONENTS AND SUBCOMPONENTS OF THE ADDIE MODEL

Analysis
• First determine the needs for which instruction is the solution. • Conduct an instructional analysis to determine the target cognitive, affective, and motor skill goals for the course. • Determine what skills the entering students are expected to have, and which will impact learning in the course. • Analyze the time available and how much might be accomplished in that period of time. Some authors also recommend a context or resource analysis.
Design
• Translate course goals into performance outcomes, and major course objectives (unit objectives). • Determine the instructional topics or units to be covered, and how much time will be spent on each. • Sequence the units with regard to the course objectives. • Flesh out the unit of instruction, identifying the major objectives to be achieved during each unit. • Define lessons and learning activities for each unit. • Develop specifications for assessment of what students have learned.
Development
• Make decisions regarding the types of learning activities and materials. • Prepare draft materials and/or activities. • Try out materials and activities with target audience members. • Revise, refine, and produce materials and activities. • Produce teacher training or adjunct materials.
Implementation
• Market materials for adoption by teachers or students. • Provide help or support as needed.
Evaluation
• Implement plans for student evaluation. • Implement plans for program evaluation. • Implement plans for course maintenance and revision.

Source: Gagné *et al*., 2005:22

As has been stated earlier, the ADDIE model is a generic model, which is most often used by learning designers. However, it is important that when one claims to be using ADDIE, then one should clearly define what is understood with regard to each component. However, ADDIE outlines the different phases of any design process and the following paragraphs demonstrate how the different phases described in the table can be used in the development of audience response activities.

During the analysis phase, the educator or designer determines the needs for which the instruction is the solution. Cognitive, affective, and motor skill goals for the course are determined. The current skills level of the learners and the time allocated to each unit are established.

What is important in the design of audience response activities, is the analysis of the need for the introduction of the audience response activity. At this stage the educator should already have determined the aspect of his teaching which will be enhanced by the audience response activity. During the analysis phase, this should be further defined and specified. It is also important that the educator takes into consideration the learners' level of technological competence. The first time that the educator introduces the audience response activity, the educator must realise that some time will be wasted on teaching the learners how to use the audience response technology.

During the design phase, the outcomes and course objectives are formulated. Then the topics and units are defined and time is allocated to each. The major objectives to be achieved in each unit are identified, together with lesson activities. Specifications for assessment are also developed at this point.

Pertaining to audience response activities, the question-answer sequence will be designed during this stage. It should be aligned to the course objectives and very importantly, the educator should determine how the aggregated feedback, produced by the system, will be managed and incorporated into the lesson. The educator will also determine whether the presentation of feedback to the learners will be followed by peer or group discussions.

The design phase is followed by the development phase, during which the lesson material and activities are developed, together with training material. The lesson material is then implemented and followed by an evaluation phase.

The audience response activity will now be developed on the available software and thoroughly tested. This is followed by the implementation and evaluation phase.

ADDIE presents the essential steps that should be followed in the design process. However, ADDIE advocates a linear process, which as Dabbagh and Bannan-Ritland (2005) suggest, is not necessarily the ideal model for the development of learning material. It advocates the design of a complete lesson, implying that all contradictions should be anticipated during the analysis phase. When introducing new technology as part of teaching and learning, this is not possible. A gradual process should be followed when developing learning activities involving the integration of new technology. Minor components should be introduced first and then progressively improved until an effective, comprehensive, fully integrated version has been developed. This is accomplished by means of the development of prototypes, therefore developing a small scale version of the final product as a sample, on which the final product will be based. The prototype provides specifications for the final product.

2.12.2 ELSYE process model

In their book *Principles of E-Learning Systems Engineering*, Gilbert and Gale describe their four steps; analyse, plan, implement and evaluate "as a very common generic approach to the management and control of any project" and a good model of procedures for the development of learning and teaching materials (Gilbert & Gale, 2008:11). They call this model *e-learning systems engineering* or ELSYE.

The ELSYE's approach to the development of learning and teaching material is underpinned by a systems or systemic approach, based on the *waterfall model* as it is known in the software engineering field.

The next figure is an outline of the ELSYE process model:

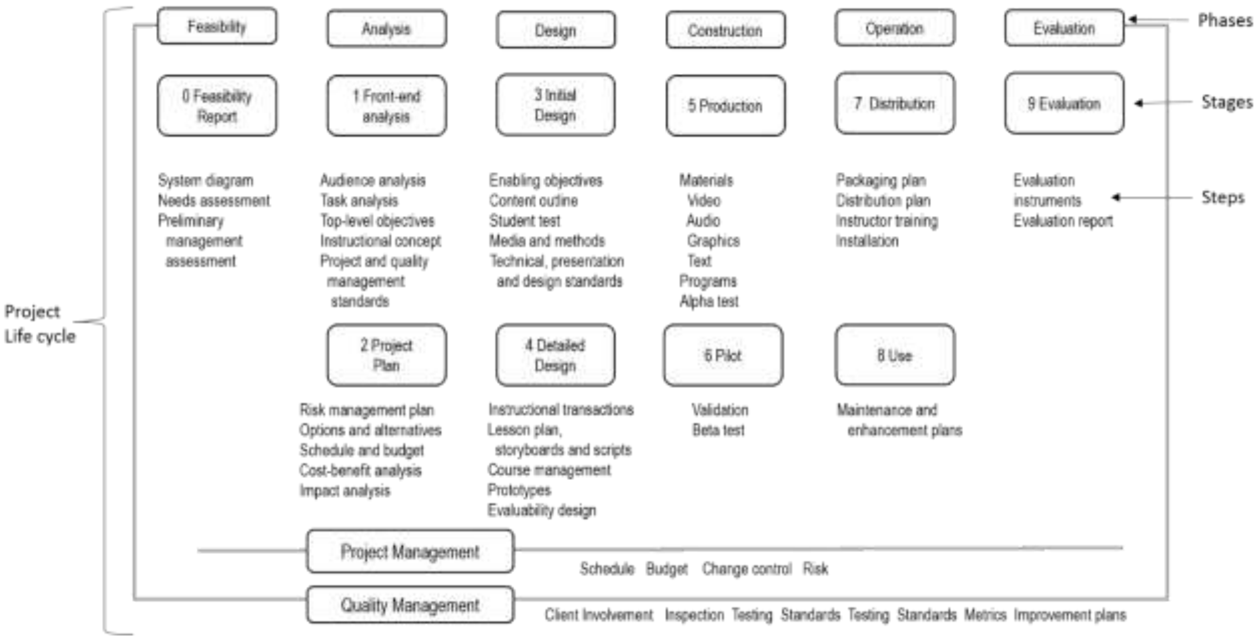

FIGURE 2.6: ELSYE PROJECT LIFE CYCLE
SOURCE: GILBERT & GALE, 2008:22

The generic project management approach, which involves the four steps analyse, plan, implement and evaluate, forms the basis of the ELSYE process model. In this model, the generic approach is broken down into analysis, design, construction, operation and evaluation. A preceding component is added, namely the feasibility component. The feasibility phase establishes the requirements for e-learning and whether or not the project will meet the needs of the learner and the customer. In this phase, consideration is given to the financial and organisational constraints of the project (Gilbert & Gale, 2008:14).

Lastly, a project management phase and a quality management phase are added to complete the model. Both span the whole cycle, with quality management embracing the entire project. The ELSYE model is similar to existing process models, but is also very similar to the process models used in the systems analysis and design of information systems. "This similarity serves to inform the practice of ELSYE with the experience and best practice of one of the largest international industries currently operating in the world, that of information technology and systems development" (Gilbert & Gale, 2008:15).

The ELSYE project life cycle consists of six technical phases. Within these phases there are ten technical stages, and each of the stages involves a number of steps. The phases and stages represent the processes of development, and the steps represent the products resulting from development.

As has been stated in the section on ADDIE, a number of problems can occur with the use of a linear model such as ELSYE. If the final product is rolled out for the first time and users experience difficulties, it may lead to negativity and resistance. Requirements may change during the process of development. As the project progresses users may change their requirements and alter their expectations of what is achievable. A linear module does not allow for effective feedback during stages, but only for feedback at the end of the project cycle. Early errors are expensive to correct and may lead to complete redevelopment. ELSYE proposes the development of prototypes or simulations to resolve this issue (Gilbert & Gale, 2008:207).

Gilbert and Gale also point out that some small scale projects (e.g. if a lecturer wants to add an technological component, like online blogging, to a blended learning course), will, for example, not require a feasibility report or complete project plan, but for a full-scale e-learning course, extensive planning and documentation will be needed.

As mentioned previously, this is a very comprehensive model, applicable in both the development of large scale projects and the development or enhancement of small projects. The lack of proper project and quality management often leads to the failed implementation of projects. This is also true when new technology is introduced as part of teaching and learning. Even though this study does not focus on the project management aspects of the introduction of new technology, because the focus is on teaching and learning, it is important to keep this aspect of processing modeling in mind; this issue is worthy of a complete study on its own.

What is important about the ELSYE model is the inclusion of a feasibility phase. Before attempting to introduce an audience response activity, it is important that the educator completes a feasibility study. No two situations are the same. Educators' personalities differ, the disciplines differ, different venues are used, age group and readiness of learners vary, and so on. What works for one educator, might not work for another. It is therefore very important that each educator completes a feasibility study, before attempting to introduce an audience response activity. This is discussed in more detail in Chapter six.

The ELSYE model also introduces the design of protoypes, even though it is not part of the core model. The design of prototypes is not possible, when using a linear model. The model used needs to display the recursive nature of the process, when a prototype is developed and tested.

2.12.3 ILDF for online learning

Dabbagh and Bannan-Ritland (2005:113) found that "traditional instructional system design models that include analysis, design, development, implementation and evaluation stages are difficult to implement because they are too linear, formal and inflexible". According to them, using a rigid, inflexible process can add to the complexity of the design and development process. Their solution was to develop "a more flexible, adaptable process of design and development that emphasizes the specific social and cultural contexts of learning and design" (Dabbagh & Bannan-Ritland, 2005:113). Although they say that their model favours a constructivist approach, the authors actually base their model, the Integrated Learning Design Framework for Online Learning on existing behaviourist, linear models of instructional design (Dabbagh & Bannan-Ritland, 2005:113).

Dabbagh and Bannan-Ritland (2005:113) claim that traditional instructional system design models are difficult to use in both corporate and school-based settings. According to the authors, these models are too linear and inflexible to be used in online learning environments which are governed by too many different and ever changing variables, e.g. technological tools, content and high-level problem solving, required by the developer. They claim that these inflexible processes add to the design and development complexity. The authors also postulate that other models do not give consideration to the need for expertise, prior knowledge and intuitive understanding of teaching and learning, nor the developer's beliefs and insights. They therefore encourage developers to select design models which are based on constructivist learning models that are iterative in nature.

This framework is specifically used to develop courses for online learning, but it is also used in a blended learning environment. At the time of writing, this framework was advocated by the Centre for Learning Technologies at Stellenbosch University as the framework of choice as part of the blended learning course given to lecturers, when integrating technology into face-to-face learning environments.

Even though the ILDF for Online Learning focuses primarily on constructivist learning models, the basic core of the model is still based on "time-tested processes from behaviourist models of instructional design that rely on systematic and iterative design methods" (Dabbagh & Bannan-Ritland, 2005:113).

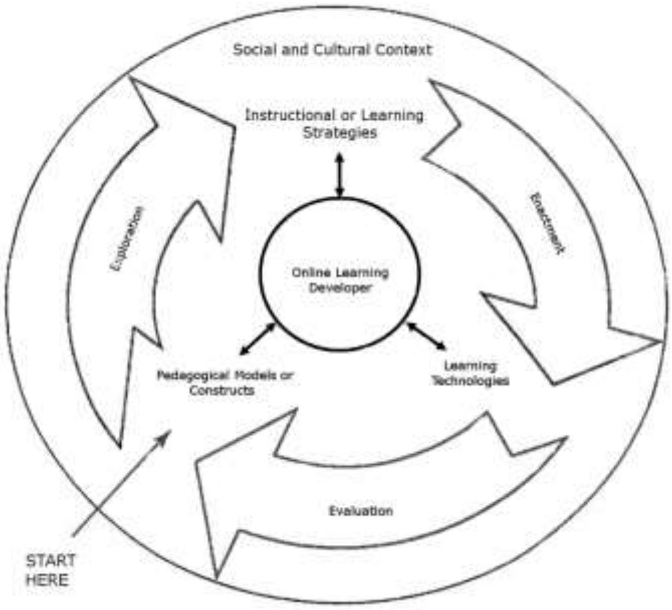

FIGURE 2.7: THE INTEGRATIVE LEARNING DESIGN FRAMEWORK FOR ONLINE LEARNING
SOURCE: DABBAGH & BANNAN-RITLAND, 2005:116

The model consists of three phases, namely exploration, enactment and evaluation. During the exploration phase, the learning developer must gather and document information about the instructional context. This information must include published perspectives on the learning process, content and delivery method (Dabbagh & Bannan-Ritland, 2005:121). This phase is similar to the analysis phase of the generic instructional design process model.

During the enactment phase, the developer maps this information to pedagogical models. Instructional strategies are selected and aligned with the features of the available technological delivery systems (Dabbagh & Bannan-Ritland, 2005:136). This phase is therefore analogous to the design and development phases.

During the evaluation phase, the purpose, desired results and methods of evaluation of online learning are determined. This phase also includes formative evaluation, conducted prior to launching the online course. The materials are revised according to the results of the formative evaluation and the course materials are implemented and evaluated according to identified goals (Dabbagh & Bannan-Ritland, 2005:146). This phase combines the implementation and evaluation phase.

According to Dabbagh and Bannan-Ritland (2005:112), using iterative cycles in the design process is one of the best ways to improve the effectiveness of instruction and increase the developer's knowledge. The circular representation of the model depicts the iterative process, starting with the exploration phase again. At the centre of the model there is a depiction of the interaction between the developer and the three components: pedagogical models, instructional strategies and learning technologies. The framework frames the design process in a social and cultural context, which is seen as the specific context in which the tools, philosophies, and support staff are available (or unavailable) to the developer.

As explained in the above paragraphs and also stated by Dabbagh and Bannan-Ritland, this framework is based on the generic design process model (Dabbagh & Bannan-Ritland, 2005:113). What makes it different to other models is the emphasis placed on the exploration and research phases.

This model does not contribute much to process models as such. The fact that it is drawn into a circular diagram, does not change the fact that it is effectively still linear. The fact that so much emphasis is placed on the research component overcomplicates the design process and does not make it a viable design model to be used by educators, who have limited time to prepare lesson material.

Even though this model advocates the concept of iterative design cycles, this is not new. All process models are iterative by default. The problem with iterative cycles as also pointed out by Gilbert & Gale (2008), is that this expects a designer to design a complete lesson and if problems are experienced early on during the lesson, it might lead to negativity and resistance, as was also found in this study. (See Chapter five).

None of these models takes the role of motivation into account as part of the design process. This chapter has already demonstrated the significance of the role of motivation. This aspect is underwritten by the ARCS model for motivational design, which is discussed in the next section.

2.12.4 ARCS process model

The underlying principle that drives this process model is that of motivation. It is vital that the process of designing for active learning includes due consideration to motivation. The ARCS design process is built around the four categories of motivation as presented in Table 2.5.

TABLE 2.5: MOTIVATIONAL DESIGN IN RELATION TO INSTRUCTIONAL DESIGN

Generic Design	Motivational Design Steps	Instructional Design Steps
Analyze	Obtain course information Obtain audience information Analyze audience Analyze existing materials	Identifying problem for which instruction is the appropriate solution Identifying instructional goals Identifying entry behaviours, characteristics Conducting instructional analysis
Design	List objectives and assessments List potential tactics Select and design tactics Integrate with instruction	Writing performance objectives Developing criterion-references tests Developing instructional strategy
Develop	Select and develop materials	Developing and selecting instruction
Pilot Test	Evaluate and revise	Designing and conducting formative evaluation Designing and conducting summative evaluation Revising instruction

Source: Keller, 2010:194

As can be seen from the table, this process model also follows the linear generic process framework, but it includes motivational design steps during each phase.

The third column of this table depicts the steps that should be taken during each phase, which are similar to those of ADDIE. The second column specifies these steps in relation to motivation. Information is gathered that will eventually be used as part of the design model.

During the analysis phase, the event that you want to enhance by addressing motivation, the learning goals, and characteristics of the students are identified and analysed. Events that require motivation will be identified and analysed. During the design phase objectives for the motivational design plan will be prepared and methods to determine success will be identified (i.e. assessments to verify that the motivational objectives have been achieved). Motivational activities are selected for use in each of the following areas: attention, relevance, confidence and satisfaction. These activities are then integrated into the design model. During the development phase, new material is developed or existing material is enhanced to facilitate the inclusion of the motivational activities. The final phase includes the implementation and evaluation of the learning material.

This model is the only model that looks at motivation, which is an important feature not included in other process models. When designing audience response activities, it is also important that the design of the activity looks at motivational factors.

2.13 The role of prototypes

As stated earlier, all models, including linear models, are iterative by default. The design process of a linear model entails the design of a complete lesson. Linear process modelling is identified as problematic by both Dabbagh and Bannan-Ritland (2005) and Gilbert and Gale (2008). Gilbert and Gale (2008) provide a viable solution to this, by introducing the concept of the development of prototypes. The concept of prototyping is best illustrated by a spiral model, starting with the development of a basic, but small prototype, e.g. introducing an audience response activity, containing only one question during the first cycle. The second cycle will include a question and a peer discussion afterwards, and so on. This makes it possible to identify problems early on and rectifying them.

When introducing audience response activities, it is important that the educator and the learners are given time to adjust, not only to the introduction of the new technology, but also to the new lesson design. Developing continuously improved prototypes introduces the concept of a spiral process model, as opposed to a linear process model. This is discussed in more detail in Chapter six.

2.14 Conclusion

This chapter started with a discussion of the integration of audience response technology as part of teaching and learning. Three different design models, currently used as part of audience response technology, were discussed, and the strengths and weaknesses of each were presented.

What transpired was that the peer instruction method still focusses on the traditional teaching method of explaining the content first and then introducing the questions. This means that students only become actively involved in the latter part of the lesson. This was also noted during the class observation of the Chemistry module. Some of the students were not paying attention at all during the first 20 minutes and only became actively involved when the audience response questions were introduced (see section 5.5).

Both the question-driven instruction method and TEFA change this paradigm by introducing questions from the beginning of the lesson. However, both advocate a constructivist approach and, in so doing, I believe that they portray a narrow-minded view of the affordances that audience response technology offers for the improvement of teaching and learning. It is also possible to use audience responsive activities effectively in an *instructivist* environment, as part of active learning. For example, a lecturer may wish to test pre-class reading or provide a cue to enable the students to retrieve information from long-term memory. These are both examples of instructivist activities, which were discussed in more detail in section 2.7.1.

None of the design models presented here include the actual *design process*. If an educator, who is accustomed to using traditional teaching methods, attempts to integrate audience response activities in his or her lesson design without thorough planning, it is likely to be unsuccessful, as illustrated in Chapter five. Integrating any kind of new technology into learning is a relatively complex process. Both educator and learners need time to adjust to the technology. Ideally an educator should begin with small changes and gradually work towards the transformation. This can only be done with careful planning of the learning activities.

As indicated in Chapter one of this study, the third and fourth principles of Chickering and Gamson's principles for good practice in undergraduate education are the encouragement of active learning and giving prompt feedback (Chickering & Gamson, 1991:140). This chapter attempted to explain active learning in the context of lessons involving the use of audience response technology in the classroom and looked at important factors required to ensure the effective implementation of active learning.

The important factor about active learning, which distinguishes it from active participation, is that active learning involves a cognitive process. It is more than just pressing a button of an audience response device. Answering a question gives the learner the opportunity to think, analyse or evaluate. This cognitive process is however not completed unless the learner can substantiate the answer given, by verbalising it as part of peer discussions, for example, and unless he/she is given feedback on whether the thought process was correct. This feedback can come from a peer, but should ultimately be substantiated by the educator. Only then can the active learning process be considered complete.

Therefore, active learning includes effective feedback. This chapter included a discussion on the characteristics of effective feedback, one of the most important of which is that it should be as immediate as possible. The immediate aggregated feedback provided by audience response systems therefore makes it the ideal tool to use. Another aspect about thorough feedback, which goes beyond grading, is the role it may play in providing motivation to encourage learner participation in the learning process. The important role that motivation plays as part of any activity has already been established, a role that is also emphasised by activity theory.

The learning theory or pedagogical approach in itself does not necessarily determine the quality of the educational experience (Jaffer, 2010:283), but the learning developer should have an understanding of the pedagogical approach underlining the design of the lessons and should be able to link theory to practice (Dabbagh, 2005:40). Similar to this concept, it is important to keep in mind that technology does not in itself help students to learn better, but should be based on effective pedagogical practices (Chang & Lehman, 2002:96). Pedagogical approaches were discussed and it was found feasible to integrate both instructivism and constructivism in an integrated approach. It was suggested that this pedagogical approach offers the best foundation for the development of a learning design model for the development of audience response activities.

Even though instructivism is regarded as obsolete and outdated by many educators, this approach does define the learning process, which was modelled by Gagné into a sequence of learning events. These learning events are still relevant even though this approach does not, for the most part, encourage active participation by learners. On the other hand, constructivism focusses on the learner and encourages active participation, but it expects the learner to direct the learning process. This is seldom viable in educational institutions. It is however possible to take the best of both worlds and combine it into one practice. This will be discussed in Chapter six.

The concept of motivation was also discussed and its importance in the educational context was established. Instructivism focuses on providing external motivation e.g. in the form of grades. Constructivism focuses on internal motivation, and postulates that an internally motivated learner will drive the learning process. Therefore, constructivist learning practices can only be successful if learners are motivated. So what happens if a learner is not internally motivated? It was seen in this chapter that the whole notion of motivation is very complicated and that it is sometimes necessary to add external motivation in the learning process, with the hope that it will lead to internal motivation. This strengthens the idea of following a combined instructivist-constructivist approach.

Gagné and others emphasise the fact that learning design expertise and subject-matter competence are two different things and, even though it is possible for one person to play both roles, the knowledge of content does not imply knowledge of effective learning design (Gagné, *et al*., 2005:26). This concept is mirrored in the TPACK framework, where the knowledge of effective design is seen as a combination of content, pedagogy and technology, which together form Technological Pedagogical Content Knowledge. Without thorough knowledge of design, which includes process modelling and learning design, it is not possible to design quality learning material.

Process modelling was also discussed and it was found that current models still advocate a linear process, even though linear modelling has been found wanting. The concept of prototyping was introduced and this, together with the concept of spiral modelling (as opposed to linear modelling), will be integrated into the proposed process model discussed in Chapter six.

Before embarking on the design or redesign of a course, it is important to understand the affordance of the available technology. One should know, before starting the design process, whether the type of activities possible with the said system can resolve the objectives that one is trying achieve. The completion of a feasibility study is a crucial exercise that should always be included before attempting the introduction of new technology.

In this chapter, I have discussed only a few design models, but there are many other models proposed by researchers (Gorsky & Caspi, 2005; Bower, Hedberg & Kuswara, 2010; MacLean & Schott, 2011; Yusop & Correia, 2012). It seems that there is trend amongst researchers to develop new models rather than to use existing ones.

In spite of all these available design models, researchers still notice that the focus in attempts to integrate technology in education is still generally on the technology (Tamrakar, 2008; Bower *et al*., 2010; Dabbagh, 2010; Bozalek, Ng'ambi, Wood, Herrington, Hardman & Amory, 2015), and not on pedagogy. So that poses the question: If there are so many models available, then why are they not being used? I do not have a definite answer to this question, but if one looks at the number of researchers who complain about the lack of pedagogical support (Graham, *et al*., 2007), (Barnett, 2006), and (Campbell & Monk, 2015), then the reason might be that these models are simply not taught to educators.

The different lesson designs of five lecturers who integrated the use of audience response activities were examined as part of this study using activity theory. Activity theory allows for the analysis of human behaviour as a collective and individual process. Taking the activity as the unit of analysis provides a hierarchical structure and framework for examining activity systems (Allen, Karanasios & Slavova, 2011:781).

The next chapter explores activity theory and the application as part of audience response activities.

Chapter 3
Activity Theory

3.1 Introduction

In the case studies that form part of this study different levels of success were achieved with the integration of the audience response activities. Even when the activities were seemingly successful, one was still left with the notion that the introduction of audience response activities did not really improve the learning experience, but it was difficult to pinpoint the exact reasons. It was necessary to analyse the audience response activities in order to determine the design of each activity and attempt to establish which factors contributed to the success or failure of the activities.

Cultural-historical activity theory (activity theory, in short) provides a theoretical lens through which to analyse the context and facilitation of any given activity. Specifically, activity theory may be used as a descriptive tool to understand the audience response activity as a complex activity system, as well as the artefact used and the subjects involved, i.e. the lecturers and students, their social environments, motivation and goals. Activity theory is also used as a means of theoretically conceptualising the underlying contradictions that resulted because of the disparity between the lecturer's original aims and final outcome of the activity. A detailed overview of activity theory will now be given.

3.2 History of activity theory

Activity theory, or cultural-historical activity theory (CHAT) had its origins in the Soviet Union. It served as an alternative to the reigning foundational psychology of behaviourism and psychoanalysis. Important names that are associated with the development of cultural-historical activity theory are Lev Vygotsky (1896-1934), Sergei Leonidovich Rubinstein (1889-1960), Alexander Luria (1902-1977) and Alexei Leontiev[3] (1904-1979).

Vygotsky is considered the father of cultural-historical psychology. Luria and Leontiev were two of his followers, who also later became his co-workers. Luria remained a

[3] Leontiev is spelt differently in the various consulted sources. Some spell it as Leontiev or Leontév, or Leont'ev. For the sake of uniformity, Leontiev will be used in this study, except when used as part of a direct quote.

supporter of Vygotsky's ideas on the concept of the cultural-historical context of human behaviour, but Leontiev later reacted against Vygotsky's work and was then mainly responsible for devising the theoretical basis for the development of the activity theory. The theory therefore originated in Russia, but separated into several strands from there.

Activity theory was introduced in the West between 1960 and 1970. Academics like Urie Bronfenbrenner, Jerome Bruner, and Michael Cole took the theory to America. A number of activists from Italy, Germany, the Netherlands, and Japan went to Russia to study with Luria, Leontiev and other colleagues. The works of Leontiev, Luria, and others were translated into German and these translations were studied in the West. At this time, some of the Nordic countries also became involved (Sannino, Daniels & Gutiérrez, 2009:10).

Once of the Nordic researchers who has become a very influential activity theorist is Yrjö Engeström. His work went through different cycles, starting in the 1960s and escalating to the "formation of activity-theoretical communities aimed at changing societal practices" (Sannino *et al*., 2009:10). Engeström is currently a professor of Adult Education and the director of the Center for Activity Theory and Developmental Work Research, at the University of Helsinki, where he addresses societal issues and learning in work activities (Sannino *et al*, 2009:15).

Activity theory aims to understand human beings, as well as their surrounding environments, by examining and analysing their activities. This includes the analysis of where activities originate, how they are constructed and how they are completed. The development of activity theory occurred in three phases or generations. Each generation saw a further expansion of the model of the previous generation.

The first generation of activity theory is based on Vygotsky's concept of mediation. It brings together the use of tools by the subject in order to achieve a certain object, which leads to an outcome (see Figure 3.1). This model focuses on individuals or a single group. Tools can include language, speaking, gestures, music or physical tools like machines, or guns, or a hammer.

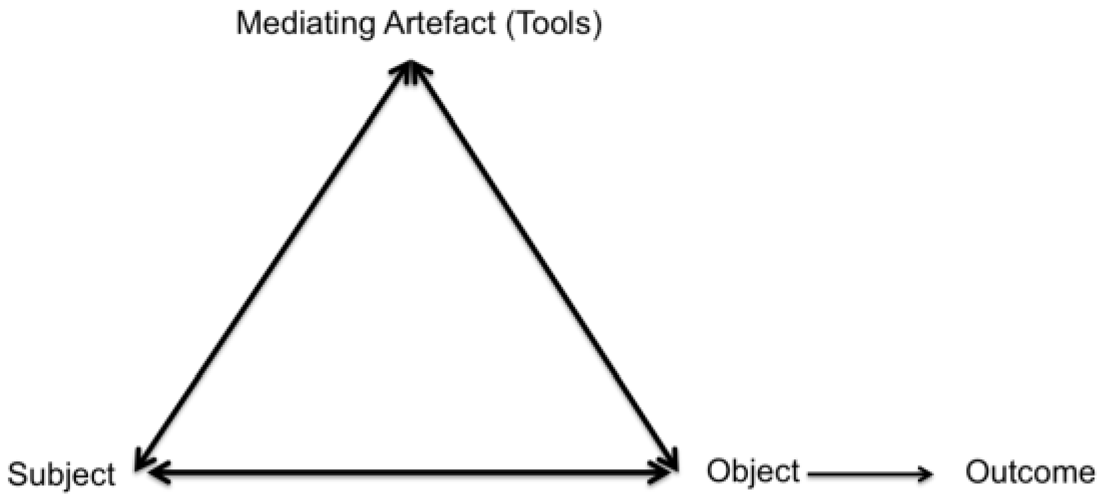

FIGURE 3.1: FIRST GENERATION ACTIVITY THEORY
SOURCE: ENGESTRÖM, 2001:134

Engeström expanded the original triangular representation of First Generation Activity Theory by adding the elements of community, rules and division of labour, while emphasising the importance of analysing their interactions with one another. (See Figure 3.2).

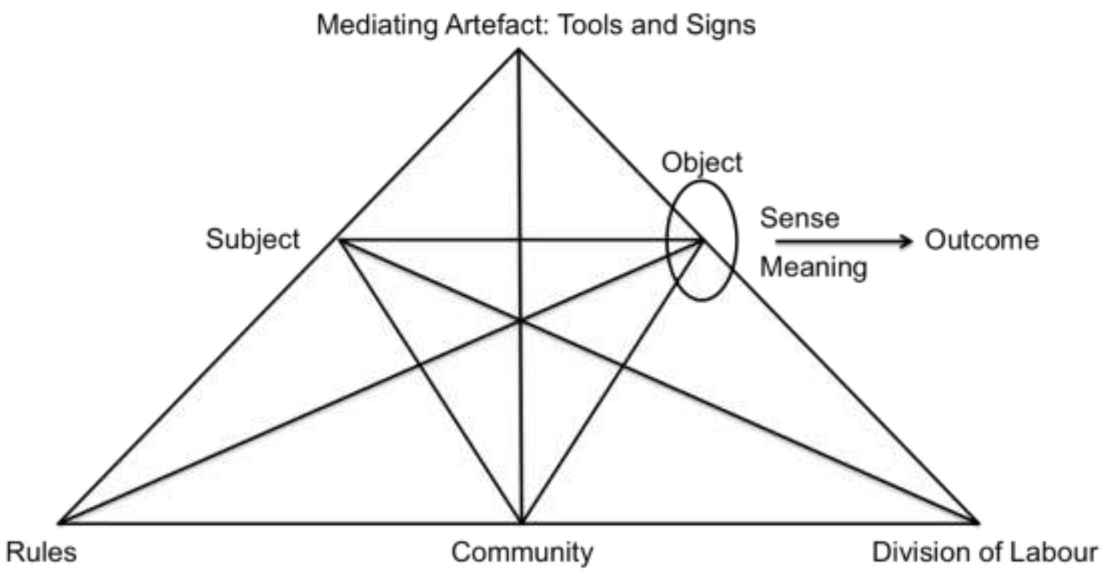

FIGURE 3.2 SECOND GENERATION ACTIVITY THEORY
SOURCE: ENGESTRÖM, 1987:78

In the Third Generation version of activity theory, individual activity is not the main focus any more, as this version includes the complete range of human activity, and also considers relationships between multiple activity systems (Engeström, 1987, 2009; Daniels, 2004; Kang & Gyorke, 2008; Sannino, 2011). Third Generation activity theory takes into account conflicts found in social practice, and includes the structure of the social world, as well as social transformation, in its analysis. It acknowledges that instability and contradiction are forces of change and development and that, not only the subject, but also the environment, is changed by negotiated activity.

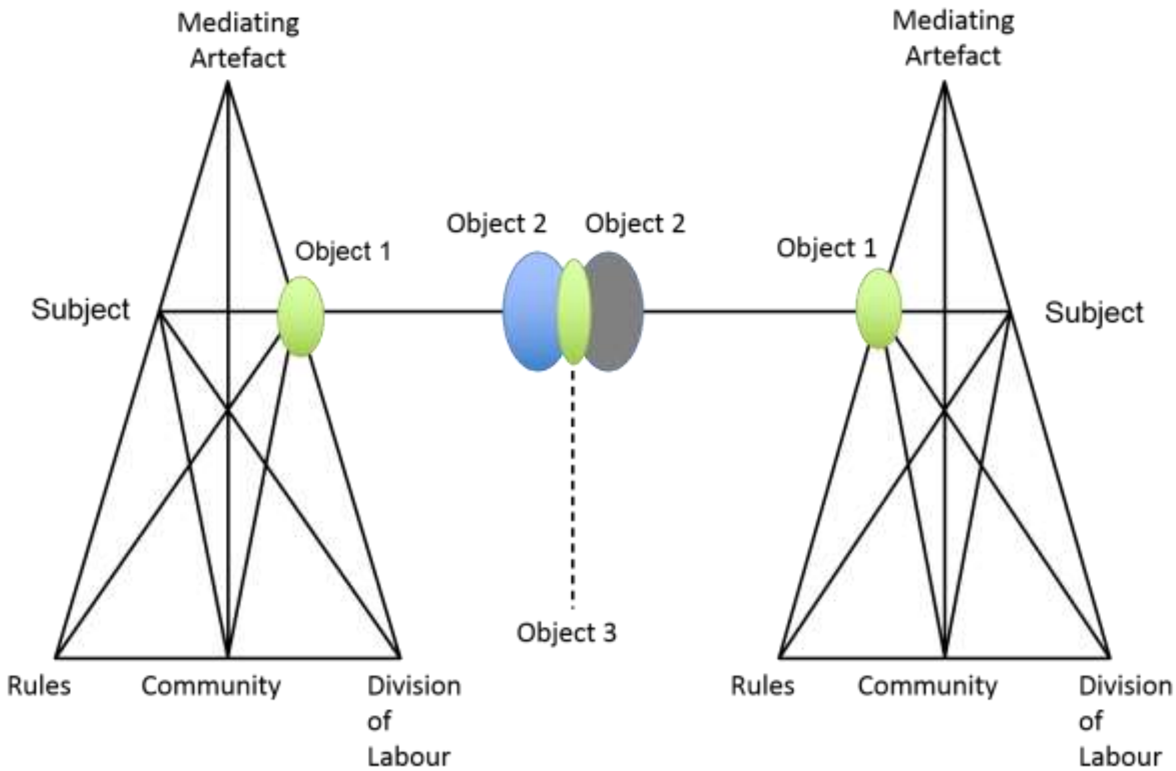

FIGURE 3.3: THIRD GENERATION ACTIVITY THEORY
SOURCE: ENGESTRÖM, 2001:136

Third Generation Activity Theory can be applied to an educational situation as follows. The activity system on the left depicts the lecturer's system. The lecturer's object is to promote active learning and he/she therefore introduces an audience response activity. The activity system on the right depicts the students' activity system. The students will have different objects, e.g. some will want to participate more actively in a classroom, so their object and that of the lecturer will be the same. Some will not be interested in actively participating in class, so their object will differ from that of the lecturer. This leads to contradiction in the activity. The concept of contradiction, as introduced by Engeström (1987, 1999, 2000, 2001), is discussed in section 3.4. The different components of activity theory will now be discussed.

3.3 Components of activity theory

3.3.1 The subject and the object

The first component of the model is the subject. Activity theory examines the subject and how the subject interacts with the world. In activity theory, any activity is an activity of a subject. A subject is something that is alive, something that has needs that can only be met by acting. A computer does not have needs, for example, and can therefore not be considered a subject. A subject has the ability to act; it has agency. The subject therefore has both the ability and the need to act.

The second component is the object, which is described by Leontiev as having a dual nature: "first, in its independent existence as subordinating to itself and transforming the activity of the subject; second, as an image of the object, as a product of its property of psychological reflection that is realized as an activity of the subject and cannot exist otherwise" (Leontiev, 1878:52). Activity is the main source of development for both the subject and the object. The change or development of the subject is caused by the nature of the activity and by participating in the activity (Kaptelinin & Nardi, 2006:31).

Most researchers agree that activities are in essence object oriented. However, the notion of 'object' remains very difficult to define (Bedny & Karwowski, 2004; Kaptelinin, 2005; Miettinin, 2006; Hardman, 2007; Blackler, 2009; Hardman & Amory, 2015).

The ultimate motivation behind human activities is needs, which can either be biological or psychological. A need can only be satisfied once it is associated with a concrete object; when it is therefore objectified. Then an activity can emerge which can satisfy the need. An activity can therefore not exist without an object. Objects can be physical, such as the creation of an assessment, or take the form of ideal, for example, "I want to pass the assessment"; (thereby describing the motive). This dual meaning of the word object is considered by some scholars to be problematic. The problem originated in the translation from Russian. The Russian words, *objekt* and *predmet*, can both be translated into English as "object". In Russian both words have similar meanings and are fully interchangeable, but they also differ subtly, which means that the finer nuances are lost in the English translation (Kaptelinin, 2005:6).

Bedny and Karwowski (2004:135) argue that the difficulty in understanding the object is not only attributable to limitations in the translation process, but also to the fact that activity theory itself evolved from diverse and conflicting schools of thought. These underlying philosophical differences are also noted by Bakhurst (2009) and Allen, Karanasios and Slavova (2011).

In German, the Russian word *predmet* is translated as Gegenstandt (Kaptelinin, 2005:7). This object (Gegenstand) motivates a new activity (Hakkarainen, 2004:5). When Leontiev uses the word *predmet* to describe the object of the activity, he refers to the "true motive" of an activity (Leontiev, 1978:62). Thus, he links the object of an activity to the concept of motive. Therefore, needs cannot be separated from objects. An unobjectified need will always seek an object, so that it can manifest itself through this object. An activity is always directed towards an object, which then motivates and gives direction to the activity.

In a study that was conducted by Wood, Tedmanson, Underwood, Minutjukur and Tjitayi (2015:35), they describe the object, as part of their study, as a tertiary qualification in teacher education, therefore they see the object as something that drives or motivates the activity, the ultimate goal. Garraway and Morkel (2015:28) define the object, in their study, as a prospect towards which the activity is directed. This prospect is reshaped by interacting elements of the activity system. Ng'ambi and Brown (2015:47) also refer to the object as a goal, first describing the object in their study as "learning tasks in which students work collaboratively to respond to a call for funding, write a proposal for an ICT intervention for a hypothetical institution and present it to an authentic funder" and then, in short, calling it a funding proposal. In this way they describe the complexity of the object, made up of a number of elements, completed through various tasks, leading to the final product. Allen and others (2011:78) believe that "actions lead to the satisfaction of a need (the motive) through the attainment of the object". The object of the activity they describe, is a completed assignment (Allen *et al*., 2011:782). These researchers all understand the concept of object as the goal or objective of the activity.

When the term is translated as *objekt*, it describes the physical object that is created, therefore the opposite of the subject. (Leontiev, 1978:50; Engeström, 1987). The object is described as "raw material" or a "problem space" to which the activity is directed. The object is then transformed into an outcome by using different tools and signs (Engeström, 1987, 1999; Hardman & Amory, 2015). In other words, the object is not the goal, but leads to the goal.

Other authors, who also define the object as the direct focus of the activity, include Lin (2007:91) who never defines the term *per se*, but whose example of object is that of a worksheet/ textbook exercise. Daniels (2004:123) describes it as the object being the focus of the activity, that which is being acted upon. Collins, Shukla and Redmiles (2002:59) describe their object of activity as "reusable knowledge for resolution of customer problems with the use of SMS". Collins, Shukla & Redmiles (2002), Kizito (2015:216), and Scanlon and Issroff (2005:432) describe how the object is transformed producing an outcome.

Marken (2008:31) clarifies the notion of the object as follows:

> *"In the sentence, 'The child kicked the ball,' the ball is the direct-object of the verb 'to kick.' The ball is what is acted upon by the verb. For us, the Object in Activity Theory is similar; it is what is acted upon by the activity system. It is what one hopes will change as a result of the activity system working as it should" (Marken, 2008:31).*

Hardman (2007) acknowledges both the material and ideal aspects of the object, i.e. containing both the 'what' and the 'why', but prefers to focus on the object of activity as an object of raw material that is acted on during an activity.

The main differences in Leontiev's and Engeström's approach to the object of activity are summarised in the following table:

TABLE 3.1: TWO PERSPECTIVES ON THE OBJECT OF ACTIVITY

Facets of Activity	**Leontiev**	**Engeström**
Activities are carried out by	Individuals (predominantly)	Communities
Activities are performed	Both individually and collectively	Collectively
The object of activity is related to	Motivation, need ("The true motive")	Production (what is being transformed into the outcome)
Application domain	Psychology	Organizational change

Source: Kaptelinin, 2005:11

Leontiev believes that activities are carried out predominantly by individuals, both on their own and collectively. Engeström believes that activities are carried out by communities and always collectively. Leontiev links the object of activity to motivation and Engeström links the object to production (also see Hardman, 2007).

However, Engeström also acknowledges that the object can be both raw material and "the future-oriented purpose of an activity" (Engeström & Sannino, 2010:4). He and Sannino describe the object as "the true carrier of the motive of the activity" (Engeström & Sannino, 2010:4), thereby linking the object to the motive of the activity. This notion is echoed by Arnseth (2008:292) who agrees that the object provides motivation, but he also believes that the object is changed by the activity itself, in other words, he sees it as the *objekt*.

Another viewpoint of the object is expressed by Wells who sees the object as either material or symbolic (Wells, 2002:45). Miettinen also sees the object as both ideal and subjective, "as objects of desire and intentions" and as objective, "capable of resisting these desires and intensions" (Miettinen, 2006:398).

Engeström describes the ever changing nature of the object as follows: "In this sense, the object determines the horizon of possible goals and actions. But it is truly a horizon: as soon as an intermediate goal is reached, the object escapes and must be reconstructed by means of new intermediate goals and actions" (Engeström, 1999:65).

Also highlighted by Leontiev and Engeström is the distinction between the general and the specific aspects of an object. Leontiev describes this dual nature of the object as, in a broader sense, something that has a relation to other things, and in a narrower sense, as something directly in opposition to the subject (Leontiev, 1981:36). According to Engeström and Sannino, this duality means that the "generalized object is connected to societal meaning, the specific object is connected to personal sense" (Engeström & Sannino, 2010:6). The example they give of a generalised object is health and illness, whereas the specific object is a particular condition or complaint of a patient. In the context of an audience response activity, the general aspect of the object could be active learning, and the specific aspect is improving students' comprehension of a specific aspect of the curriculum.

Adding to the complexity of the object, Kaptelinin says that an alternative option to distinguish between the *predmet* and the *objekt* is to translate *predmet* as "subject". The example he gives, "a subject of dispute", is a literal translation of the Russian expression *predmet spora* (Kaptelinin, 2005:8).

Roth also links the object to the subject, saying that "the nature of the object necessarily presupposes the knowing subject and the nature of the subject necessarily presupposes the object as apparent in perception" (Roth, 2007:58-59).

Bedny and Karwowsk, who are critics of Engeström's interpretations of the different components of activity theory, criticise in particular his interpretation of the object in his study of children's medical care (Engeström, 2000). Bedny and Karwowski believe that a distinction should be made between subject-object interactions and subject-subject interrelationships. Engeström denotes the physician as the subject and he sees the patient and his father as the object. However, Bedny and Karwowski do not believe that a human being can be an object. They see the patient and his father as subjects, and the health condition of the patient as the object. They differentiate between the subject-object component of the activity, which is when the physician evaluates the patient's health, and the subject-subject component, when the physician addresses the patient and his father (Bedny & Karwowski, 2004:135).

Hakkarainen acknowledges this dispute concerning the subject-object and the subject-subject relations, saying that this argument has not been resolved and that "it remains a challenge in the development of the third generation of activity theory" (Hakkarainen, 2004:9). I believe that this matter cannot be completely resolved without looking at the mediating artefact, which can either take the form of tools or signs. I will discuss this matter further, when tools and signs are discussed later on in this chapter.

The last concept, related to the object, that needs to be elaborated upon, is that of linking the object to the artefact. The notion that there is a continuous movement among the different nodes of an activity means that the object may be turned into the outcome, which then becomes the artefact, and this could later be turned into a rule (Antoniadou, 2011: 246; Engeström, 1996: 261; The Activity System).

Bedny and Karwowski claim that, when people create artificial objects to regulate their interactions with the external world, these objects are called artefacts. They distinguish between material and ideal objects, with ideal objects being described as signs or symbols (Bedny & Karwowski, 2004:141).

According to Bakhurst, the concept of objectification can best be described when looking at artefacts. A table is distinguished from raw material by the significance which it possesses. It was designed and produced for specific use and incorporated into a system. The object therefore has meaning, assigned and sustained by goal-oriented activity (Bakhurst, 1995; Daniels, 2004).

A study that was conducted by Collins, Shukla and Redmiles found that activity theory provided them with helpful insights, but when they tried to explain these concepts to other colleagues, the distinction between the object and the objective was too difficult to describe, and this made it problematic to convince their colleagues of the value of the use of activity theory (Collins, Shukla & Redmiles, 2002: 77).

Kaptelinin (2005:11) and Blackler (2009:27) do not see these differences as a weakness of activity theory, rather that the two versions can be considered complementary, each dealing effectively with the issues of their respective domains. For Blackler (2009:27) it "both reflects and reveals the complexity of human activity"**.**

Educational contexts are especially complex. It is therefore vitally important to identify the object, and also define the objective; to identify the specific object, but also ascertain how it links to the generalised object. This study therefore does not adopt a single view of the object, but includes both the *predmet* and the *objekt* in the analysis of the audience response activities.

3.3.2 Activities, actions, motivation and goals

Activities are distinguished by differences in their objects, whereas objects give direction to a subject. At any given moment, the subject interacts with a whole range of different objects, which can be categorised into a hierarchy of importance. For example, the subject is typing letters on a keyboard, which are forming words, in order to create an assessment. Therefore the creation of the assessment is the top level unit in the hierarchy, the ultimate object. In order to fulfil that need, lower level needs must first be fulfilled, e.g. the typing of the words. The top-level need motivates the subject and also leads to the lower-level objects and therefore motivates those activities. The concept of activity is therefore always connected to the concept of motive. According to Leontiev (1978:63), seemingly non-motivated activities are not activities without a motive, but activities with a subjectively and objectively hidden motive.

A lecturer's motive for the use of an audience response activity is to determine whether students understand the explained work. A student's motive for participating in the activity would ideally be the same motive, i.e. by participating in the audience response activity, the student will be required to think about the explained work, find an answer to the question, and upon receiving feedback, can determine whether or not he or she understands the work.

An activity is a single unit, a subset of a number of activities that form the interaction of the subject with the world. This activity, or subset, can be defined by the specific motive of this activity. However, activities are not inflexible structures and they may change over time. For example, short class assessments were traditionally completed on paper. The audience response software makes it possible to do the assessment on a mobile device. An activity is also composed of a sequence of steps. Each of these steps may not be directly related to the motive, but the whole sequence will result in achieving the motive. For example, the student has to complete a number of steps on the mobile device, before it is possible to answer the questions, which form part of the activity, e.g. the correct web address must be visited and the correct activity must be found.

The different components of an activity are called actions. The objects at which actions are directed are called goals. Different actions may be undertaken to meet the same goal and goals can also be categorised into different levels of importance. Goals are always conscious; we are generally aware of the goals we want to achieve, but we are not always aware of our motives (Engeström, 1987, 2001; Leont'ev, 1978; Leonyev, 1981). Roth and Lee (2007:145) posit that "goals realize motives, but motives give rise to goals, each presupposing the other." If a student's goal is to pass the subject at the end of the year, so that she can continue to a next level or get a degree, she will only be motivated to participate in an audience response activity if it will realise this goal.

Roth and Lee (2007:145) further suggest that "actions are not the outcome of subjectivist singularity but rather, because they realize collective activity, inherently are shared and intelligible." In order for an audience response activity to be successful, the educator and students should have common goals and align their motives.

Leontiev observed that, in order to make motives conscious, activities and the dynamics surrounding the activities should be analysed. Motives are generally only indirectly expressed through wishes, desires or striving toward a goal (Leont'ev, 1978). As described in Chapter two, the fourth TEFA principle is to develop students' metacognitive skills by discussing the design and purpose of a lesson. By analysing the activity and discussing it with students, the students' motive to participate can be aligned towards the goal of improving learning.

The primary motive for integrating technology into face-to-face teaching would be to improve learning. Any other secondary motives should eventually lead to the primary motive, e.g. a secondary motive could be to increase participation (i.e. active learning), which ideally will lead to improved learning. Alternatively, a secondary motive could be to foster critical thinking, which again will lead to improved learning.

The motive directs the energy that is applied to the activity. The actions that form part of an activity are directed by its motive, but appear to be directed towards a goal. In Leontiev's example of the hunt, the beater's task was to frighten the game, which is his goal. This goal does not coincide with his motive of the activity. The motive of his activity is the hunt (Leontyev, 1981:210). Returning to the educational example, an activity constitutes the completion of an online assessment by students. The motive for this activity is to see if the students understand the subject matter. A number of actions must be carried out which are not aimed directly at completing the assessment. For example, the students must be given access to the online course that contains the assessment. So the goal of this particular action is to give the students access to the course. It does not have anything to do with the assessment, but giving the students access to the course will allow the students to complete the assessment.

Actions are further broken up into lower-level units, called operations. Operations are actions that have become routine (Engeström, 1987; Leontyev, 1978, 1981). People are not aware of doing an operation. For example, for a person who has been typing on a typewriter for a number of years, the act of typing will be an operation. When this person has to learn to type on a computer instead of on a typewriter, this operation will change back to an action, for a while, until the person has become accustomed to typing on a computer and the action therefore has become routine. As illustrated here, there is thus no difference between the term action and operation. In the aforementioned example, the goal is to type information in both cases. The conditions under which the action or operation is performed did change, but ultimately the goal stayed the same.

Bedny and Karwowski criticised Engeström's interpretation of actions in his medical care study. They argue that the actions which Engeström attributed to the junior physician, namely the examination and diagnosis of the patient, were really tasks, which included distinct actions (Bedny & Karwowski, 2004:135). They consider actions as the most important units of analysis, the fundamental elements of an activity. Each action has its own set of goals, which must be achieved in order to realise the overall goal of the task. Actions are again made up of several operations (Bedny & Karwowski, 2004:174). "The task is a specific kind of activity, which comprises from different actions and operations and presents by itself a complicated system" (Bedny & Karwowski, 2004:144).

Engeström (1987:15) also uses the term *task* to describe an action, as illustrated by the following quotation: "This implies that the tasks or actions (including their objects) themselves are not objectively transformed" (Engeström, 1987:86). The task is described as something given to a person, which then becomes an action when the task is carried out (Engeström, 1987; Roth & Lee, 2007; Collins, Shukla & Redmiles, 2002).

Therefore, Engeström and others interpret tasks as actions, whereas Bedny and Karwowski interpret tasks as special kind of activities. It is not within the scope of this study to determine which version is correct. This study will use the term action.

3.3.3 Tools and signs

Artefacts are divided into two kinds of instruments, tools and signs, which may be referred to as technical tools and psychological tools (Vygotsky, 1978, 1981; Engeström, 1987; Allen *et al*., 2011; Kang & Gyorke, 2008). Both types mediate activity, but "only psychological tools require reflective mediation, consciousness of one's (or the other person's) procedures" (Engeström, 1987:78).

Tools and signs play a central role in activity theory. Physical tools are material and facilitate object-oriented activity. They change the way that human beings interact with the world. They are designed and created by people to help them solve problems. Therefore a tool will reflect the experience of other people, who tried to solve similar problems. Some people will become experts in creating or modifying the tool, others with implementing it. This creation and modifying is done within a particular context, or culture – hence, cultural or social knowledge influences the creation of the tool. It also influences the external behaviour and mental functions of the individuals creating or using the tool. Even though tools are an inseparable component of human activity, the focus should not be on the tool, but on its relationship with the other components of an activity system. This is also true for technology, used as a tool. As has been argued in Chapter two, audience response technology itself does not necessarily improve learning, but the pedagogy behind it may do so.

In contrast to physical tools, signs are abstract and are used to control human behaviour (Allen *et al*., 2011; Kang & Gyorke, 2008; Vygotsky, 1978). Vygotsky uses an example of a person tying a knot in a handkerchief as a reminder for herself. The knot becomes a sign that constructs the process of memorising (Vygotsky 1978:51).

Toomela agrees that the relation of a sign to the object is created internally. "Thus, signs in essence represent a dialectical unity of external and internal aspects of a world" (Toomela, 2000:358).

When human beings give meanings to external artefacts, they turn them into signs. These signs are then used by the subject to control his or her action and develop a new understanding of the situation. This process aids the subject to transform a meaningless situation into a meaningful situation (Vygotsky, 1978; Sannino, 2011; Bedny, Seglin & Meister, 2000).

Bedny and others claim that speech is the most important sign system and language is a major component that facilitates mental activity. Communication and social interaction is critical in the formation of human consciousness and cognitive functions (Bedny *et al*., 2000:170).

As was noted in the discussion on the object, the tool or sign is not fixed and can play different functions in the activity system. Signs can therefore become tools and further generate new tools and signs (Smagorinsky, 2001; Roth & Lee, 2007).

Leiman (1999) claims that tools mediate object-oriented activity and the signs, in the form of language, mediate social intercourse. Tools are externally oriented and are used to modify objects, but signs change nothing. Signs are merely "multifunctional tools of communication and representation" (Leiman, 1999:421).

The aggregated feedback provided by the audience response software is an example of a sign. If this sign is not turned into an object, it does not change anything. The educator should interpret the feedback, thereby changing it into an object, and then use it to direct the lesson. Then the activity becomes meaningful.

Bedny and Karwowski make a distinction between object-oriented and subject-oriented activities (Bedny & Karwowski, 2004:138). Subject-oriented activities are referred to as social interaction. They justify their view by referring to the work of Bakhtin, who differentiated between subject-object and subject-subject relationships.

> *"The entire methodological apparatus of the mathematical and natural sciences is directed toward mastery over mute objects, brute things, that do not reveal themselves in words, that do not comment on themselves. … In the humanities - as distinct from the natural and mathematical sciences – there arises the specific task of establishing, transmitting and interpreting the words of others" (Bakhtin, 1981:353).*

This sign (aggregated feedback) that has become an object must be used otherwise it has no meaning and is dead to the world. Words find meaning in dialogue, when they are used as part of social interactions. (Bakhtin, 1981:354). Continuing the example of the aggregated feedback as object, the aggregated feedback becomes meaningful when the educator uses it to direct the lesson, in other words, interpreting the feedback and using it either to introduce another activity or to explain the feedback to the learners.

I do believe that there is merit in Bedny and Karwowski's argument and that it is especially vital in an educational environment to identify the subject–subject relationships. At any given moment, an educator might be engaged in two different actions, simultaneously using both tools and signs. For example, the educator (the subject) is using a projector and screen (the tool) to display content (the object). He or she also addresses the students (the subject), giving meaning to the words (the object) on the screen, using language (the sign).

This is illustrated by the following diagram.

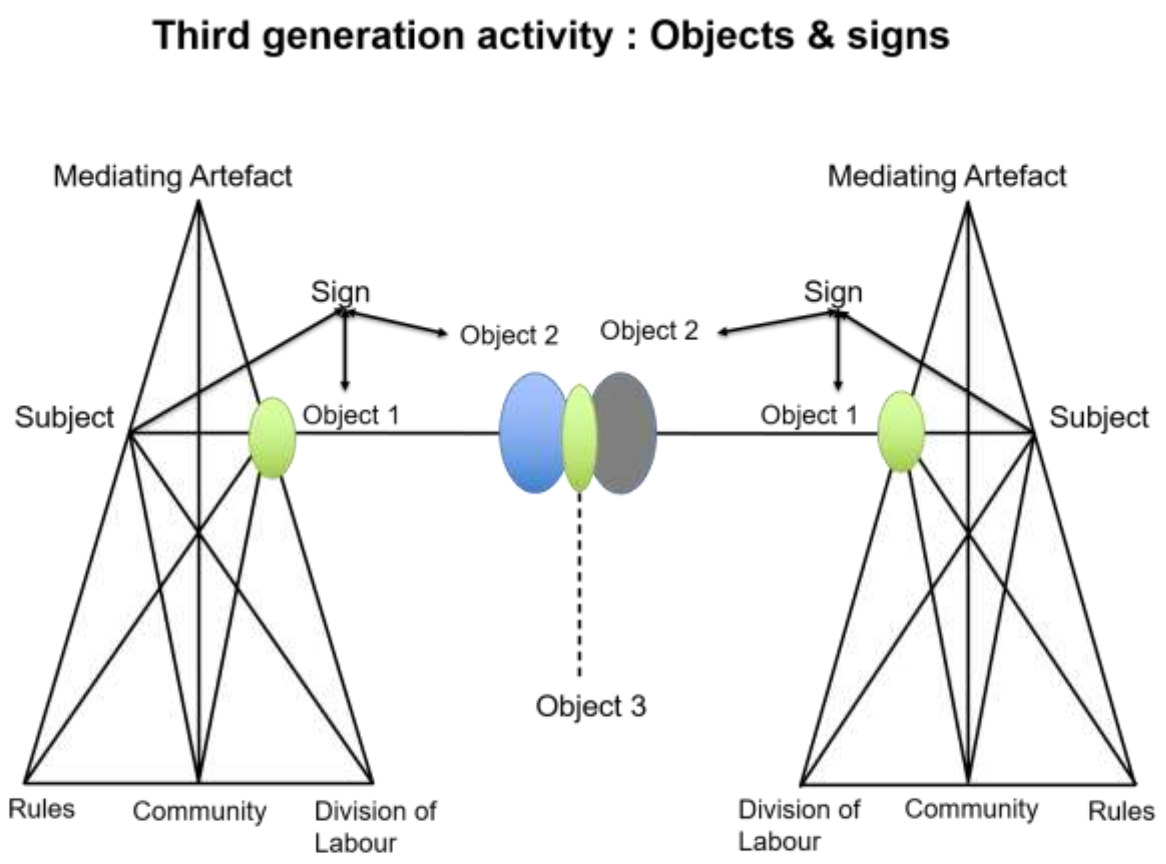

FIGURE 3.4: THIRD GENERATION ACTIVITY THEORY: OBJECTS & SIGNS

The different components of an audience response activity are described in detail in Chapter five.

3.3.4 Rules

The pedagogical approach that forms the foundation of the educator's lesson design also influences the design of the audience response activity. If an educator follows an instructivist approach, then he or she will not include dialogue and peer learning as part of the process. If an educator follows a constructivist approach, he or she may not give any feedback on the aggregated feedback provided by the system, expecting learners to interpret it themselves. The rules of the pedagogical approach form the theoretical framework within which the design takes place.

Activities always occur within a context, in a specific society, and the rules of this society will have an influence on the activity. Rules refer to "the ever-changing explicit and implicit conventions that govern interactions between the subject and the community and are useful for explaining embedded behaviour" (Allen *et al*., 2011:783).

Education institutions and systems have their own sets of rules and these differ between education institutions and systems, e.g. high schools have different rules to higher education institutions. Students find themselves in different communities, e.g. the home, the community they grow up in and then the education institution where they study. They are required to adapt, constantly, to the different rules of each community.

Maistre and Paré conducted a study in which they examined the move from classroom to workplace and found that "the rules and divisions of labour are dramatically different in each activity system. Academic rules may discourage collaboration (which may be regarded as cheating), while workplace activity demands it. And those workplace rules that are codified and studied in school, such as ethical guidelines, are far more difficult to apply on the job than to regurgitate in school assignments" (Maistre & Paré, 2004:45).

The study by Maistre and Paré concluded that students found it difficult to adapt in the workplace. In cases where the rules of the university and the workplace overlap more, the transition is easier (Maistre & Paré, 2004: 49). Introducing collaboration during audience response activities can aid in bridging this divide.

Audience response activities take place within the higher educational community and, if the rules of the university include continuous assessment, thereby requiring the educator to accumulate a number of grades throughout the year, the educator might be tempted to use the audience response activity to accumulate these grades. These assessments are easy to mark and therefore lighten the administrative load, providing a relatively easy means by which to gather the required number of grades. In this example, the rules of the institution interfere with the goal of the audience response activity, changing it from improving learning to accumulating grades.

This section demonstrated that a number of rules can influence the success of an audience response activity and these rules should all be taken into consideration during the analysis phase of the design process.

3.3.5 Community

The second generation model of activity theory also takes into account the context or community in which the activity takes place and the focus of the particular community. Analysing the community can help determine how the community influences the subject. Activities take place in a certain society and context and are bound by the rules associated with these, so any activity system is described as part of the context in which it operates. The community prescribes the rules and customs and beliefs (Jonassen & Rohrer-Murphy, 2013: 66).

The aim of any higher education institution is to ensure that, as many students as possible pass every year and thus complete their studies. Students come from high school, where they have become accustomed to a certain way of learning, usually rote learning, so that they can pass subjects at the end of the year and continue to the next level in the system. If an educator in the higher education system introduces any activity that is different from what students experienced in their school community, it will be difficult to motivate them to participate in the activity, unless they believe that it is to their advantage.

The rules of the community are usually part of tradition, fixed and engrained into society; these rules are not easily changed. If an educator introduces a new activity in this community, it is bound by the rules of the community. If the community does not have any (applicable) rules, new rules must be created. Sometimes an activity goes against the rules of the community, forcing it to change and create new rules.

Roth mentions that, by participating in activities, the individual produces outcomes which are circulated, swapped and consumed. In this process the individual reproduces herself as a member of the community, thereby changing the structure of the community of which the individual is a part (Roth, 2004: 4).

3.3.6 Division of labour

Another new element of second generation activity theory is the division of labour. When a person participates in a socially distributed work activity, actions are typically motivated by one object, but directed to another (Kaptelinin & Nardi, 2006:58). The division of labour makes attaining a goal within a collective activity meaningful (or at least rewarding), even if the relation of the goal to the object of the activity, as a whole, is not obvious.

Intermediate goals can only exist if distributed among people, but contributing individuals should understand the relationship between intermediate goals (or own goals) and ultimate goals (the goals of the activity). "The division of labor creates conditions for the dissociation between motives and goals. This dissociation first emerges in collective activities and then in individual activities and minds" (Kaptelinin & Nardi, 2006:59). The individual should first understand the collective goal of the community and align these goals with his or her own. The individual should be able to attain his or her own goals within the collective activity and also the intended goal of the collective activity. A whole community can have the same object, or strive for the same outcome, yet different activities will lead to this outcome. For instance, should a university's goal change from encouraging rote learning to promoting deeper understanding, critical thinking and knowledge sharing, all the stakeholders in this community will have to understand the collective goal and align their own goals with the community's goal. This will result in different activities that will eventually lead to the desired outcome.

3.4 Five principles of activity theory

Engeström (2001:136-137) identifies five principles of activity theory that should be examined when analysing an activity.

The first principle is that an activity consisting of a tool oriented towards an object, seen in relation to other activity systems, is the most important unit of analysis. Individual and group actions, as well as operations, are independent, but subordinate units to be analysed. This can only be understood against the background of entire activity systems. Through these activity systems, actions and operations are generated (Engeström, 2001:136).

The second principle is the multi-voicedness of activity systems. An activity system is always formed by numerous points of view, traditions and interests. The division of labour organises the participants into different roles. Each participant brings his or her own history and the activity itself also carries its own history consisting of tools, rules and traditions. This multi-voicedness creates both tension and innovation (Engeström, 2001; Avis, 2009).

Audience response technology is developed by a technologist with certain rules in mind. This system is used by an educator to design audience response activities, within a certain context, with certain rules in mind, whether pedagogical or not. It is used by learners who carry certain habits learned in the past, based on some traditions. If all of these participants' goals are not aligned, it will create tension. The system developed by the technologist may not be what the educator has in mind; it may be very complicated, or lack the necessary functionality for the intended activity. The learner may not be motivated to participate in the activity, or he or she may find the system too complicated to use.

The third principle is historicity. Activity systems evolve over time and any tribulations or possibilities can only be understood if examined in their historical context. History shapes an activity and should therefore be included in the analysis of an activity (Engeström, 2001:136). The theories and tools that had an influence on the formation of the activity should be studied. Thus the audience response activity should be analysed against a particular pedagogical background. Learning theories and pedagogical tools that concern the creation of audience response activities need to be investigated, when the audience response activity itself is the activity under scrutiny.

The fourth principle is that of contradiction. Contradictions are considered to be the source of change and development. When an activity system starts to use a new element, e.g. a new form of technology, it almost always leads to contradiction, where the old rules collide with the new rules. Such contradictions generate conflict, but can also lead to innovations. The object of an activity is always contradictory. "It is these internal contradictions that make the object a moving, motivating and future-generating target" (Engeström & Sannino, 2010:5).

There are levels of contradictions, starting with inner contradictions. Inner contradictions are described by Roth and Lee (2007:203) as follows:

> *"When inner contradictions are conscious, they become the primary driving forces that bring about change and development within and between activity systems. Generally overlooked is the fact that contradictions have to be historically accumulated inner contradictions, within the things themselves rather than mere surface expressions of tensions, problems, conflicts, and breakdowns."*

Contradictions that arise from adopting new technology are examples of secondary contradictions, when outside elements collide. Tertiary contradictions arise when external objects try to replace existing objects within a system. And then quaternary contradictions arise between a central activity and other closely related activities (Engeström, 2001:137).

The adoption rate of the use of technology as part of education has been very low. Technology is often met with a lot of negativity from a number of educators who believe that there is nothing wrong with their current model of teaching. When some educators want to start using new technology in their classrooms, they often elicit scepticism or even ridicule from other educators who believe that they are wasting their time. Contradictions also arise between workload and time available to spend on the integration of new technology. Social constructivist learning, active learning and the use of audience response activities are time consuming methods of instruction and educators often complain that the amount of work prescribed by the curriculum does not allow them to adopt these practices. These are only a few examples of contradictions that may arise as a result of attempts to introduce the use of audience response activities.

The fifth principle provides for the possibility of extensive transformations in activity systems. As contradictions within an activity system arise, individuals question and start to deviate from the norm. In some cases this will lead to collaboration and collective efforts to bring about change.

"An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity. A full cycle of expansive transformation may be understood as a collective journey through the zone of proximal development of the activity" (Engeström, 2001:137).

3.5 The cycle of expansive learning

The theory of expansive learning was developed within the framework of activity theory (Engeström 1987). The model maps the different learning actions as the subject moves from the abstract to the concrete. The learning actions are the different steps in the development process.

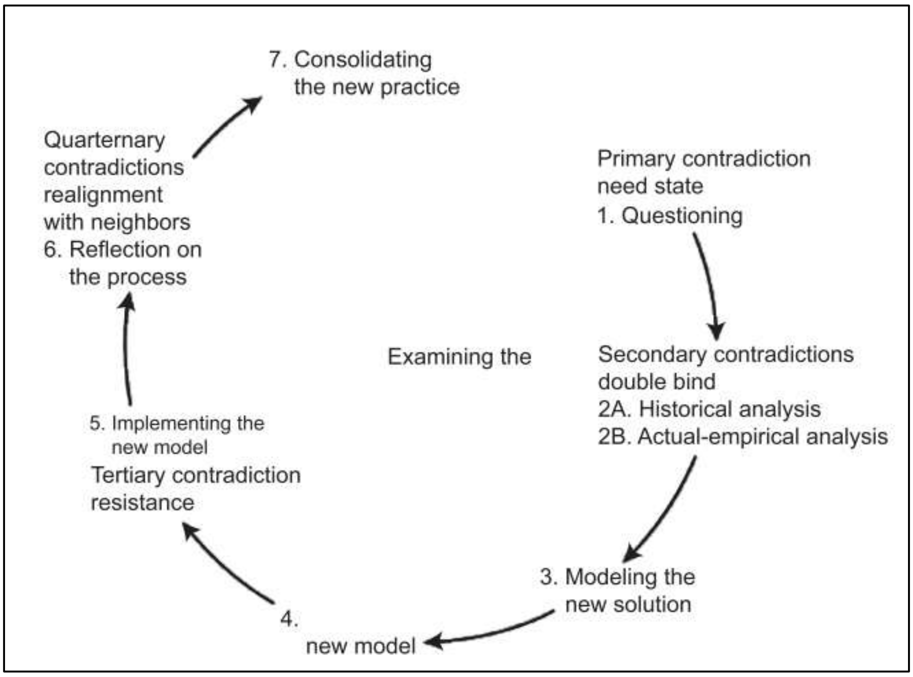

FIGURE 3.5 THE CYCLE OF EXPANSIVE LEARNING
SOURCE: ENGESTRÖM, 2001:152

This model corresponds to the process models discussed in Chapter two, but added to it are the possible contradictions that can arise. When planning the activities, educators can anticipate contradictions and provide solutions before these contradictions arise. During phase one, the educator determines the possible uses for the audience response activity and how the audience response activities will be implemented. During second phase, the educator will determine how his or her existing lesson design is going to change. The educator should also include how the new lesson design will influence the learners and how the learners will be prepared for the changes, in an attempt to minimise secondary contradictions. This will lead to the building of a new design model, which will then be implemented. During this phase, tertiary contradictions might arise. These may include unforeseen contradictions. This is followed by an evaluation and reflection process, during which any resulting contradictions are studied and rectified, and the new practice can then be consolidated.

The current cycle of expansive learning depicts only one iteration. I propose that this is not enough, and that a new practice will seldom be satisfactorily efficient after only one iteration.

Contradictions that did not arise during the first implementation of a new activity, might arise during a second implementation, and therefore a new model will seldom be perfect after only one iteration. For example, the first time learners take part in an audience response activity, the novelty of using new technology as part of a lesson may motivate them to participate in the activity. This novelty will wear off and will be replaced by a contradictory state, when the learner realises the implications of ensuring that their mobile device is always in class, charged and in working condition. If the learners cannot see the benefits of participating in the audience response activities and they perceive using their mobile device to be burdensome, they may no longer participate in the audience response activities. The educator then has to redesign the audience response activity and include, for example, consideration of external factors of motivation to ensure that the learners participate.

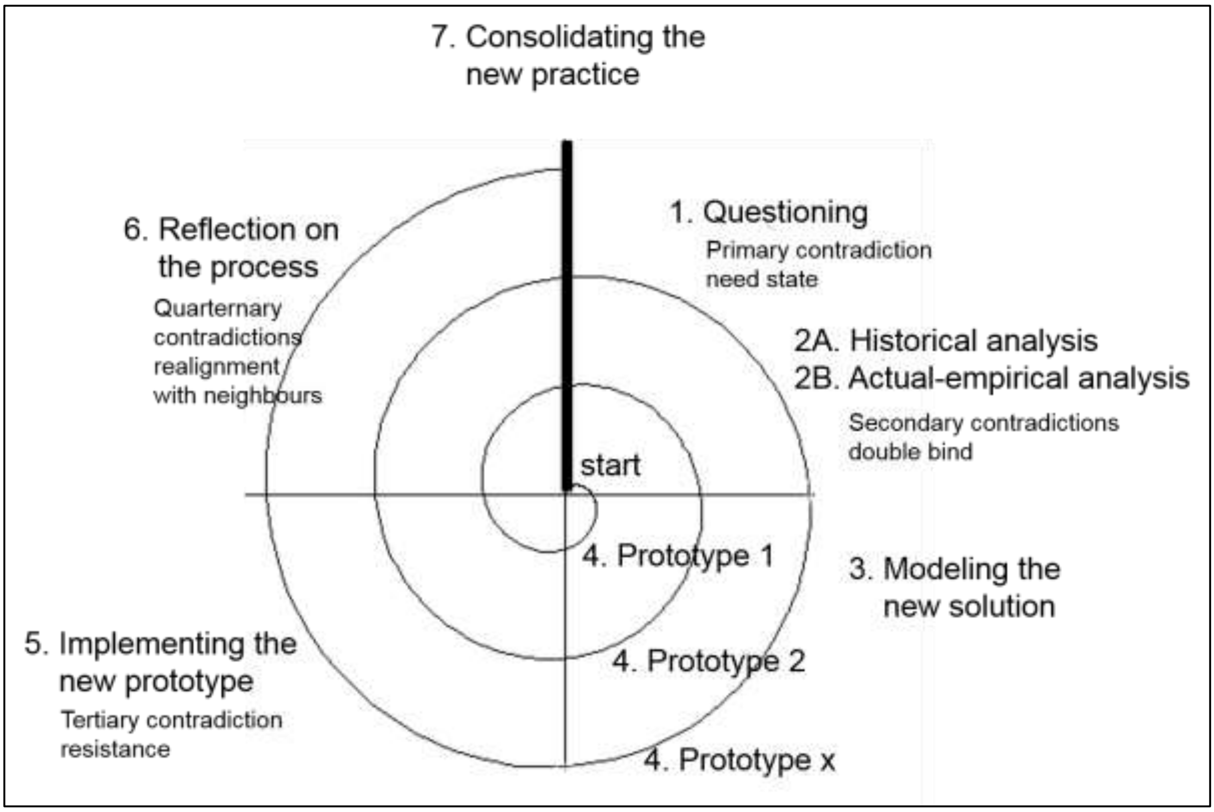

Figure 3.6: Proposed spiral model for the cycle of expansive learning

Therefore the cycle of expansive learning should be redesigned, so that it graphically represents the iterations (see Figure 3.5). Each iteration will produce a prototype that will be implemented, and any tertiary and quaternary contradictions that arise during implementation should then be evaluated, reflected upon and improved, until the new practice can be consolidated.

3.6 Conclusion

Activity theory is practice-based and it involves the researcher directly in the activities of the research subjects. This is a crucial aspect of activity theory (Sannino, Daniels & Gutiérrez, 2009: 3). This theory has been applied successfully in several educational studies (e.g. Kizito, 2015; Lerman, 2013; Garaway & Morkel, 2015; Ng'ambi & Brown, 2015) and in studies in many other fields.

Martin and Peim (2009: 137) believe that activity theory has become very important in research on education and in the development of educational practices. They also argue that the global reach of the theory will ensure that the theory is constantly transformed by opposing views from different contexts. An example of such an opposing view, which was discussed in this chapter, is that of Bedny and Karwowski

(2004). I support the views of Bedny and Karwowski, and propose that it is important to identify the subject-subject relationships. Signs too play a very important role in Third Generation Activty Theory. Signs need to be converted into objects and used as part of an activity for an activity to become meaningful. The interaction between two systems is characterised by the use of signs by a subject of one system, directed to the subject of another system, which in turn turns this sign into an object. This object can then be used to achieve a particular objective. The interaction is continued by the subject of the second system, which again uses signs directed at the subject of the first system, which in turn turns the sign into an object to achieve a particular objective. This distinction is used in the analysis of the case studies (see Chapter five).

The opposing views of the object have also been discussed because, as Hardman indicated, it is essential to identify the object (Hardman, 2007). This study further proposes that both views of the object, namely the *objekt* and the *predmet*, should be taken into consideration when analysing an activity. The object being worked upon should be identified, in this case the audience response activity. Its characteristics should be analysed, e.g. the number of questions asked, the type of questions asked and how the activity is applied. It is also important to identify the objective of the audience response activity, namely the reason for the introduction of the audience response activity.

This chapter also discussed the five principles of activity theory that were developed by Engeström (2001). It was found that these five principles provide an effective method to analyse an activity. These five principles will therefore be used in the analysis of the case studies (see Chapter five).

This chapter further discussed the cycle of expansive learning, because this defines the process involved in the development of a new activity. Since it was found in this study that activities are seldom complete after only one cycle, and that contradictions might arise during second and third cycles of an activity that were not present during the first cycle, it proposes a change to the cycle of expansive learning. It is therefore proposed that the cycle of expansive learning should be expanded by redesigning it into a spiral model, so that the different cycles of the design of a new activity can be depicted.

This chapter has provided a detailed analysis of the theoretical lens through which this study is viewed, and proposed changes to current practices. This is used to analyse the data that was gathered by means of a mixed method approach. The research approach is discussed in Chapter four.

Chapter 4

Research Methodology

4.1 Introduction

As explicated in Chapter three, activity theory proposes that all activities take place in a social context where the subject interacts with an object, using culturally produced tools or signs, and being influenced by the rules of the community he or she is part of. Any activity consists of various components, and each of these components should be examined, because each influences the activity in some way. These basic principles of activity theory had to be taken into account in selecting a research methodology, as I believed that it would be important to adopt a research methodology that would complement the theoretical framework of this study.

Both quantitative and qualitative research methods have strengths and weaknesses. Quantitative research, producing numerical data, is useful when cause-and-effect relationships need to be established, and statistical generalisations made. Qualitative research provides the opportunity to gather in-depth and detailed narrative data. For this study, I had to take account of the fact that an audience response activity consists of the lecturer, students, the audience response technology used, and the lesson design, and that all of these are being influenced by the rules of the university. I thus needed to be able to make statistical generalisations about components that were present in all the cases, but these had to be followed up by detailed narrative information to determine factors that influenced each case. Using either a qualitative approach or a quantitative approach would not have been sufficient. I decided to follow a mixed methods approach, since mixed methods research combines the strengths of both qualitative and quantitative research to improve the overall quality of the research study (Johnson & Christensen, 2008; Creswell, 2014; Creswell & Plano Clark, 2011; Creswell & Tashakkori, 2007). Other authors (Greene, Caracelli & Graham, 1989; Sandelowski, 2000) add the following reasons for the use of mixed methods research: to achieve validation through triangulation; to better clarify, explain or elaborate on results; and to guide the use of data collection and analysis.

4.2 Mixed methods methodology

Creswell and Plano Clark (2011:5) define the core characteristics of mixed methods research as the collecting and analysing of qualitative and quantitative data, based on the research questions; mixing the two forms of data sequentially or embedding one within the other; and giving priority to one or both forms of data. This can be done either in a single study or as part of a program of study. Mixed methods research, similar to other research forms of research, should be conducted within a particular philosophical worldview (paradigm) and adopt a particular theoretical lens in analysing the data. Furthermore, the different research procedures (methods of data collection) should be carefully united into a specific design.

4.2.1 Pragmatism as a paradigmatic perspective

Whereas Creswell and Tashakkori (2007:304) claim that there are not many discussions on worldview and paradigms found in mixed methods literature, and Greene, Caracelli and Graham (1989:256) propose that mixed methods researchers can use any paradigm, Johnson and Christensen (2008:442) find that researchers who use a mixed methods approach, often adopt a pragmatist approach. Rather than expecting to find concluding evidence, which is impossible in empirical research anyway, the pragmatist researcher attempts to provide evidence that will meet the standard of what John Dewey called "warranted assertability" (Johnson & Christensen, 2008; Johnson & Onwuegbuzie, 2004).

Among the strengths of pragmatism that are important to this study is the endorsement of practical theory. The theoretical framework adopted for this study, activity theory, is not only used to theorise the evidence, but should also be used in practical interventions (Bedny & Karwowski, 2004:135). "Practical transformation, change, and experimentation are actions at the root of theoretical abstraction" (Sannino, 2011:586). Applying activity theory should therefore lead to practical transformation and the paradigm followed during the research process should endorse this vision.

Pragmatism also "recognizes the existence and importance of the natural or physical world as well as the emergent social and psychological world that includes language, culture, human institutions, and subjective thoughts" (Johnson & Christensen, 2008:443). Johnson and Onwuegbuzie (2004:19) highlight some weaknesses of pragmatism, for example, that the usefulness or workability of pragmatism can be vague and that the logical nature of pragmatism fails to find solutions for philosophical disputes. Another weakness is that "pragmatism might promote incremental change rather than more fundamental, structural, or revolutionary change in society" (Johnson & Onwuegbuzie, 2004:19). However, I do not regard this as a weakness. Educational practices evolve constantly and researchers should continuously try to improve on past findings.

4.2.2 Designs in mixed methods methodology

While there is still a lack of consensus on what mixed methods research is, many researchers also find it difficult to combine qualitative and quantitative data collection and analysis (Sandelowski, 2000; Tashakkori and Creswell, 2007). Disputes are usually about the manner in which the two data sets are integrated. In this regard researchers have to take a number of important decisions: if the qualitative and quantitative data are going to be given equal priority; if they will conduct both types of data collection sequentially or concurrently and thirdly, when the mixing will occur (Doyle, Brady & Byrne, 2009; Mertens, 2011).

Johnson and Christensen (2008:443) state that the strategy followed by the researcher to combine qualitative and quantitative research approaches is the fundamental principle of mixed methods research and this should be done in such a way that the overall design is one with "complementary strengths and nonoverlapping weaknesses" (Johnson & Christensen, 2008:443).

Creswell (2014:15) identifies three basic mixed methods design models used in social sciences, namely convergent parallel mixed methods; explanatory sequential mixed methods and exploratory sequential mixed methods, and then goes on to discuss how these can be used in more advanced models like the transformative mixed methods design, the embedded mixed methods design or the multiphase mixed methods design. The designs are all described in terms of the weighting given to either qualitative or quantitative data, the order in which mixing occurs and when the mixing occurs.

Several other models are discussed by other researchers like Sandelowski (2000), Creswell and Plano Clark (2011), Johnson and Christensen (2008), Doyle, Brady and Byrne (2009). Even though these models are well designed and very useful, none of them includes the context in which the research takes place.

One component of activity theory that forms an integral part of the activity, is the role of the community and the rules applied by the community (see section 3.3.5 for more detail). This foregrounding of the context (community) is accommodated by David Plowright's Framework for an Integrated Methodology (FraIM) (Plowright, 2011), and FraIM was therefore considered a viable mixed methods option.

Plowright (2011:9) places the emphasis on the research question and argues that this should determine the methodology used. The FraIM includes a detailed analysis of the context in which the study is conducted and advocates that the data should include an analysis of the professional, organisational, and national context; any policies that might have had an influence on the study and a discussion of the theoretical approach followed to conduct the study.

It was therefore decided to use David Plowright's Framework for an Integrated Methodology (FraIM) (Plowright, 2011) as framework for the design of the research methodology.

4.3 The Framework for an Integrated Methodology (FraIM)

David Plowright's framework for an Integrated Methodology is depicted as follows:

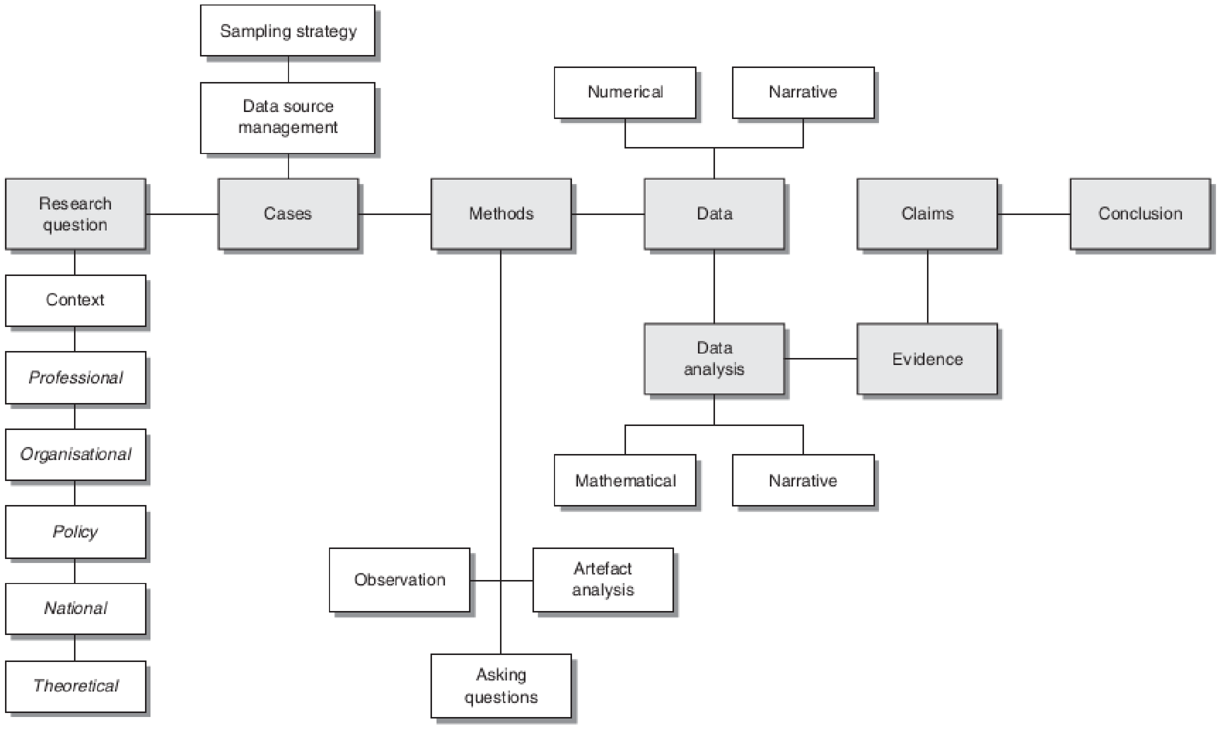

FIGURE 4.1: THE EXTENDED FRAMEWORK FOR AN INTEGRATED METHODOLOGY.
SOURCE: PLOWRIGHT, 2011:9

The research design is determined by the research question, which influences the cases that will be selected, the methods used, the type of data gathered and the data analysis. Five different contexts are identified that influence the research process, namely the professional, organisational, policy, national and theoretical contexts.

The contexts of this study will now be discussed and thereafter the design process that was followed.

4.3.1 Professional context

At the time of completing the study I was employed as a system administrator in the Information Technology Division at Stellenbosch University, where my main role was the administration of the Learning Management System. I also provided technical support to lecturers. In this capacity I developed the audience response software used by the University and therefore also supported the use of the audience response technology. This role enabled me to work closely with lecturers in the design and development of the audience response software.

Prior to joining the University I was a high school teacher for sixteen years, having completed a Higher Education Diploma after my Bachelor's degree. I also completed a Master's degree in Hypermedia for Language Learning, in which I revisited learning theories and the use of technology as part of online learning. This gave me a solid background in the pedagogical aspects of the implementation of the audience response technology.

Working closely with the lecturers enabled me to determine what their requirements of the audience response technology were and I could therefore develop the audience response software accordingly.

4.3.2 Organisational context

Stellenbosch University (SU) is based in the Western Cape in South Africa. It has approximately 29 000 students of which 4 000 are foreign students from 100 different countries. "The university is one of South Africa's leading tertiary institutions based on research output, student pass rates and rated scientists, and is recognised internationally as an academic institution of excellence. It has the highest student success rate in the country" (Discover Stellenbosch University).

In the preface to the SU Institutional Intent and Strategy, the then Vice-chancellor, Prof Russel Botman, advocated for more flexibility and innovation in order to respond to continuous change, expressing his belief that technology will help to sustain and accelerate the University's growth beyond 2020 (Institutional Intent and Strategy 2013 – 2018: 4). Objectives of the University include the increasing of undergraduate success rate and retention rates of first-year students (Institutional Plan: 2012 – 2016: 8). In order to achieve these objectives SU promotes innovation in teaching and learning and emphasizes technologically mediated instruction (SU Institutional Intent and Strategy 2013 – 2018: 9).

The University's primary mode of delivery is facilitated in-class learning, supported by technology e.g. the learning management system. Innovation and research in teaching and learning is encouraged and several lecturers do research on the integration of technology as part of their teaching and learning.

As pointed out above, SU, in keeping with international trends, adopted as one of its strategies in its new Institutional Intent and Strategy for the years 2013 – 2018, the increase in the use of technology in teaching and learning. The aim was to "blend information and communications technologies with a sound tertiary educational pedagogy, with a focus on learning and not just on teaching, which will contribute to easier, more effective and affordable learning opportunities" (SU Institutional Intent and Strategy, 2013 – 2018:16).

One of the institutional divisions that is central to this strategy, is the Centre for Learning Technologies (CLT), previously consisting of six staff members who were responsible for providing support to all lecturers and students in the use of technology. One of the strategies of CLT that was implemented at the beginning of 2013 was to place support staff in each faculty, who would work together with CLT to provide support for lecturers with the integration of ICTs. Some of the strategies of CLT included increasing interactivity in class, the use of technology in assessment, the introduction of MOOCs (Massive Open Online Courses) and the use of ICT in offering short courses. Support for lecturers would include tailor-made workshops, presentations, demonstrations and "hands-on" sessions of latest trends, e-learning short courses and e-learning partnerships (Strategy for the use of ICT in learning and teaching at Stellenbosch University, 2013:18).

Plans to encourage lecturers to adopt ICT include the following:

- The development of ICT skills to form part of the work agreement and development plan of lecturers.
- Successes will be acknowledged in the annual performance appraisal.
- Promoting research on the use of ICT in Learning and Technology.
- Allowing students to assess the lecturer's use of ICTs as part of the student feedback programme (Strategy for the use of ICT in learning and teaching at Stellenbosch University, 2013:18).

4.3.3 Policy context

Currently no policies exists regarding the integration of technology as part of teaching and learning at Stellenbosch University.

However, a task group that was appointed at Stellenbosch University to formulate a vision and strategy for the effective incorporation of technology into teaching and learning has as part of its vision the drafting of the following policies:

- The assessment policy's guidelines for e-assessment, including formative and summative assessment.
- The recording of lectures by students and other student-generated content.
- The giving of students and lecturers affordable access to academic electronic sources.
- A policy that will address electronic security risks around the use of technology as part of teaching and learning.
- Policies around the integration of technology into teaching and learning, assessment policy, incentives as part of performance evaluation, copyright and equity of access.

(Strategy for the use of ICT in learning and teaching at Stellenbosch University, 2013)

4.3.4 National context

In The White Paper on e-Education (2004), compiled by the Department of Education, South Africa, it is stated that the use of ICTs in education can improve the quality of education and training. The White Paper also recognises the fact that ICTs influence curriculum development and delivery and continues to pose challenges for education and training systems around the world (The White Paper on e-Education, 2004:8).

It further highlights the digital divide between Africa and the remainder of the world which includes connectivity and infrastructure disparities, knowledge generation and the overcoming of cultural inhibitions and uncertainties about using ICTs (The White Paper on e-Education, 2004:9).

In order to overcome this under-development, Africa adopted a renewal framework in 2004, the New Partnership for Africa's Development (NEPAD), which believes that ICTs can be a contributing factor in the struggle against poverty on the continent. "ICTs provide hope for overcoming barriers of social and geographical isolation, increase access to information and education, and enable the poor to participate in the making of decisions that have an impact on their lives." (The White Paper on e-Education, 2004:9) It is further stated that:

"The introduction of information and communication technologies (ICTs) in education represents an important part of Government's strategy to improve the

quality of learning and teaching across the education and training system. The policy intention is to focus on learning and teaching for a new generation of young people who are growing up in a digital world and are comfortable with technology. GET and FET institutions must reflect these realities" (The White Paper on e-Education, 2004:19).

However, high connectivity and telecommunication costs, and inadequate technical and pedagogical support were but some of the barriers experienced which prohibited the integration of technology into education. Also the ability of educators and learners to use technologies effectively slowed the progress to integrate ICTs into teaching and learning.

Even though this White Paper was written in 2004, the status quo in educational institutions had changed very little at the time of completion of this study. Only a few general educational institutions managed to integrate technology as part of teaching and learning. This means that the majority of students who come to university still have no background in the use of technology as part of teaching and learning.

4.3.5 Theoretical context

A comprehensive literature review was completed about audience response technology and problems experienced with the integration of audience response activities. This included the concern about the world-wide lack of pedagogical approaches towards the use of audience response technology. The literature review also included the investigation of learning theories and learning design which determine the pedagogical approach and methods used to develop lesson designs. Activity theory, together with the literature review, provided the theoretical lens through which the data was analysed.

This concludes the background on the five contexts of this study. I will now discuss the different components of the research design which includes the research question, the case study design, the methods of data collection and the data analysis.

4.4 Components of research design

According to Plowright (2011:24) the research question determines what the sources of data will be. He distinguishes three design types according to which data can be organised, namely the case study, the experiment and the questionnaire. He further identifies three characteristics that identify each design type. They are the number of cases in the research; the degree of control the researcher has over the allocation of cases and the degree of 'naturalness' or researcher intervention in the research situation. These characteristics were taken into account in my decisions on a design type for this study.

4.4.1 The research question

Like Plowright (2011:24), Yin also argues that the research question determines the choice of the design type, and distinguishes between 'how' and 'why' questions (Yin, 2014:9).

The fact that audience response technology can contribute to active learning is evident from cases described in literature. Yet, in this study a large number of lecturers at the University started using the audience response software, but stopped using it after a while. It some cases it did not lead to better teaching and learning, but in other cases it did. All the lecturers used the same software under the same conditions. So why did it work for some, but not for others? Which factors hindered the successful implementation?

The primary research question which I hoped to answer through this study was thus:

- How should an audience response activity be implemented to ensure effective active learning?

A number of related sub-questions which were also taken into consideration are:

- What contradictions had an impact on the success of the implementation of the audience response activities?
- What are the critical elements that should be included in a design model intended to facilitate the successful implementation of audience response technology, as part of active learning?

- Which support structures should be in place to assist and support lecturers in the implementation of audience response technology?

In order to answer these questions it was necessary to conduct a study on how lecturers were using the system and to try to determine which factors contributed to the successful implementation of audience response activities and which factors hindered the successful implementation. Each case had to be studied in depth, including all factors which had an influence on the audience response activity, namely the audience response technology, the lecturer and the students involved. I therefore decided to follow a case study approach, limiting the number of cases studies so that I could complete an in depth analysis of each case.

Gerring defines a 'case' as a "spatially delimited phenomenon (a unit) observed at a single point in time or over some period of time" (Gerring, 2007:19). Yin (2014:14) argues that the case study is preferred when studying contemporary events over which the researcher has no control. He recognises that the boundaries between phenomenon and context are unclear so that "other methodological characteristics become relevant as the features of a case study". He further emphasises that there will be "many more variables of interest than data points" and that one should therefore rely on "multiple sources of evidence, with data needing to converge in a triangular fashion" (Yin, 2014:14). Using multiple sources of data collection to ensure validity is also stressed by Plowright (2011:138)

All of the above conditions were present in the phenomenon that I intended investigating, and this confirmed the appropriateness of the case study design for this study.

4.4.2 Case study design

4.4.2.1 Descriptive, exploratory and explanatory case study research

The aim of this study was to investigate the factors which contributed to the success and failure of the implementation of audience response technology. In order to do this I had to explore the activity from the point of view of the lecturers and the students, and also from my own point of view as an outsider to try to include as much data as possible (bot qualitative and quantitative) to be able to develop a comprehensive view of each audience response activity implementation. By looking at the activity from all angles and gathering and analysing multiple forms of data, I hoped to be able to identify all the possible factors which had an influence on the audience response implementations.

Three types of case study designs are identified; descriptive, exploratory and explanatory.

Bleijenberg (2010:3) describes a descriptive case study as a number of cases with common characteristics that can be studied. While descriptive case studies describe cases separately the focus is not on looking for common patterns or explanations. Yin (1993:22) also typifies a descriptive case study as "a complete description of a phenomenon within its context." I concluded that this study was not descriptive in nature, because the aim was to look for common patterns and explanations as well.

According to Bleijenberg (2010:4) in exploratory case studies the focus is on developing hypotheses or theories that will explain the social phenomenon. Exploratory case studies use an inductive approach. For Yin (1993:22) the focus of exploratory research is on defining the questions and hypotheses of previous studies or focusing on testing the feasibility of research procedures used as part of a proposed study. Streb (2010:374) notes that a feature of exploratory case studies is often the lack of detailed preliminary research, the fact that there usually is not a formulated hypothesis that can be tested, and that this form of study is often done as a preliminary step to an explanatory research study.

For Bleijenberg (2010:4), explanatory research focuses on theoretical considerations and lends itself to a deductive research design. This gives the researcher the opportunity for falsifying existing theories or hypotheses. Yin (1993:22) states that an explanatory case study should explain cause-effect relationships; which causes produced which effects. Harder (2010) describes explanatory case studies as having both qualitative and quantitative research methods, exploring and describing phenomena and explaining causal relationships. This then leads to the development of theory.

This study is therefore explanatory in nature. It looks at a number of cause-effect relationships, e.g. the role of learning design, active learning and factors which inhibit the successful implementation of audience response technology. The research methods include qualitative and quantitative research methods and then ultimately the study develops a framework around the use of audience response technology.

4.4.2.2 Holistic versus embedded case studies

Yin describes the following basic types of designs for case studies:

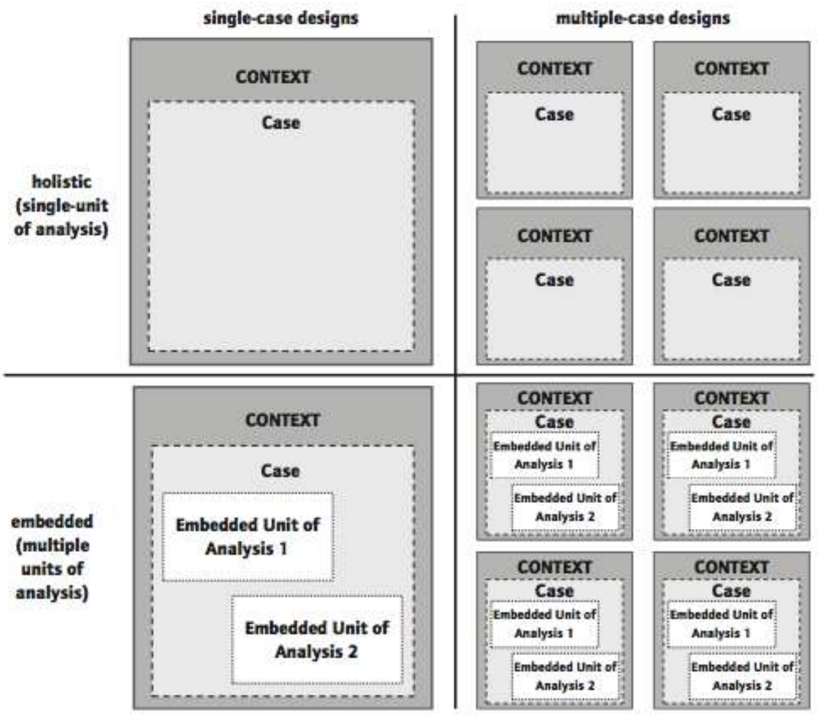

FIGURE 4.2 BASIC TYPES OF DESIGNS FOR CASE STUDIES
SOURCE: YIN, 2014:50

If, as part of a single case study, subunits are also investigated then it is said that the study follows an *embedded case study design* approach. If, however, the study only looks holistically at a study, then a *holistic design* is used.

A holistic design can be used if no logical subunits can be identified, or if the underlying theory is of a holistic nature. This type of research could however lead to a study being conducted at an abstract level lacking clear measures or data or it can become too generalized omitting operational detail.

At the other end, Yin (2014:55) warns that when following an embedded design approach, care should be taken not to only focus on the subunit level, but to focus also on the larger unit of analysis, or the study might become a multiple-case study of different projects.

There are many factors that contribute to the holistic nature of this study e.g. most students went to South African schools and most have never used technology as part of the learning process. Within the University, all modules should adhere to the same policies e.g. policies regarding assessment. All the lecturers made use of the same tool. Therefore, I could have pooled all the data together and analysed all the cases as one. There are, however, also several factors which make each case unique; the way in which the tool was used as part of the lecturer's learning plan; the lecturer's personality, the subject content, the number of students per module, year group, and so on. It was therefore decided to study each case separately, but to also look at the holistic picture to identify the factors that influenced all the cases.

Bishop (2010:588) states that one of the strengths of the multiple-case study is that both common and unique characteristics can be identified, which leads to richer and deeper understandings of a phenomenon, but then each case must be separately analysed.

In an embedded design the results of a questionnaire will not be pooled across different case studies, but the findings will be kept to each individual case. With this study, it was decided to follow an embedded design approach, but to also focus on the University as a whole. Cases needed to be studied individually, because the results of each case study would have been directly influenced by factors which would have been unique in each case and one of the aims of the study was to identify these factors. At the same time, a holistic view was also required because there were common factors that influenced all the cases.

The design of this study is therefore depicted as follows:

FIGURE 4.3: CONTEXT OF THIS STUDY

The context of the faculties was excluded from the design, because it was found that the faculties themselves did not influence the audience response activities in any way.

This study follows both an embedded design and a holistic design approach. The different cases were analysed individually, but common factors were also identified and analysed.

4.4.2.3 Selection of cases

Most of the studies on audience response technology available in literature were conducted in the Faculties of Sciences, in subjects like Chemistry. This is also where most of the success stories around the use of audience response technology are found. So the question was: can only so-called hard sciences benefit from the use of audience response technology or can any subject benefit? A number of lecturers from various subjects used the audience response software, which made it possible to select case studies from other disciplines as well. So the first criterion for the selection of cases was that each case study had to be from a different discipline, including as many different disciplines as possible. Class size and year group were also factors taken into consideration.

The second criterion for selection was that the lecturer had to use the audience response technology as part of active learning. A number of lecturers used the system for assessment purposes. These cases were therefore excluded.

I wanted to select cases from as many different disciplines as possible, but my choices were limited to the lecturers who used the audience response software.

The first lecturer who started introducing audience response activities in 2011 was in the Science Faculty. A number of lecturers followed from this faculty. From 2012 the audience response software was also used by a few lecturers from the Faculty of Economic and Management Sciences. Then a few lecturers from the Faculty of Education followed. The remainder of the ten faculties had very few lecturers who used the system.

Eventually two cases were selected from the Faculty of Education, two from the Faculty of Sciences and one from the Faculty of Economic and Management Sciences. However, the subject content differed extensively among the different subjects, ranging from ones where the focus is on application to others with purely theoretical subject matter. The following table provides a layout of the different subjects selected for the cases.

TABLE 4.1: SUMMARY OF CASE STUDIES

Subject	**Chemistry**	**Bio-chemistry**	**Logistics**	**Mathematics (Educ.)**	**English (Educ.)**
Number of students	240	60	183	82	65
Year group	1st year	3rd year	3rd year	4th year	2nd year

The strategic selection of cases was done taking cognisance of the following guidelines by Yin (2014:57):

> *"Each case must be carefully selected so that it either (a) predicts similar results (a literal replication) or (b) predicts contrasting results but for anticipatable reasons (a theoretical replication). The ability to conduct 6 to 10 case studies, arranged affectively within a multiple-case design, is analogous to the ability to conduct 6 to 10 experiments on related topics; a few cases (2 or 3) would be literal replications, whereas a few other cases (4 to 6) might be designed to pursue two different patterns of theoretical replications" (Yin, 2014:57).*

More than three cases were needed, because I expected the results to follow different patterns and I needed to explore these patterns. Each case applied the audience response technology differently, had different results and experienced different levels of success. However, five case studies were regarded as sufficient, because an in depth analysis of each case was needed, rather than selecting more and only doing a surface analysis of each.

4.4.3 Data collection

A major strength of the case study, according to Yin (2014:119f), is that different sources of evidence can be used. The most important advantage of using multiple sources is the development of converging evidence. "By developing convergent evidence, data triangulation helps to strengthen the construct validity of your case study. The multiple sources of evidence essentially provide multiple measures of the same phenomenon" (Yin, 2014:121).

Whereas Yin (2014:105) distinguishes six different types of sources, namely documentation, archival records, interviews, direct observations, participant-observation, and physical artefacts, Plowright (2011:49) aggregates sources of evidence into three categories namely observation, asking questions and artefact analysis. Data collection methods for this study consisted of questionnaires and individual interviews, i.e. asking questions, observation and artefact analysis.

4.4.3.1 Observation

Data obtained by means of observation are generally thought to be more objective than own accounts, i.e. self-reported data (Bergman, 2008; Sandelowski, 2000). Observations of the lessons allowed me to better interpret the results of the interviews with the lecturers and the results obtained by the questionnaire of the students. The observations were done according to a self-designed schedule based on activity theory. (See Addendum F for the observation schedule.) Aspects like the subject, the object, the tool and the context were studied. These were compared to the results of the interviews and the questionnaire. Only one observation per case was conducted. This was sufficient to examine how the audience response activity was integrated into the lesson design.

Ideally the role of observer should have been that of full-observer, where the participants were completely unaware of being observed, and I could stay completely detached, but most often my role was that of observer-as-participant. Ethical consideration determined that I could not attend a class without the knowledge of the lecturer and the students. It was therefore necessary to carry out the research as observer-as-participant, and the lecturer and students were aware of being observed. I usually sat at the back of the class so that I could observe the class proceedings *in toto,* including external elements such as lighting and sound, which could have an influence on the use of the audience response technology. Since most of the classrooms have a raised seating plan, I had a bird's eye view of the whole procedure and I could observe the lecturer and the students simultaneously.

Observation allowed me to note elements that interfered with the working of the audience response technology that the participants were usually unaware of and which they would never have thought of mentioning during the interviews or when responding to the questionnaire. For example, in one lesson, the sound system was not very effective, and the students at the back could not hear the instructions clearly. This had a negative impact on the success of the lesson; therefore an external factor influencing the main activity, which I would not have picked up if I had not attended the lesson.

I was introduced to the students as a PhD student. I believe that this contributed to setting the students at ease so that they did not act differently from the way they normally did and the results of the study were not influenced by the Hawthorne effect of my presence.

Observation also allowed me to cross-check the data that was obtained during the interviews and the questionnaire, which strengthened the validity of this study (Simons, 2009:55).

4.4.3.2 Asking questions

(a) Interviews with lecturers

The interviews with the lecturers following a structured approach. A predetermined set of questions was used. (See Addendum D for the lecturer interview schedule.) This was followed up with open ended questions. The lecturer was asked to explain the reasoning behind the use of the audience response technology, how their lesson design was altered to accommodate the integration of the audience response activities and how they interpreted the feedback given by audience response software. The aim of the interviews was to understand how the lecturers experienced the integration process and to determine their needs and expectations with regard to audience response technology.

(b) Student questionnaire

The questionnaire distributed to the students also contained closed and open ended questions, allowing for the collection of both numerical and narrative data. (See Addendum E for student questionnaire.) The questionnaire was deployed in each module on the university's Learning Management System, so the students would not have to search for it. Completion of the questionnaire was voluntary. The aim of the questionnaire was to understand how the students experienced the audience response activities. It was necessary to determine if the students understood why lecturers incorporated audience response activities in the teaching and learning process and what their attitude was towards this integration. It was also necessary to determine what aspects of the audience response activity the students found advantageous to their learning process and what not.

4.4.3.3 Artefact analysis

It is important to note that the artefact analysis of this study differs from the artefact analysis as described by Plowright (2011). The types of artefacts listed by Plowright (2011:93), include different kinds of texts, visual aids and media. These artefacts are typified as either informational, presentational, representational or interpretational (Plowright, 2011:94). In short, for Plowright, artefacts are material that information can be gathered from.

In this study artefact analysis comprised the analysis of the artefact used, namely the audience response technology. It was found necessary to analyse the tool used that formed part of the audience response activity, because together with the activity itself, it also influenced the results of the study.

In order to generalise the results of the research, the audience response technology used should be analysed and compared to similar technology to determine if this particular technology had an impact on the success or failure of the audience response activities. Lecturers were encouraged to use other audience response technology, but this particular audience response software was created to work under the classroom conditions of the University and the lecturers preferred to use this technology.

A holistic approach was followed with the artefact analysis, since all the lecturers used the same system. This included defining the strengths and weaknesses of the technology used and identifying where it might have contributed to the success or failure of the implementation of the audience response activities.

4.4.4 Data analysis

Each case study was individually analysed using activity theory as theoretical lens. Each analysis started with mapping the activity using the results from the observation schedule. Then the data gathered during the lecturer interviews was used to complete the structure of the activity and to gain an understanding of the design of the lesson.

Subsequently the numerical results of the student questionnaire were analysed. These were compared and contrasted to the narrative answers to the open-ended questions in the questionnaire. The numerical results were therefore supplemented with the narrative results. This was done to identify possible explanations for the numerical results.

The results of the analysis were warranted by referring back to the content from the literature study and this made it possible to develop a framework which can be used to ensure the successful implementation of audience response activities as part of active learning.

Warranty of results is explained in the next section.

4.4.5 Warrantable research

According to Bergman, the idea behind triangulation is that "by drawing data from sources that have very different potential threats to validity it is possible to reduce the chances of reaching false conclusions" (Bergman, 2008:23). This notion that multiple forms of data strengthens triangulation, is echoed by a number of researchers, like Creswell and Plano Clark (2007); Freshwater (2007); and Spratt, Walker and Robinson (2004).

Traditionally, reliability and validity are two terms associated with quantitative data, whereas credibility and trustworthiness are associated with qualitative data (Mertens, 2011:4). However, the researcher should find criteria unique to mixed methods studies.

Bergman (2008:105) claims that the term 'validity' has lost it meaning and become obsolete, because there is so much confusion around the term. The term legitimation is used by many researchers and Onwuegbuzie and Johnson (2006:52) define the problem of legitimation as "the difficulty in obtaining findings and/or making inferences that are credible, trustworthy, dependable, transferable, and/or confirmable".

Plowright (2011:136) argues that these terms are all linked to an existing paradigm and that selecting any one of these terms cannot work in a mixed methods approach. He further states that research is a process and that the whole design and process should lead to credible answers. He refers to this process as warrantable research.

Plowright (2011:142) explains that to warrant the findings of the study, the researcher needs to be able to explicitly substantiate the conclusion of the study, referring to the policy and theoretical contexts of the research. The strength of the warrant lies in the researcher's ability to support his findings by being able to quote evidence from published literature.

4.5 Ethical considerations

Approval was received from the Research Ethics Committee: Human Research of Stellenbosch University to conduct the study (Addendum A). Institutional permission was also granted by the Division for Institutional Research and Planning (Addendum B). All participation was voluntary. Written consent (Addendum D) was given by each lecturer who participated in the study for me to conduct observations and to participate in the interviews. The student questionnaire was delivered on the university's learning management system, therefore the students had to answer the questionnaire online. The questionnaire was anonymous. The study was explained to them and the students were expected to give consent to using their answers as part of the study (see question 1 of Addendum E).

Data capturing was done during the first semester of 2013. The literature review was conducted from 2009 until the submission of the thesis. The results of the observation, questionnaire and interviews were kept on my computer protected by a password. No one else had access to the data.

4.6 Conclusion

The usefulness of adopting a mixed methods approach to this study is illustrated by the following example quoted by Viadero (2005:1): "If Northwestern University researcher Greg J. Duncan and his colleagues hadn't used more than one research method to study an anti-poverty experiment in Milwaukee, they would never have known about the gangs and the sneakers". Likewise, if I had not done classroom observation, I would not have known about the poor sound system; if I had not used open ended questions in the questionnaire, I would not have known about the difficulty students had to complete large numbers on a small screen; if I had not used a questionnaire to question the students, I would not have known that the majority of students are positive about the use of mobile devices as part of their learning. Using a mixed methods approach made it possible for me to conduct a study in which I could triangulate results and that is warrantable.

By analysing each case study separately and then comparing and contrasting them with one another and with what was found in the literature review, I was able to determine which factors led to the successful implementation of the audience response activity and which factors prevented the successful implementation. Thereby a framework could be developed which can be used to effectively design lesson activities that include the use of audience response activities, eventually leading to improved learning.

The next chapter comprises the complete data analysis of this study.

Chapter 5
Data analysis

5.1 Introduction

The previous chapter made a strong case for the adoption of a mixed methods approach and a case study design for this research project. These choices are vindicated by a systematic review of 67 peer-reviewed articles on the use of audience response activities as part of education by Kay and LeSage (2009). Not only did they identify four areas that for future research, one of which was to determine specific benefits and challenges that influence the use of audience response technology (Kay & LeSage, 2009:826), but they also levelled some criticism against current research being mainly qualitative. They argued that both qualitative and quantitative data are necessary to fully research the use of audience response technology (Kay & LeSage, 2009:825). By using a mixed methods approach, a case study design and by including both quantitative and qualitative data, this study attempts to offer a more holistic picture of the challenges in the use of audience response technology.

Activity theory provides the theoretical lens through which this data is analysed. Separating the activity into different components, makes it possible to identify contradictions that have an impact on the activity. This chapter therefore comprises the data analysis viewed through the activity theory lens.

5.2 The five principles of activity theory

The five principles of activity theory as described by Engeström (2001:136-137) will be used to examine each case. The five principles are defined as follows:

1. The activity itself, consisting of a subject, tool and object, including both individual and group actions and operations.
2. The multi-voicedness of the activity which includes the numerous points of view, traditions and interests. This includes the division of labour which organises the participants into different roles.
3. Historicity: The theories and tools which had an influence on the formation of the activity.
4. Contradictions: When the old rules collide with the new rules and more specifically:

   a. Inner contradictions e.g. when an educator becomes dissatisfied with current teaching methods and decides to implement new teaching methods.
   b. Secondary contradictions: e.g. traditional teaching methods versus new methods.
   c. Tertiary contradictions: when external objects try to replace existing objects e.g. when technology replaces paper.
   d. Quaternary contradictions between a central activity and closely related activities.
5. Expansive transformations in activity systems. When collaboration and collective efforts bring about change.

The audience response activity is first analysed according to the five principles to establish the guidelines according to which the different cases will be analysed.

5.2.1 The activity, actions and operations

The different actions that form part of the audience response activity can be mapped according to the different cycles of a process model. The main stages of the process model; analysis, design, development, implementation and evaluation also form the stages of the audience response activity. The first actions are the analysis and design of the audience response activity. These are followed by the development of the activity in the available software. Then comes the implementation action, which is followed by the evaluation action.

A more detailed breakdown of each action now follows:

5.2.1.1 Action 1: Analysis and Design

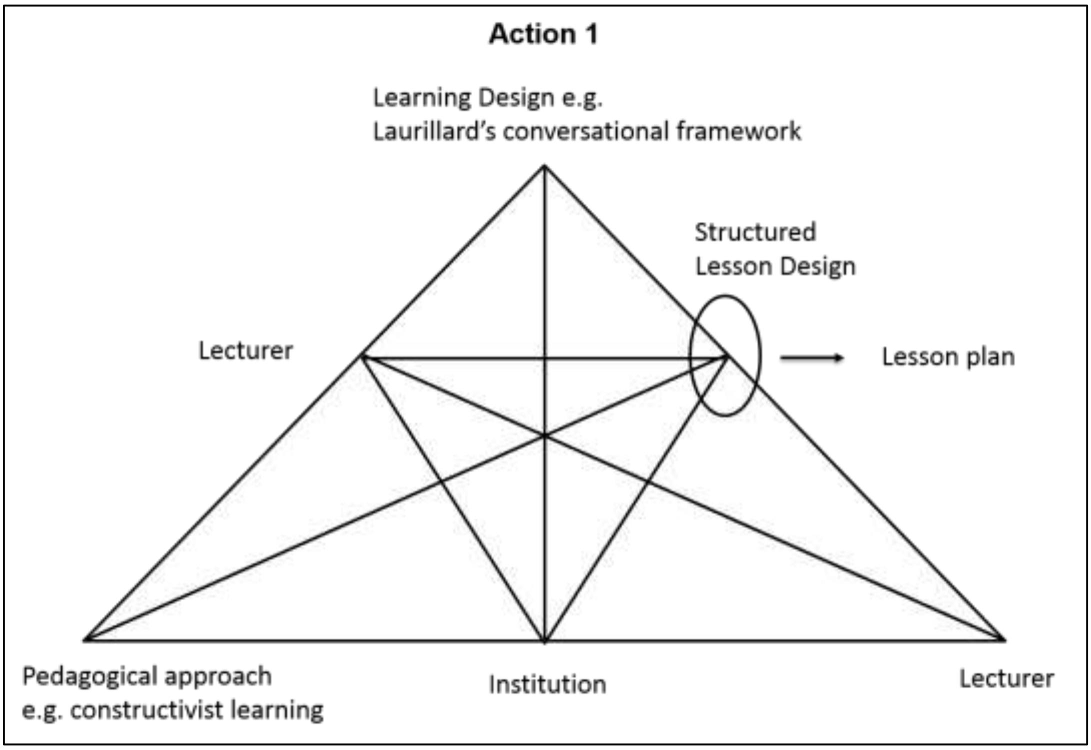

Figure 5.1 Audience response activity – Action 1

Action 1 is made up of the first two stages of the process model; the analysis and design phase. The lecturer (subject) uses a specific learning design (tool) to develop a lesson plan (outcome) that is governed by the pedagogical approach (rules) that is followed. The outcome of the action is a lesson plan that will be followed. The object of this action is not the audience response activity itself, but the lesson plan. This lesson plan includes the different actions of the lesson, one of which is the introduction of one or more audience response activities. The lesson plan should include the motivation for using the audience response activity, the questions that will be asked; and how the aggregated feedback from the system will be handled to determine the flow of the lesson.

After the analysis and design action have been completed, the development can proceed.

5.2.1.2 Action 2: Development

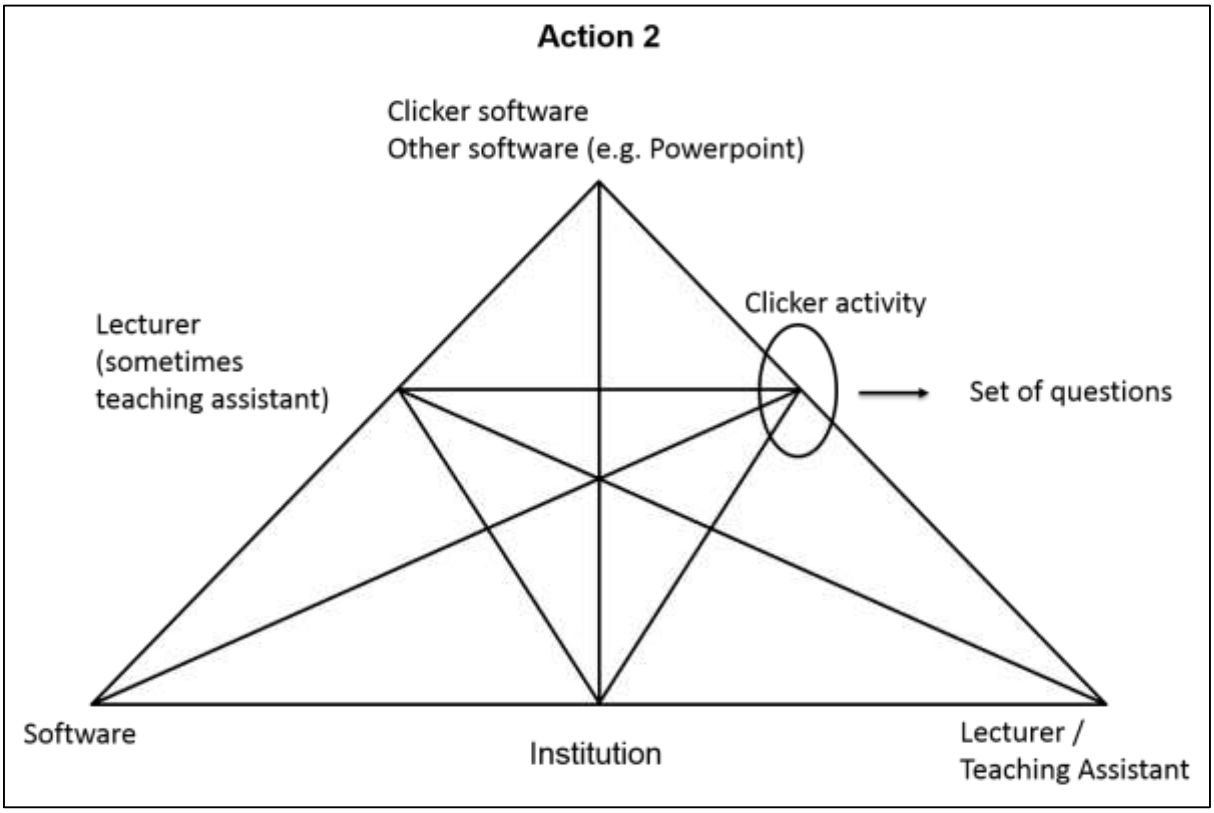

Figure 5.2: Audience response activity - Action 2

The second action is the development of the audience response activity on the available platform. This action is sometimes assigned to a teaching assistant to complete. The specific rules of the software being used should be followed to create the object, namely the audience response activity. Sometimes other software is included, e.g. the lecturer might decide to display the questions in a Powerpoint presentation. The outcome is then a set of questions that will be asked during the implementation. A number of operations form part of this action, namely to log in to the LMS, to turn the editing button on, to select the audience response activity from the available list of activities; enter a title, add questions and then to save it.

The implementation phase is made up of two actions; action 3 and 4. Action 3 is the introduction of the audience response activity by the lecturer and action 4 is the answering of the questions by the students.

5.2.1.3 Actions 3 & 4: Implementation

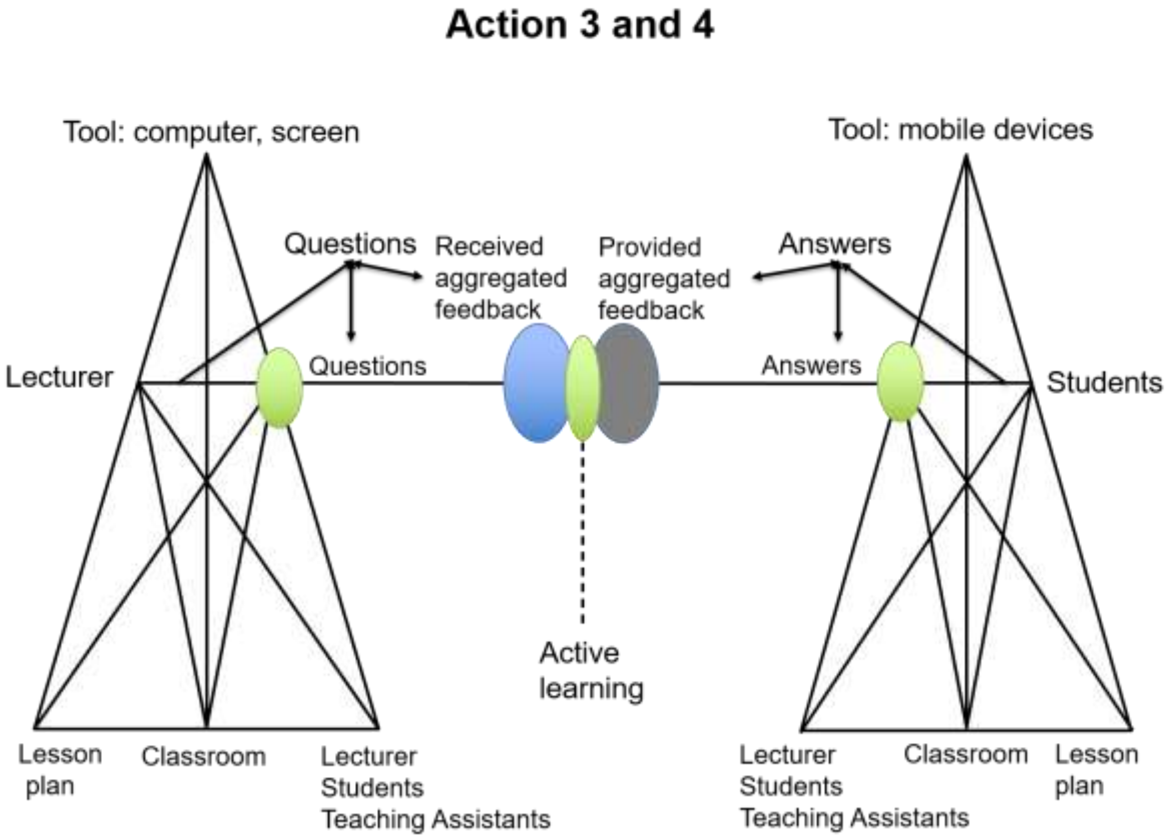

Figure 5.3: Audience response activity - Actions 3 & 4

The lecturer (subject) introduces the audience response activity by asking a question (the object). The tool used is a computer with the relevant software and a screen so that the students can see the question. The lecturer might either verbally ask the question as well, or expect the students to just read it on the screen. The question then becomes the sign directed at the students which they have to interpret. This question then becomes the object, which after having been answered by the students, will lead to the aggregated feedback by the system. This feedback then becomes the sign again that the lecturer must interpret and make sense of.

The rules of the lesson plan need to be followed and the outcome of this action is to get the students to answer the question(s). Some operations which form part of this activity is the display of the questions, sometimes on a Powerpoint presentation, which means that a separate programme needs to be opened. The lecturer needs to log into the audience response system and navigate to the screen where the feedback will be displayed.

The students (subject) use their mobile devices to navigate to the answer screen, where they complete the answer (object). The answer then becomes the sign which is interpreted by the audience response software to provide the aggregated feedback, directed at the lecturer. For active learning to take place, the students should take the answer (the sign) and turn it into an object again, at which time they need to defend the answer given (now the object), ensuring that they actively thought about the question, in other words, that some form of higher-order thinking took place during the answering of the question. The students have to follow the lesson plan (the rules) as determined by the lecturer. The objective of the audience response activity is active learning, which should be the motivational drive for both the lecturer and the students to participate in this activity.

After having received the aggregated data, the lecturer then decides how to proceed with the lesson. After the lesson another action should follow which is the evaluation phase where the lecturer determines the outcome of the lesson plan and how to improve on subsequent lesson plans.

5.2.1.4 Action 5: Evaluation

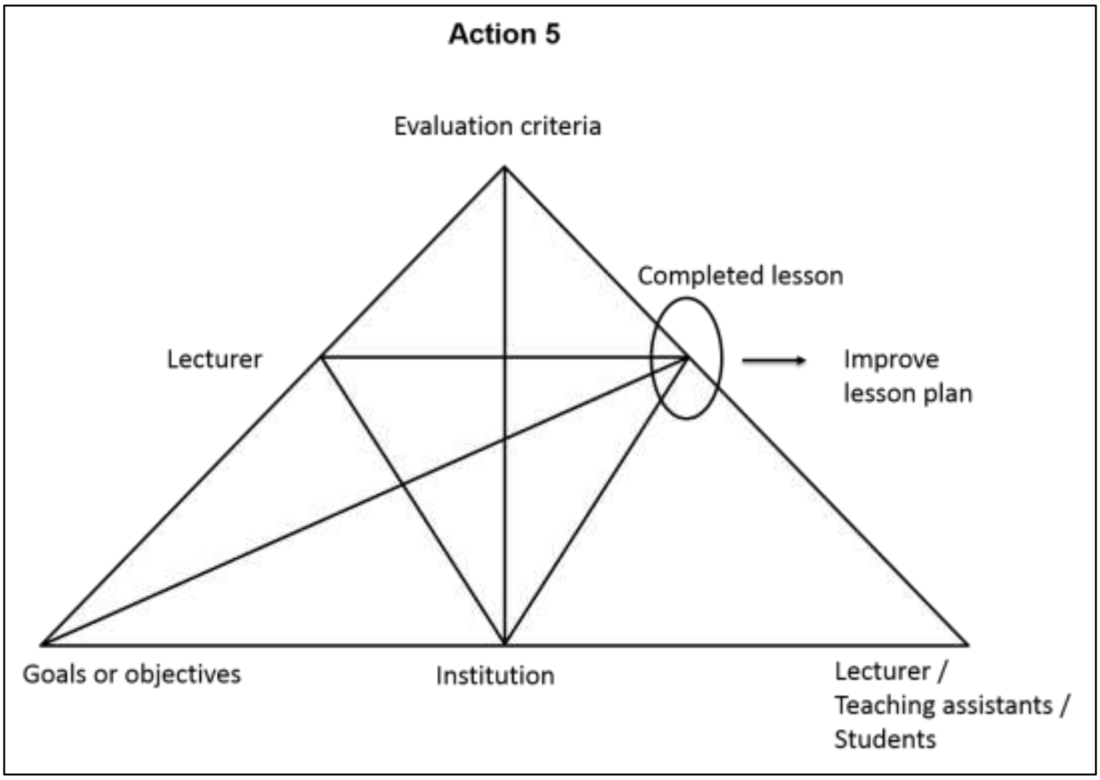

Figure 5.4: Audience response activity - Action 5

The lecturer evaluates the lesson using evaluation criteria. These criteria are created according to the goals and objectives for the lesson determined during action one, the analysis phase.

The audience response technology (the artefact) will not be analysed per case study, because all the lecturers used the same technology. A holistic analysis of the audience response technology will be given after the individual analyses of the cases.

5.2.2 Multi-voicedness

Education debates are characterised by numerous points of view when it comes to pedagogical approaches and especially the use of technology as part of education. At the one end of the spectrum there are those who prefer traditional teaching methods and do not believe that change is necessary. At the other end of the spectrum are those who believe that the old methods do not work anymore and that change is essential.

Stellenbosch University is no exception. The lecturers who participated in this case study are all lecturers who felt that they needed to improve their teaching methods, taking into account that the institution is open to change and allows lecturers to explore new teaching methods.

A number of role players are necessary to enable the success of the introduction of new teaching methods, i.e. the lecturer, teaching assistants who can help in the process and support from the Centre for Teaching and Learning. If the new teaching method includes the introduction of new technology, the Centre for Learning Technologies and Information Technology Division are two crucial role players that should also be included.

That said; the role player very often forgotten, is the student. Students are often subjected to new teaching methods without taking them into consideration. The new methods and especially the reasons behind using the new methods are often not explained to them, i.e. very little meta-level communication takes place. The students come from a school background where they became used to rote-learning and suddenly it is expected of them to change their learning styles without informing them why. If students understand the reasons behind the introduction of a new activity, they may be more motivated to participate in it.

A part of action one, the analysis phase should be the analysis of all the role players who will form part of a particular activity and which roles they will play. It is important to include the analysis of the students. This is especially relevant where students come from diverse backgrounds.

5.2.3 Historicity

The general lack of response from students during lessons is one of the main reasons for the introduction of the audience response activity. In the traditional classroom, a lecturer would explain new concepts to students, and would then ask a question which the students had to answer in order for the lecturer to determine whether the students understood the new concepts or not. This was often met with poor response from the students. The reasons for the poor response are varied, but it necessitated the introduction of a solution.

Another reason for the introduction of audience response technology was that students seemed very disengaged during classroom activities, so in order to get students to actively participate activities were needed that would motivate students to participate and contribute to the lesson flow, even in large classes.

The introduction of the audience response activity is therefore characterised by a number of contradictions which lead to the incorporation of the audience response activity, which in turn lead to a number of other contradictions during and after the implementation. Some of the more general contradictions which form part of the audience response activity will now be explored in more detail.

5.2.4 Contradictions

Starting with the point of view of the lecturer, the primary or inner contradiction need state entails that the lecturer is dissatisfied with the current status quo and wants to change his/her current teaching methods. Some reasons for this were mentioned above; others are that the students do not participate in class activities; the lecturer does not know where the knowledge gaps are; the students perform poorly in tests and examinations and the lecturer wants to improve student performance.

The lecturer therefore introduces the audience response activity. This introduces secondary contradictions. One of these could be that audience response activities are time consuming and that the lecturer is pressed for time as the curriculum needs to be completed in a fixed amount of time.

The difference in the object or motive of students i.e. to memorise the subject matter so that they can pass at the end of the year; and the introduction of active learning by the lecturer to make the whole learning experience more meaningful, leads to tertiary contradictions.

Conflicts between the central activity and one of its neighbouring activities then arise. This results in quaternary contradictions. These contradictions will be discussed in more detail during the analysis of the case studies.

5.2.5 Expansive transformations

In some cases, the successful implementation of the audience response activity leads to expansive transformations. This will be holistically discussed and not individually.

Each case study will now be analysed according to the first four principles.

5.3 Case study 1: Mathematics Education

5.3.1 Activity

The subject is Mathematics Education for fourth year students. Students do not only learn how to do Mathematics but also how they will teach Mathematics in schools. There are approximately 60 students in the class during the class observation. The lesson is performed as follows:

The lecturer starts with a general introduction to the concept of assessment. The students are instructed to discuss two questions in pairs.

1) What is assessment?
2) Why would you assess?

The class is active and a lively discussion in which most students participate, follows. There are a few students who do not participate. When the lecturer asks for feedback, a few students raise their hands to give feedback on what they discussed.

Then a video is shown and questions are asked about the video which the students have to discuss again. Then an audience response activity is introduced.

Question: Which of the following should be assessed?

a) Basic skills
b) Knowledge and methods
c) Feelings and beliefs about mathematics
d) Processes

The students use their mobile devices to answer the question. The aggregated feedback from the system is not shown to the students, but they are instructed to find another student who votes differently and try to convince that person to change his or her opinion. A lively discussion follows. The lecturer tells them that the aggregated feedback will be discussed during a subsequent lesson.

The lecturer uses question-driven instruction throughout the lesson, even though she does not make use of the audience response technology with every question. The type of questions asked raise a number of related issues, which the students then have the opportunity to discuss. All the questions are followed up by peer or group discussions enabling the students to clarify and defend their points of view. The audience response software is only used with the last question of the lesson and the students are notified that their answers will be discussed during a follow-up period. The answers of the students are therefore not used during the lesson to adjust teaching decisions, but the aggregated feedback is used to adjust teaching decisions for a follow-up lesson.

The lecturer acknowledged that she did not tell all her classes about the reason why she introduced the audience response activities. Therefore, no meta-level communication took place.

5.3.2 Multi-voicedness

The lecturer is well experienced and has been teaching for a number of years. The students are fourth year students and therefore in their final year.

5.3.3 Historicity

The lecturer introduced the audience response activity, because the response rate from her students was very poor in previous years. She also used to ask the students to answer questions on a piece of paper which would be handed in at the end of the lesson. This would then be aggregated by a student assistant and the results would only be used during a follow up lesson.

She therefore had two goals for using the audience response activity; one was to increase active participation and another was to aggregate the responses of the students more easily.

5.3.4 Contradictions

During the interview with the lecturer, she admitted that her biggest problem with using the audience response software is her clumsiness with the technology. Since she does not use the audience response activity during every lesson, she forgets how to use it. She admitted that this sometimes resulted in chaos and the unsuccessful implementation of the audience response activity.

During the class observation I found that most students actively participated during the lesson even when the audience response software was not used. Therefore, the audience response activity alone did not contribute towards the active participation of the students - the lecturer's teaching style already accomplished that. The received aggregated feedback should be turned into an object again, so that it can lead to the objective of the lesson, active learning.

The following diagram displays the contradiction. If the received aggregated feedback is not turned into an object again by the lecturer and used, then the objective of the activity cannot be met.

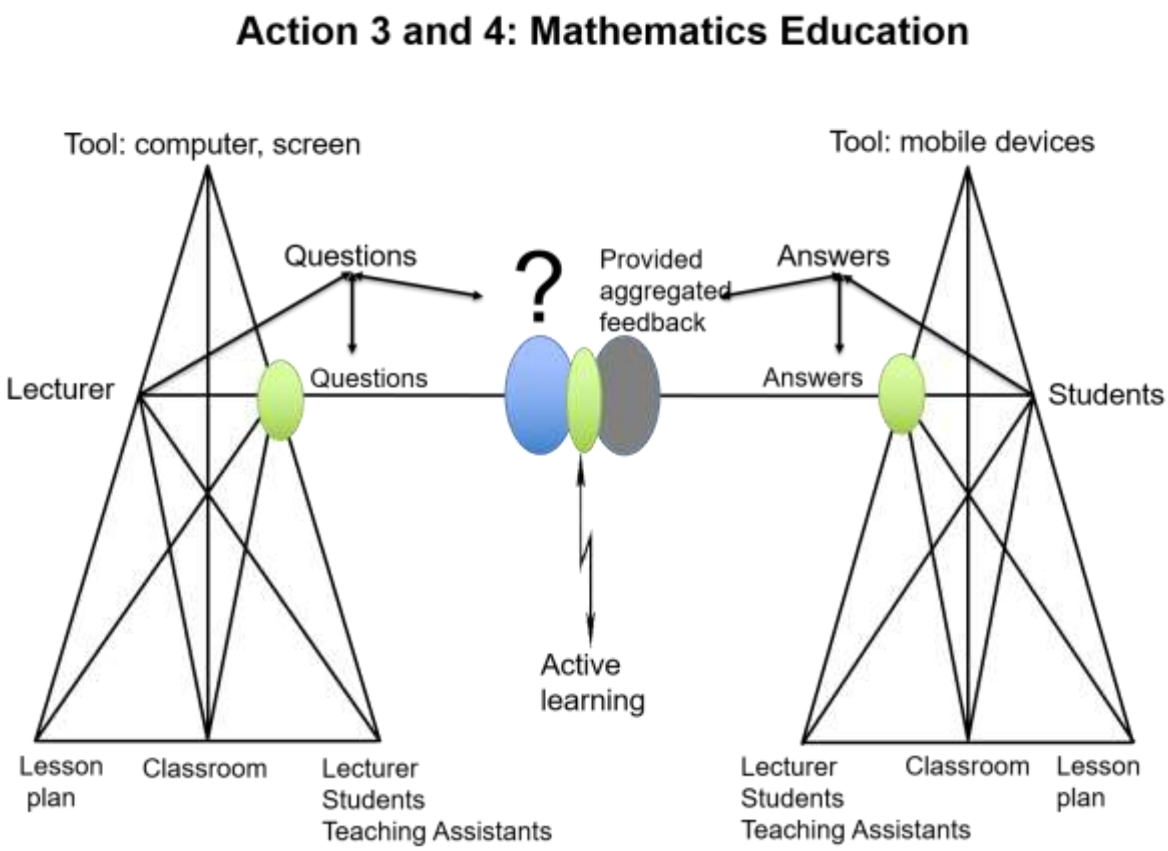

FIGURE 5.5: CONTRADICTIONS - MATHS EDUCATION

The response rate for the student questionnaire was very low and only 10 of the 60 students completed the questionnaire. Those who did respond were very positive about the use of the audience response software. Of the respondents 80 % believed that the audience response activities contributed to a better learning experience. They also valued the anonymity of the answers. During the class observation I also noticed that there was a very positive atmosphere in the classroom. Most students enjoyed the lecture and reacted positively towards the lecturer.

5.3.5 Learning design

The lecturer mostly followed a question-based approached, even before she introduced the audience response activity. However, the results were not used to inform and adjust teaching and learning and no meta-level communication took place.

Students already participated actively in the discussions so the audience response activity *per se* did not necessarily contribute to active learning. The software did solve the problem with the aggregation of the answers that was previously done by a student assistant.

Referring back to the conversational framework and more specifically to the e-learning transaction (Gilbert and Gale 2008:35), it is clear that the audience response activity should consist of four actions namely guidance by the educator, response by the learner; feedback by the educator and lastly, response by the learner using the feedback given by the educator. One of the strengths of the immediate feedback given by the system is that it allows the lecturer to adapt feedback given to the students to allow for more instructive and efficient teaching. If this is not going to be used, then it seems pointless to use the audience response technology at all

The lecturer did indicate that the aggregated results of the feedback will be used in a subsequent lesson, but if one takes all the technical issues around the use of the audience response technology into consideration, then a better option might have been to request the students to submit their answers on the Learning Management System before the next lesson. This will save class time and allow students to complete the question at a more convenient time and place. This theory is supported by Barbour (2013:43) who states that costs and drawbacks should be taken into account when using audience response technology and that it should not be used if the activity is not going to yield any significant value.

In order for active learning to take place, the whole sequence should be completed. The aggregated feedback should be turned into an object again by the lecturer, interpreted (turned into a sign), and then used to direct or redirect the lesson.

In a study that was conducted by Holland, Schwartz-Shea and Yim (2013) a similar situation occurred. The class was already interactive before the introduction of audience response activities. Yet the use of audience response activities allowed the lecturer to adapt her lectures according to the answers given by the students. Their conclusion was that the value of using audience response activities depends on the lecturer's pedagogical approach. If a lecturer's classes are already interactive, then the use of audience response activities does not make an additional contribution (Holland, Schwartz-Shea and Yim, 2013:287).

5.4 Case study 2: Logistics

5.4.1 Activity

The subject is Logistics and the students are third year students. There are approximately 150 students during the class observation.

The audience response software is used as part of a practical lesson. The students receive a handout containing the questions, with spaces where the necessary calculations can be completed. They have to complete the paper based questions and then fill in the final answer on their mobile device as part of the audience response activity. The questionnaire contains 13 questions. The lecturer decided not to use multiple choice questions, because he did not want the students to guess the answers. The answers that the students have to type in on the mobile device are all in currency.

The lecturer proceeds to explain the lesson plan to the students. The sound system does not work very well, and as a result a number of students at the back struggle to follow the instructions and consequently this results in a certain amount of confusion.

The students navigate to the audience response activity on their mobile devices and proceed to answer the questions. After a while, the lecturer, with the help of two assistants, consults the aggregated feedback from the system and proceeds to explain some of the questions that a number of students answered incorrectly. The results from the audience response software (aggregated feedback) are never shown to the students. The students have to hand in the completed answers on paper at the end of the lesson.

When the lecturer proceeds to explain the answers, some students are still busy completing those questions. The students therefore have to 1) continue to complete the questions on paper; 2) navigate to the right place on their mobile device to give the final answer; 3) pay attention to the lecturer when he explains the questions.

This can be seen as an example of question-driven instruction, since students had to answer questions and the results of the answers were used to inform and adjust the teaching and learning process. However, the lecturer did not introduce any dialogical discourse and no meta-level communication took place.

5.4.2 Multi-voicedness

The lecturer is aided by two assistants who help with the technology and to make the aggregated feedback available to the lecturer. This makes it easier for the lecturer to focus on the subject matter and the students.

5.4.3 Historicity

This exercise was previously completed on paper only and then handed in at the end of the lesson. The lecturer had to explain all the questions, not knowing which questions the students understood. This meant that time was wasted, because he explained questions that were already understood and then there was not enough time to explain the questions that the students had problems with. It was therefore decided to use the audience response software, together with paper, so the students still had to complete the questions on paper, but they also completed the final answers on their mobile device. The aggregated feedback given by the system helped the lecturer to adapt his teaching.

5.4.4 Contradictions

The questionnaire was completed by 36 % of the students. The small majority of the respondents (51%) believed that the audience response technology did not contribute to better learning. The feedback from the students was predominantly negative. Some students felt that the use of the audience response activity caused confusion and disrupted the class:

> *In big classes in which the lecturer has less control over the class, the clicker test has the ability to become very time consuming and therefore very frustrating.*

> *It is a good idea which is not applied properly. It has the effect that the class is not effectively controlled! [Dit is wel 'n goeie idee wat net nie reg toegepas word nie. Dit veroorsaak dat die klas nie doeltreffend beheer kon word nie!]4*

> *The experience that I have had thus far is that the use of the clickers leads to chaos and nobody benefits from the experience. [Die ondervinding wat ek tot*

[4] Afrikaans reponses were translated into English. The original Afrikaans is given in square brackets.

dus ver gehad het met clickers het gelei na chaos in die klas en niemand het voordeel uit die oefening geput nie.]

The following three contradictions are identified:

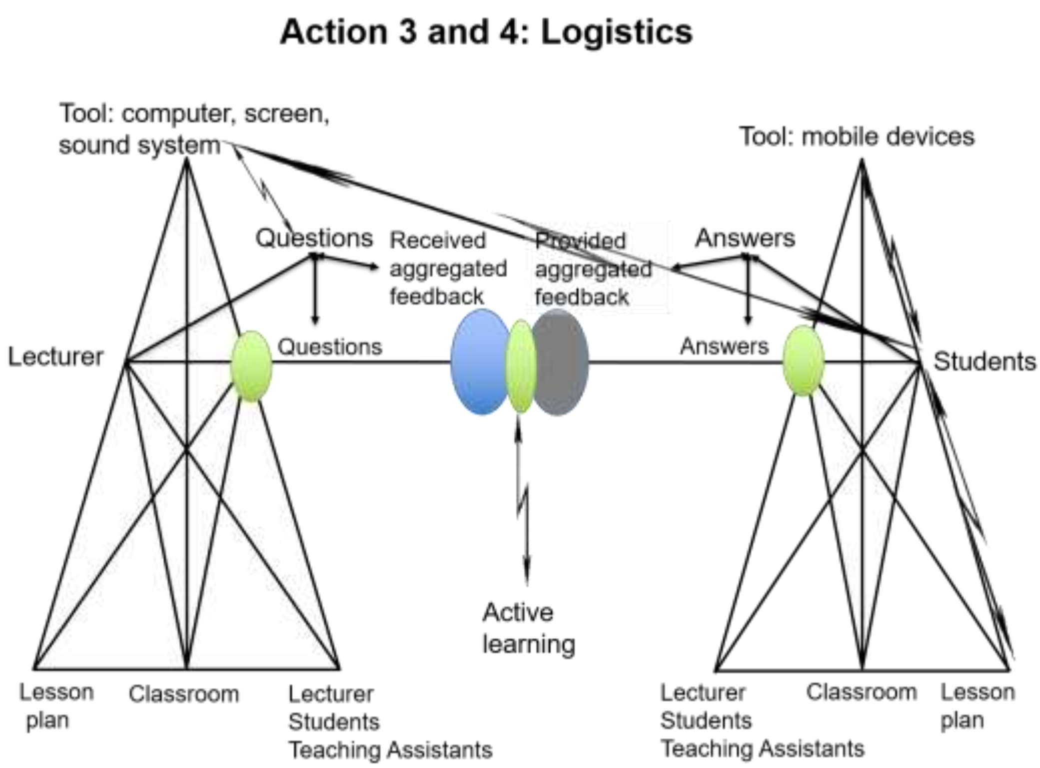

FIGURE 5.6: CONTRADICTIONS: LOGISTICS

1. The Rules: The lesson plan indicated that 13 questions had to be answered. The questions were not answered at the same time which lead to confusion. Some students had not completed the questions by the time that the answers were explained. Therefore students struggled to follow the rules of the lesson plan.
2. The Tool: Question display – Questions. The students had to enter large numbers on a very small screen, which some found difficult to do.
3. The Sign: Students – (Tool: sound system): Due to the fact that some students did not hear the instructions, they struggled to navigate to the audience response activity and therefore to complete the activity on time. This is a good example where a seemingly unrelated action to an activity can interfere with the success of the activity. Due to a faulty sound system (tool), the students could not hear the instructions (sign) and interpret them, which contributed to the unsuccessful completion of the activity.

5.4.5 Learning design

Practical classes are by default active classes and the students all participate. The use of the audience response software therefore does not contribute to active learning, but can make the whole process more meaningful, by allowing the lecturer to respond to the answers during the lesson instead of marking the practical work and only giving the answers back during a next lesson.

However, in this case it was found that the tool used, namely the mobile devices, became a hindrance and not an aid. The size of the screen, and the manner in which the students had to participate did not contribute to a better learning experience. From the next quote, it is evident that the students struggled to discern the numbers on the screen.

> *It is difficult to discern the 0's on the clicker system, e.g. 513'000'000'000. With large numbers it is easier to get confused with the number of 0s for the answer without the ' sign. Currently it is represented as 513000000000. [Die getalle op die klieker sisteem is moeilik om te onderskei tussen die 0'e daar kort bv 513'000'000'000. Met groot getalle raak mens maklik deumekaar met hoeveelheid 0e vir die antwoord sonder die ' teken. huidiglik sal dit so voorkom 513000000000 as antwoord]*

However, the lecturer found the whole process very useful. He did not have to explain every question in detail, but only the ones that the students had problems with.

The type of content taught has an influence on the technology that can be used (Technological Content Knowledge) and this is a good example of where the wrong technology was used for this type of content. The constraints of the mobile device had a very negative impact on the success of this exercise.

During the analyses and design phase, the affordances and constraints of the technology that is going to be used should be thoroughly investigated. In this case; the small size of the screen should be taken into consideration and the design should have reflected it. For example, instead of asking the students to type in the numbers, multiple choice questions could have been used. Even though this could result in students guessing the answers, it might have made the whole process easier for the students, and as a result made them more positive towards the activity.

The number of questions that the students should answer could also have been minimised and the whole process could have been done in a more orderly fashion, i.e. giving students a certain time period, and asking them to answer only the first three questions. Then proceed to explain the work, and then ask students to continue with the next three questions.

This type of exercise can definitely benefit from the use of aggregated feedback calculated by the audience response software. A possible solution for this would be to conduct the class in a computer laboratory, where they have access to computers with large screens, which will make it possible for them to answer the questions with more ease.

Only two of the TEFA principles were followed, i.e. question driven instruction and formative feedback. The number of questions that had to be covered were too many to allow time for peer or group discussions. A complete redesign of this lesson might be necessary to make it workable and effective.

Students were not informed about the reason why the audience response software was introduced as part of the lesson and this had a negative impact on the motivation of the students to participate in this activity.

5.5 Case study 3: Chemistry

5.5.1 Activity

The subject is Chemistry and the students are first years. There are approximately 240 students in the class.

The first half of the lesson is used to explain new concepts. The audience response activity is then introduced which tests the concepts explained during the first half.

The students have to answer a multiple-choice question on the newly explained concepts without discussing it. Then they have to discuss their answer with a peer and then they answer the question a second time. The lecturer waits until everybody has answered and then proceeds to explain. She shares the aggregated feedback given by the system and explains any misconceptions.

The activity is not conducted anonymously and even though the answers of the students do not count for marks, the fact that they participate does. Their participation rate is taken into consideration at the end of the semester, when the final grades are calculated. It is not expected of students to have a 100 % participation rate, but a substantial participation rate is expected from them.

During the observation I sat at the back of the class. During the first half of the lesson while the concepts were being explained, a number of students sitting at the back were not concentrating. They were either texting on their mobile devices or chatting and one student was even lying on his arms, half-asleep. However, when the audience response activity was introduced, everybody stopped what they were doing, and participated in the activity.

The lesson design is based on Mazur's peer instruction model and the audience response activity is only introduced during the second half of the lesson. The lecturer does introduce dialogical discourse in that the students have to discuss their first answer with a peer before answering a second time. The lecturer used the feedback from the system to adapt her teaching which allows for more constructive teaching and learning to take place. The reason for introducing the audience response activity was explained to the students, therefore meta-level communication did take place

5.5.2 Multi-voicedness

The lecturer designs the lessons and she has an assistant who is responsible for the administration around the audience response activities. She develops the audience response activities and also downloads the responses by the students afterwards, which are added up so that she and the assistant can build a picture of every student's participation.

5.5.3 Historicity

This lecturer was the first person at the University to start using the audience response software. I developed the initial system in conjunction with her. When I did this observation, she had been using the system for a period of five years.

The reason why she introduced the audience response activity was because she found it difficult to plan her lessons, not knowing how much her students understood of the work. The students did not respond verbally when she asked a question. She also wanted to do away with rote learning. The students had to understand the concepts and be able to apply them in any given situation.

5.5.4 Contradictions

The questionnaire was completed by 38 % of the students. The respondents are predominantly positive towards the use of the system and 78 % believe that it contributes to a better learning experience.

Some of the comments included:

> *The clicker tests are very effective. It helps you to capture a concept of the work in your brain. Sometimes you think you understand the work, but you don't and the clicker tests wakes you up in time so that you realise which aspects of the work you need to pay more attention to. If your participation counts for marks, then it will be good motivation to attend the class and to pay attention but sometimes all the students do not manage to access the clicker site or the batteries of their phones are dead and then it will be unfair if participation counts for marks. I have also struggled in the past to get access, but it still helped me, because I completed the calculations for the answer, even though I did not manage to submit the answer. The clicker activity is very helpful.*

> *[Die klikker toetse is baie effektief. Dit help om 'n konsep van die werk in jou brein vas te le. Soms dink mens jy verstaan die werk, maar doen nie en die klikker toetse maak jou betyds 'wakker', sodat jy weet waaraan jy nog aandag moet gee. As mens se deelname vir punte tel sal dit goeie motiveering wees om klas by te woon en aandag te gee aan die klas, maar partykeer kry nie al die studente toegang tot die klikker webtuiste nie, of hul fone is pap en sal onregverdig wees as deelname dan vir punte tel. Ek self het al gesukkel om toegang te kry, maar dit het my steeds gehelp omdat ek die antwoord uitgewerk het (maar nie ingestuur gekry nie). Die toetsies in die klas is vir my baie voordelig.]*

> *The clicker tests are basically homework, but just takes longer. However, it helps to draw students' attention and to get them to participate actively and to pay attention in class.*

> *Knowing that I have to answer a question on the worked explained, helps me to concentrate in class and I know immediately if I understand the work or not. [Die wete dat ek 'n vraag moet antwoord oor die werk wat behandel word help my om op te let in klas en ek weet dadelik of ek wel die werk verstaan of nie.]*

However, the following quote by a student illustrates a tertiary contradiction.

> *I prefer writing class activities and assessments because I find it easier to learn from physical material at a later stage than from reading things on screen. I also prefer and find it quicker to write any side/personal notes on the paper or assessments that I can read and learn from at a later stage also I find that some lecturers' go through concepts quite quickly and I am faster at writing than I am at typing.*

The lecturer introduces technology as part of the learning process, an activity that the students are unfamiliar with, because they did not use technology during their school career. This student does not only find the replacement of paper by technology problematic, but is also uncomfortable with the new teaching method, because he / she is used to rote learning. At school students are given questions and answers which they use to prepare for tests and examinations and they find it difficult to adapt their learning strategies.

5.5.5 Learning design

The use of the audience response activity definitely contributes to active learning in this class. It starts with guidance given by the lecturer, followed by response from the learners, then feedback by peer students, response again by students, completed by feedback given by the lecturer.

As was seen from the feedback, some students do understand the benefits of the audience response activities. However, there are some students who still do not understand this or are unable to adapt to it. It might be useful to introduce more meta-level communication and explain to students the difference between rote learning and active learning.

5.6 Case study 4: Biochemistry

5.6.1 Activity

The subject is Biochemistry; the students are in their second year and there are 72 students in the class at the time of the observation.

The audience response activity is used three times during the lesson; at the start of the lesson, half-way through the lesson and at the end. The lecturer asks a question about concepts that will be covered. He reads the aggregated feedback from the software to the students and then continues to explain the concepts. The participation is completely anonymous, and therefore voluntary.

A small number of students sitting in front of the class participate in the lesson, but a large number of students are not engaged in the class activities. When the lecturer asks a general question without using the audience response software, nobody responds.

Even though very few students participate in the audience response activity, the lecturer still uses the results to direct the lesson. Overall I found that this is a very apathetic class who responds very little to anything the lecturer does.

The lecturer does use question-driven instruction. He does not introduce dialogical discourse, so the students are never asked to substantiate or explain the reasons for their answers. He uses the results of the feedback to inform and adjust his teaching. He also did not explain to his students why he introduced the audience response activities.

5.6.2 Multi-voicedness

The lecturer plans the lesson and develops the audience response activities. He is proficient with the use of technology and therefore does not have a problem with the use of the audience response software.

5.6.3 Historicity

The lecturer introduced the audience response activity because the students did not respond to questions he asked in class and he hoped that the anonymity that the audience response technology provided would result in better participation so that he knew which concepts to explain again and which ones the students understood.

5.6.4 Contradictions

Class participation was very low, and very few students actively participated during the lesson. The lecturer also did not introduce peer discussions, therefore the students never had to explain or justify their answers. This means that the students did not turntheir answers, the sign, into an object as depicted in the following figure, and active learning did not take place. Students should be given the opportunity to defend their answers. Only then can the cycle of active learning be considered complete. If students know that they have to explain or justify their answers, they might be motivated to participate from the start.

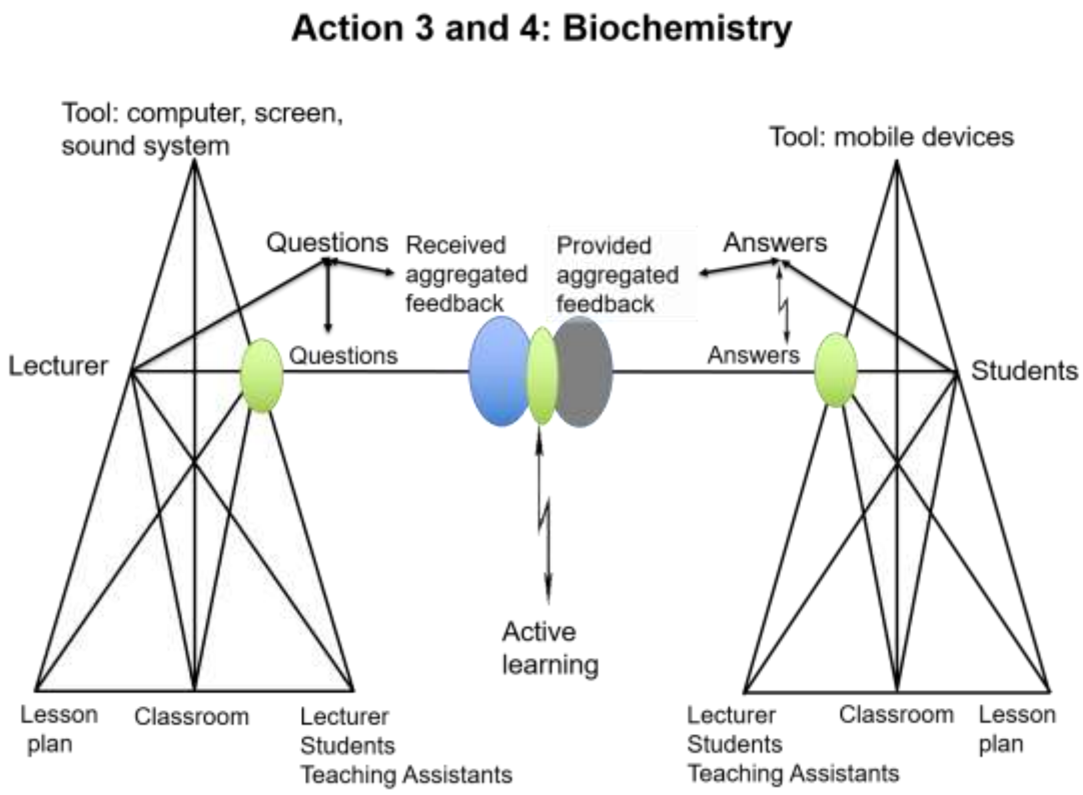

FIGURE 5.7: CONTRADICTIONS: BIOCHEMISTRY

Even though class participation was very low, 67 % of the students completed the questionnaire. Of the respondents, 89 % believe that the use of the audience response activity contributes to better learning, which is the highest of all the case studies. 64 % of the students felt that the fact that they could answer anonymously, made it easier for them to answer the questions.

The following quotes by students illustrate why they found the audience response activities beneficial.

> *I have definitely learnt more and understood the work better when the lecturer uses clicker questions. It is very easy to use on my cell phone.*

> *Clicker is cool if you actually take it as a learning opportunity and for you to assess yourself. It also gives you the opportunity to see how the entire class is doing (if they actually attempt the questions and not just give random answers)*

It forces interaction with the material and provides an anonymous platform for me to test my understanding of the concept immediately without having to single myself out in front of a large class who can be overpowering.

You are able to see then and there if you are understanding the work or not instead of waiting until exam prep and not having a clue.

We recently used the clicker and it helped the lecturer to see where he has to give more attention/explain more and spend less time on concepts that we understand very well

The lecturer also said that he definitely benefited from using the audience response software, but that he wished more students would participate.

The following quote illustrates that this student experiences the same contradiction that is experienced by the first year student from Chemistry.

Even though using the clicker tests is very helpful I feel that it is more important for my future study efforts to write down these questions as they are presented. This due to the fact that certain departments do not release practice questions papers. By using this time to write the question down it is sometimes difficult to think about the question and respond to the clicker as well.

As was the case with Chemistry, the fact that the students are used to rote learning also makes the successful implementation of active learning problematic.

5.6.5 Learning design

Even though this class was the most positive about the use of audience response technology, the response rate during the audience response sessions was extremely low. So even though most students who answered the questionnaire believed that audience response activities contribute to better learning, a large number of students did not participate.

Student motivation is an important aspect of learning design. If one revisits the four categories of the ARCS model namely Attention, Relevance, Confidence and Satisfaction, and one evaluates the type of questions asked, then one can say that they do grab the student's attention, they are definitely relevant, they could be installing a feeling of confidence, if the student answers the questions correctly, which should then ultimately lead to satisfaction.

Therefore, the design has lecturer input, input from students, and the feedback is attended to and the motivational aspects are covered.

Students were asked to rate the importance of awarding grades to either their participation or the answers given. Forty eight percent of the students did not want their answers to count for marks and 42 % wanted their answers to count for marks. However, 58 % of the students felt that they wanted their participation to count for marks.

TABLE 5.1: BIOCHEMISTRY STUDENTS' RESPONSE RATE ON THE IMPORTANCE OF GRADES VS PARTICIPATION

Rating scale: 1 = unimportant – 5 = very important	**1**	**2**	**3**	**4**	**5**
My answers count for marks.	35%	13%	11%	10%	32%
The fact that I participate counts for marks.	19%	8%	14%	22%	36%

The majority of these students want to be awarded for participation. If the lecturer introduces rewards for participation, more students might be willing to participate. Introducing meta-level communication might also help students to see the benefits of active learning and motivate them to participate in the activities.

Keller, Finkelstein, Perkins, Pollock, Turpen and Dubson (2007:131) found that students' motivation to participate in audience response activities improved when peer discussions were included with the activity as opposed to working independently. Barbour (2013:44) also concludes that all audience response activities should include discussion. He believes that the power of audience response activities lies in the conversations that they enable. Adding peer discussions, meta-level communication and the rewarding of participation, might therefore encourage more students to participate in these activities.

5.7 Case study 5: English Education

5.7.1 Activity

This subject is English Education for second year students. There are approximately 140 students in the class.

The first twenty minutes of the class is spent lecturing. The content covers background on the school curriculum. An audience response activity is then introduced. The students have to answer 15 questions; all yes/no answers. They submit their answer to all the questions at the same time. The participation rate is very high.

The questions are about personality traits. These are all student teachers who have to teach one day. By identifying their personality traits, they can determine their confidence with the types of exercises that they are going to give their students one day. The students see the aggregated feedback given by the system, but they do not participate or take part in group discussions. The exercise is meant to contribute to self-knowledge.

Question-driven instruction is not used, no dialogical discourse is introduced and the results are not used to inform or adjust the teaching and learning and no meta-level communication took place.

Even though peer or group discussions were not used during this lesson, the lecturer said that she sometimes did use the audience response activity combined with peer or group discussions.

5.7.2 Multi-voicedness

The lecturer is proficient in the use of technology and develops the audience response activities herself.

5.7.3 Historicity

The lecturer found that student participation was very low and that the usual show of hands, when she asked questions, did not work. She also found it necessary to aggregate the answers so that she could introduce peer discussions.

5.7.4 Contradictions

Of the 50 % of students who answered the questionnaire, 78 % felt that the audience response activities contributed to better learning.

The type of question often asked, is either personal or asks for an opinion and therefore more difficult for students to answer in front of other students. It is therefore understandable why 96 % of the students either wanted their contribution to be completely anonymous or only the lecturer could know what their answers were.

The quote from the following student illustrates the fact that audience response technology makes it possible for the more reserved students to also participate.

> *I think clickers are a great idea it gives a voice to those people in my class that don't usually have a say.*

The fact that audience response technology makes active participation possible in class is valued by 64 % of the students. The following quote by a student also illustrates this:

> *Yes because you get to see other peoples opinion on certain matters and then they have the opportunity to state why they chose that answer and explain their reasoning to the class. this enables you to see their point of view and broadens your perspective on certain matters*

5.7.5 Learning design

This exercise is a good example of an exercise that speaks to relevance; one of the aspects of motivational design. The anonymity of the exercise contributed to make it easy for them to answer the questions and to participate.

The questions asked were not used to direct the lesson. They merely allowed students to see how their personal traits compare to others in the class, which might be considered important, but if active learning is the objective of the integration of audience response activities, then the objective was not met. The answering of the question was not followed up by peer discussions, therefore the students were not given the opportunity to discuss the results of the question and therefore the significance of the feedback. As was the case with Biochemistry, the students did not get the opportunity to convert the sign into an object for further use. One can therefore understand the comment from the following student:

I do feel the clickers CAN contribute to better learning in a way, but thus far, from the clickers i have participated in, I don't feel it has contributed to any learning.

Therefore the activity led to active participation, but not necessarily to active learning as depicted in the following figure.

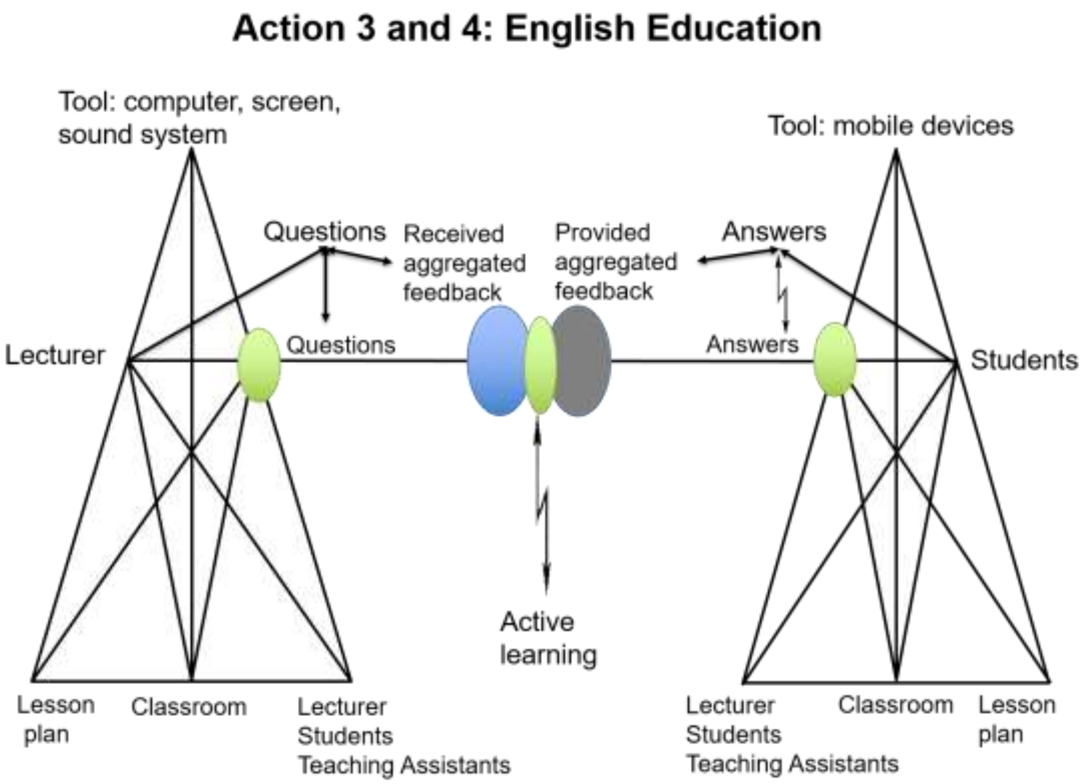

FIGURE 5.8 CONTRADICATIONS: ENGLISH EDUCATION

Even so, 78% of the respondents believe that the audience activities contribute to better learning, as evidenced in some of the qualitative feedback.

5.8 Comparison of the five cases

The following table answers the questions asked by the cycle of expansive learning. This table makes it possible to see what pedagogical approach was followed by the lecturers during the implementation of the audience response activity.

TABLE 5.2: COMPARISON OF THE FIVE CASES

	Case 1	Case 2	Case 3	Case 4	Case 5
Who	Maths Educ lecturer and students	Logistics lecturer and students	Chemistry lecturer and students	Biochemistry lecturer and students	Eng Educ lecturer and students
Why	Low participation rate	Practical lesson	Low participation rate	Low participation rate	Low participation rate
What	Opinion based question	Calculation questions	Concept questions	Concept questions	Informative question
How	One audience response question at end of lesson	Practical lesson 13 audience response questions	20 min lecture and then audience response question	Three times during lesson; at the start, in the middle and at the end.	20 min lecture and then audience response question
	Aggregated feedback not shown	Aggregated feedback not shown	Aggregated feedback not shown	Aggregated feedback not shown	Aggregated feedback are shown
	Aggregated feedback not used	Aggregated feedback used	Aggregated feedback used	Aggregated feedback used	Aggregated feedback not used
	Peer discussion	No discussions	Peer discussions	No discussions	No discussions

Three of the lecturers used the aggregated feedback by the system to direct the lesson. Only one lecturer showed the feedback, but ironically the feedback was not used by this lecturer. This lecturer however said that she does sometimes use the feedback to direct the lesson and to introduce discussions.

As can be seen from this table most lecturers followed an instructivist approach as part of the audience response activity and only two lecturers included social constructivist elements in the form of peer discussions.

I believe that omitting social constructivist elements from the audience response activity weakens the impact of the activity. Even though it is not always possible or viable to introduce peer discussions as part of every audience response activity, they should be included as often as possible.

5.9 Artefact analysis

Problems with using the audience response technology were experienced by students in all the cases. Even in the venues with available wifi, some students struggled to access the audience response activities. The system is therefore not 100% reliable and in every activity there were students who could not submit their answers. Students also had to use their own data for some of the activities, when there was not an available wifi connection.

In spite of this, when students were asked if they were willing to use their mobile devices in class, the response was very positive. The students were asked for which purposes they were willing to use their mobile devices in class. They had to select one of the following options:

- I will only use my mobile device for assessments if the marks count
- I will only use my mobile device if it will help me to understand the work better.
- I will use my mobile device in both cases.
- I do not want to use my mobile device as part of class activities.

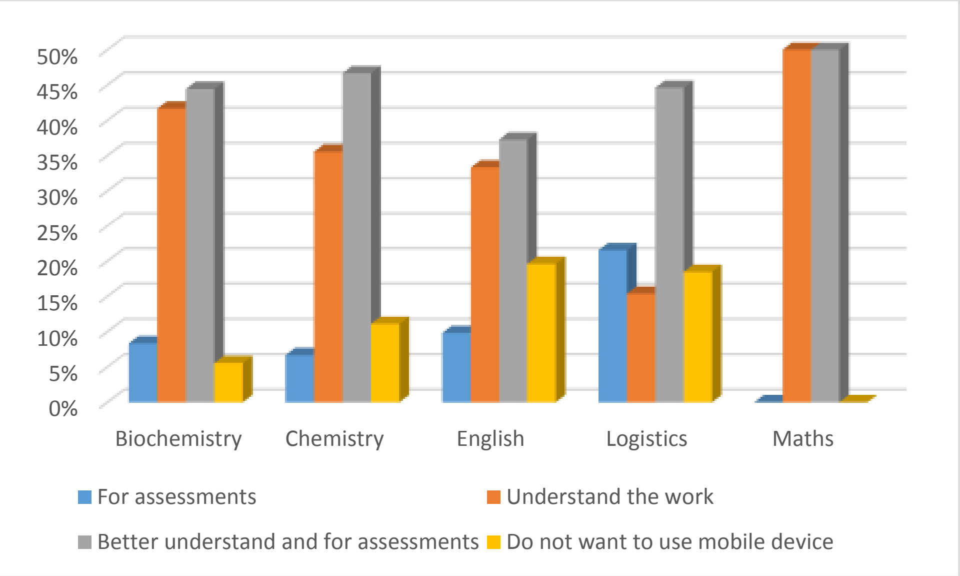

FIGURE 5.9: STUDENTS' RESPONSES FOR THE USE OF MOBILE DEVICES AS PART OF CLASS ACTIVITIES

As seen from the graph, most students are willing to use their mobile devices for assessments and to enable them to understand the work better. The second highest score, except for Logistics, was that students would use their mobile devices if it would help them to understand the work better. The fact that many students do not want to use their mobile devices only for assessments can be attributed to the fact that the audience response technology used is not 100 % reliable or that the screen size of mobile device makes it very difficult to complete an assessment on.

Fixing the technology problems around the use of mobile devices in class remains a challenge and the biggest problem is adequate wifi that will enable students to connect with ease, even in large classes.

A second identified problem is battery life of mobile devices. When a mobile device is connected to wifi, it uses a lot of battery power. If all lecturers start to incorporate audience response activities in class then mobile devices' batteries will not last a full day. Charging stations will have to be made available to students as well.

Inefficient technology resulted in a feeling of negativity towards the use of audience response technology. This poses a number of questions that needs to be answered. Whose responsibility is it to ensure that the system works and that all students have devices that can connect to the system? This question is also asked by Barbour (2013:41). One lecturer told a student to buy a mobile device that can connect to the wifi, because using mobile devices and technology is part of the future of teaching and learning. Is this fair towards the student since it is not compulsory for students to have smart phones when they enter university? What is the role of the institution when it comes to policy around the use of new technology?

The questionnaire indicated that 79 % of students think that technology can contribute to better learning. However, it seems that the focus on technology and not on pedagogy that many researchers identify as problematic, is also prevalent in students. The following quotes by students echo this sentiment.

> *Technology is the base on which we will do business in the near future. Best we get used to it early on.*

> *The use of technology in learning is on the rise, and there is no better way to learn to use technology by trying, it is useful as it is the way in which the world is progressing, soon it will be an instrumental part of one's day to day working life.*

> *Our new generation is visually and technology oriented and that is why clickers will contribute to better learning. [Ons nuwe generasie is visueel en tegnologies ingesteld en daarom sal klieker bydra tot beter onderrig.]*

These students see technology as the key to learning success and not the pedagogy that accompanies it. Students also need to be made aware of the fact that technology *per se* does not contribute to better learning, but effective pedagogical practises that are made possible through technology, do.

Most institutions use audience response technology which requires students to buy extra audience response devices and the use of mobile technology as audience response technology only exists in isolated instances. (Twetten *et al*., 2007:67). Ayu, Taylor and Mantoro (2009) also designed audience response software that uses mobile technology. They recommend the use of mobile technology instead of dedicated audience response systems because it does not require students to buy extra devices and it does not require specialist infrastructure to be installed in the lecture halls (Ayu, Taylor & Mantoro, 2009:711).

Many researchers commented on the technology problems associated with audience response systems (Barnett, 2006; Duncan, 2006; Graham *et al*., 2007; Simelane & Skhosana, 2012; Bode, Drane, Kolikant & Schuller, 2009; Campbell & Monk, 2015). Similar problems that were encountered with the use of audience response technology and mobile devices were also encountered with the use of audience response technology and audience response devices. Students forgot them at home, the batteries did not last and submitted answers were not received.

Neither of the two options are currently fool proof, but I agree with Ayu and others (2009), that it is better to invest in audience response technology using mobile devices. The inconvenience and cost of setting up extra infrastructure and expecting students to buy extra devices is not a future investment. It is better to invest in technology that can be used in the long run.

5.10 Expansive transformation

The concept of expansive transformation involves that a fundamental change occurs which results in new ways of working, in this case in teaching and learning. What the fundamental change comprises is different for every situation. When one reviews the literature on audience response technology, it is safe to say that audience response technology has brought about expansive transformation in the world of education.

There are reports of increased learning performance (Simelane & Skhosana, 2012; Brady, Seli and Rosenthal, 2013), better quality of learning (Campbell, 2007), and improved long term retention (Crouch & Mazur, 2001; Pradhan, Sparano & Ananth; 2005), to name but three benefits. This study looked at the integration of audience response systems as part of active learning at Stellenbosch University.

In four of the case studies, the goal of introducing the audience response activities was to increase student participation and it is safe to say that this goal was achieved in Chemistry, Mathematics Education and English Education. In Chemistry and Maths Education, the students were asked to discuss their answers given, which gave them the opportunity to actively think about their answers, and therefore gave them the opportunity to actively learn.

In Biochemistry, most students did not participate and discussions were also not introduced, therefore active learning could not take place.

In the case of Logistics, the introduction of the audience response activity did not lead to active participation or active learning, because active participation and active learning were already part of the practical lesson. The idea behind the introduction of the audience response system was to streamline the process, but this, due to the reasons mentioned, did not work.

Therefore, even though the introduction of an audience response system led to moderate success, one cannot say that it led to expansive transformation in these five departments at Stellenbosch University as was the case elsewhere in the world. The reasons for this will be discussed in more detail in section 6.4.

5.11 Student motivation

Students were requested to rate the importance of the following options on a scale of 1 to 5 with 1 equals unimportant and 5 equals very important. The first option is: My answers count for marks, and secondly; my participation counts for marks.

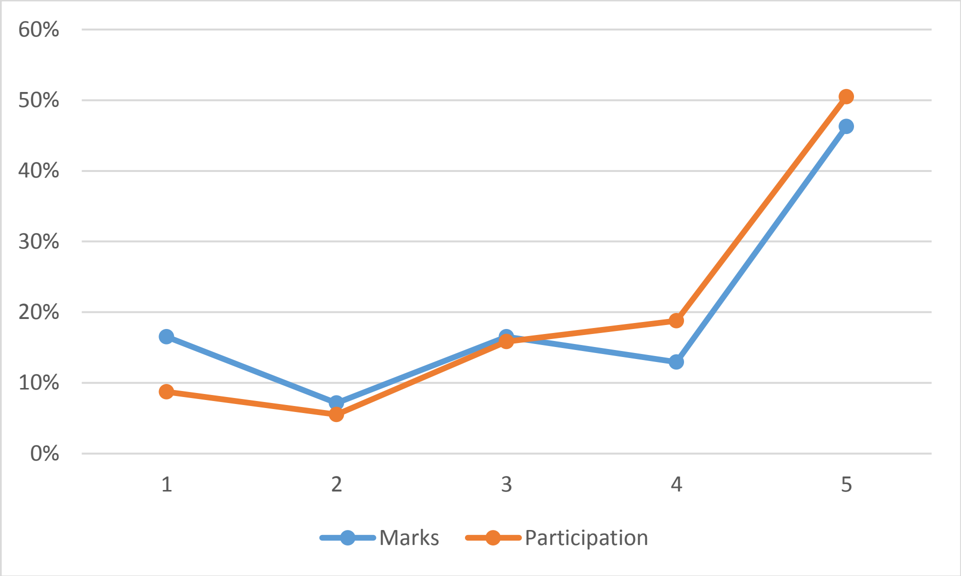

FIGURE 5.10: STUDENTS' RESPONSE RATE ON THE IMPORTANCE OF MARKS FOR CORRECT ANSWERS VS MARKS FOR PARTICIPATION

As can be seen from the graph, most students felt that there had to be some form of recognition for participating in the activities. Being recognised for participation, above being graded for answers, was considered slightly more important by respondents.

In both the Maths Education and Biochemistry case studies, participation was anonymous. Therefore these students were not rewarded for participation nor for answers given. The participation rate for students in Maths Education was much higher than in Biochemistry, even when the audience response technology was not used.

This leads to the conclusion that there is no one-size-fits-all recipe. Sansone and Harackiewicz (2000:444) found that successful student motivation greatly depends on the nature of the audience response activity, the type of questions, how the feedback is handled, and those offering and receiving the reward. These are important aspects that are part of the design model and which is discussed in more detail in Chapter six.

5.12 Conclusion

In conclusion it is necessary to point out that the above analysis pertains to one observation per case study, and that this does not mean that the lecturers did not use the audience response activities in other ways. All the lecturers had been using the audience response system for some time before I performed the formal class observation that was used as part of the analysis in this study. Some of them had various ways of using the audience response activities, which were noted during former class observations. This analysis merely identifies the contradictions that took place during one observation of an audience response activity and suggests improvements for similar situations.

Also, the audience response activities of each of the five cases were analysed in the context of active learning as objective of the activity. Even though some of the audience response activities led to active participation by students, and were successful in that respect, this analysis focuses on whether the activities lead to active learning.

The type of question asked is an important contributor to whether active learning will take place or not. It indicates the type of discussion that will be introduced after the audience response activity. In Chemistry, Logistics and Biochemistry, for example, the type of questions asked is fundamental to the learning process, involving knowledge of concepts that are important for the student to fully comprehend. During the discussion afterwards the student should be able to verbalise the reasoning behind the given answer. The student should therefore be able to describe the thought process that led to the answer. The questions asked in Mathematics and English Education were more opinion based and did not involve the understanding of complicated concepts. In these cases too the student should be able to defend the answer given.

In Maths Education the studentshad to decide what was important to be assessed as part of Maths Education. The selection criteria was a) basic skills, b) knowledge and methods, c) feelings and beliefs about mathematics, and d) processes. As part of the peer discussion the students had to convince someone else of their opinion which gave them the opportunity to defend their answer.

In English Education, the students had to identify their personality traits, so that they could determine their confidence with the types of exercises that they were going to give their students one day. The lecturer could have introduced a peer discussion during which the students could have discussed the implications of their particular personality traits on their teaching, for example, or any other type of discussion which allowed the students to evaluate or synthesise the answer given.

Active learning cannot take place if the students are not actively involved, and active involvement is more than just the pressing of a button. The moment a student has to explain the reasoning behind an answer given, he or she uses higher order thinking skills, and therefore active learning can take place.

Most lecturers are not sufficiently skilled in Technological Pedagogical Knowledge, in this case related to the integration of audience response activities as part of teaching and learning. The most important aspect of audience response technology is the immediate aggregated feedback that it provides. Lecturers should learn how to redesign their lessons around this. Another feature of this is the ability to adapt questions to the technology itself. Lecturers need to learn how to phrase questions that are worthwhile and lead to better learning (Cambell & Monk, 2015:33).

Understanding Technological Content Knowledge is equally important. The lecturer should understand the constraints of a specific technology when it comes to the integration of this technology with the subject content. For example, in Logistics, the fact that students were expected to type in large amounts on a small screen, had a very negative effect on the success of the integration of the audience response activities.

Many problems that are experienced by lecturers can be avoided if the analysis and design phase is properly conducted as part of the design process.

Even though a number of process models and design models exist which can be used in the design of audience response activities, they have a number of shortcomings that were addressed in Chapter two. This study proposes a framework that can be used by lecturers in the development of audience response activities. This framework is discussed in Chapter six.

Chapter 6

A learning design framework: Conclusions and recommendations

6.1 Overview of the study

The primary value of audience response technology, in the context of teaching and learning, lies in the fact that it promotes active learning, if it is utilised effectively. Although several models have been proposed to map out the design of lessons in which the use of audience response technology is intended, all the design models that I reviewed originated in the mathematical and natural sciences. It was therefore deemed necessary to develop a design model for the use of audience response technology, which can be applied to any educational field. This is what this study aimed at achieving.

First of all, it was important to create a common understanding of educational technology terms. Czerniewicz (2010:531) identifies the importance of a commensurable language in the educational technology field in order to improve pedagogy. Therefore this study set out to identify some of the discrepancies in educational technological terms, to clarify them and to formulate appropriate terminology. Since educational technology is at the nexus of education and technology, it makes sense to use the established and clearly defined terms used in the field of technology. Clarification of terminology, as well as the research problem, the aim of the research and research questions to be answered were covered in Chapter one.

When designing new lesson material, both a process model and a design model should be followed. Chapter two reviewed a number of process models and design models currently used in the field of educational technology in the design of e-learning material and blended learning material. The same chapter also reviewed current views on the use of audience response technology and presented design models currently used in this field. At this stage no process models intended for use as part of the development of audience response lessons could be identified.

Seeing that audience response technology should never be employed for its own sake, but rather to promote and facilitate active learning, Chapter two also took a close look at the concept of active learning and identified three pedagogical approaches, namely instructivism, constructivism and an integrated approach, that can be used as the underlying framework for the design of the audience response activities. Important aspects of active learning, namely assessment, feedback and motivation, were also discussed, in an attempt to define all the aspects that influence the successful implementation of active learning using audience response technology.

The empirical study was determined by the primary and secondary research questions. The primary research question was: How should an audience response activity be implemented to ensure effective active learning?

In order to answer the primary research question, the following sub-questions had to be answered:

- What contradictions had an impact on the success of the implementation of the audience response activities?
- What are the critical elements that should be included in a design model intended to facilitate the successful implementation of audience response technology, as part of active learning?
- Which support structures should be in place to assist and support lecturers in the implementation of audience response technology?

To find anwers to these questions, an investigation was done of several lecturers at Stellenbosch University who made use of audience response technology as part of their lessons. However, only some of them used it as part of an attempt to promote active learning. Five of these lecturers were selected to participate in this study. This selection included various faculties, so that subjects from the mathematical and natural sciences, as well as the social sciences and humanities, were included in the study.

It was necessary to research all the aspects of the audience response activity and consider the elements and contradictions which contributed to the success or failure of the integration of the audience response technology. These included the lecturer, the students, the technology used, the design of the lessons and the role of the institution. Any other, seemingly unrelated factors, which might have had an influence on the activity, also needed to be identified. The combination of the use of activity theory as a theoretical lens and a mixed methods approach made this possible.

Even though audience response technology is a great tool for use as part of active learning, it is important to take the costs and limitations of current audience response technology into account, when using it. If the inclusion of audience response technology in the lesson design does not contribute to what constitutes as an effective pedagogical approach, then it should not be used.

What constitutes successful pedagogy is complex to define. For one person, a pedagogical approach may only seem effective if it leads to a substantial improvement in grades; for another, success may depend purely on whether or not the approach increases the involvement of the learner in the learning process. The characteristics defining successful pedagogy may also differ from one context to another. What is important is that they should be clearly defined.

I was able to identify a number of contradictions that had an impact on the success of the audience response activities. This enabled me to identify critical elements that should be included in a design model, and also to identify the support structures that should be in place to assist and support lecturers. These answered all three sub-questions. These answers and the literature review enabled me to develop a framework that can be used as part of the integration of audience response systems, and therefore answered the main research question.

Another important factor that was identified was the lack of meta-level communication between lecturers and students, where the learning process is concerned. Explaining to learners how learning takes place and why a new pedagogical approach is being introduced is a crucial aspect of motivation. This should be discussed and clarified with students, before the introduction of the new pedagogical approach.

A very important outcome of this study is the conclusion that the integration of technology in education cannot be done haphazardly. This is where the role of the institution becomes crucial and it includes supplying adequate pedagogical and technological support.

6.2 Contribution of this study

When educators consider pedagogical approaches, the current tendency is to adopt either an instructivist approach or a constructivist approach. This study proposes that the theoretical framework for the integration of audience response activities can be an integrated approach (Cronjé, 2006), combining both an instructivist and a constructivist approach. The proposed design model reflects how instructivist and constructivist elements can be combined in an audience response activity to make the activity a meaningful learning experience.

It was found that the traditional linear approach used in most process models is not adequate. Where the integration of technology as part of teaching and learning is concerned, it is vitally important that this integration takes place gradually. It is not always possible to foresee contradictions that might arise during the implementation phase when new technology is used as part of teaching and learning. By designing prototypes, the detrimental effect of contradictions can be minimised.

The cycle of expansive learning, used by Engeström as part of activity theory, advocates a linear approach consisting of only one cycle. This study proposes a spiral approach to the development of new activities. Therefore the cycle of expansive learning is extended, so that it includes the development and implementation of prototypes. (See Chapter three for detail on this model.) This model can then be applied as the foundation of a process model in the design of audience response activities.

The design model and the process model proposed in this study form a framework that answers the main research question and provides a possible solution for the development and implementation of audience response activities intended to ensure effective active learning.

Using activity theory made it possible to identify the elements that form part of an audience response activity. It was also possible to identify a number of contradictions that prevented the effective integration of audience response technology as part of active learning. These elements were integrated into the proposed design model.

The study further proposes a number of recommendations for practice and for institution strategy, intended to ensure the effective implementation of audience response activities, as part of active learning.

Therefore, the combined use of activity theory and the mixed methods research approach followed, made it possible to answer all the questions asked in this study. The framework and the implications for practice and policy will now be discussed in more detail.

6.3 An integrated question-driven framework

The framework consists of two models, a process and a design model. The process model identifies the different phases that should be followed when implementing an audience response activity. The design model classifies the pedagogical approach and presents the different components that form part of the audience response activity.

The process and design model will now be discussed in more detail.

6.3.1 Process model

The only researchers who hint at prototyping are Gilbert and Gale (2008), even though it is not part of their core process model. Designing prototypes is the best way for the development of audience response activities. The educator should start with the development of a basic prototype, by adding one question, followed by feedback and a discussion. The implementation should then be evaluated to determine the strengths and weaknesses of the prototype. A second prototype is then designed, developed, implemented and evaluated, building on the first prototype. This process is repeated until a successful model has been implemented.

Therefore the proposed process model for this framework is based on the spiral model. The spiral model makes it possible to indicate graphically the continuity and building-up of the process.

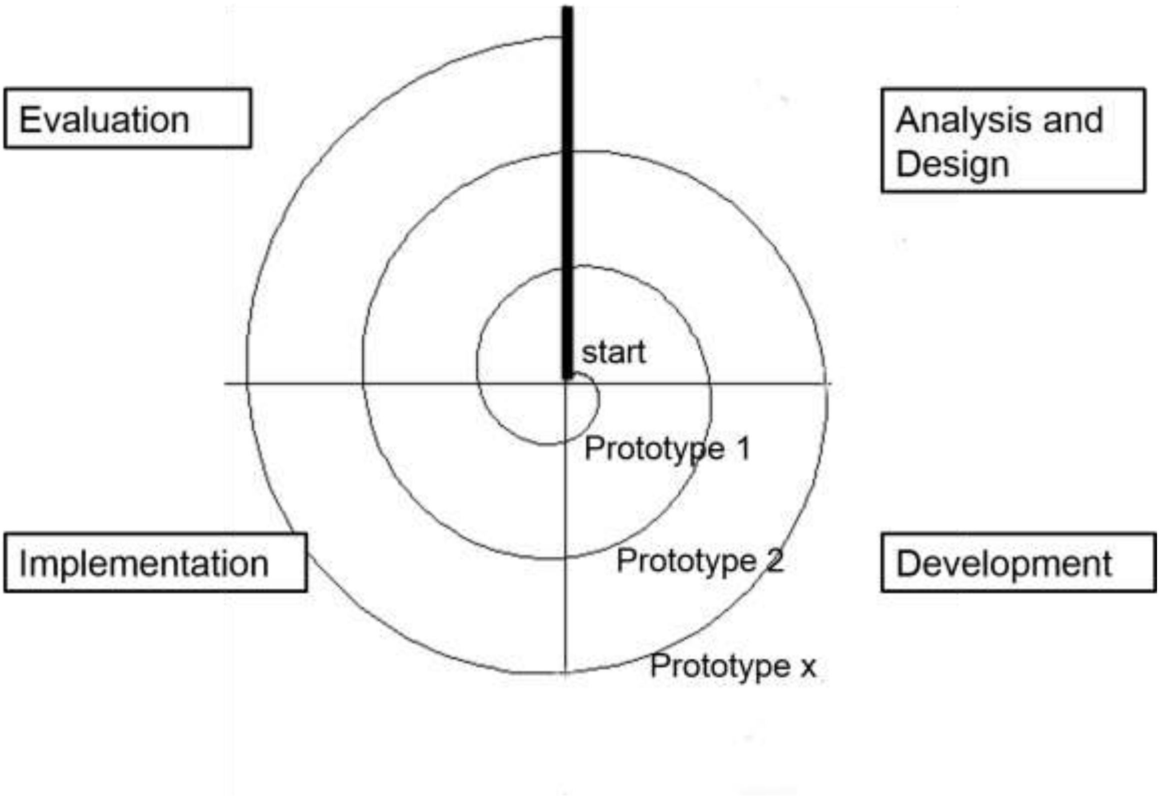

FIGURE 6.1: PROCESS MODEL FOR THE CREATION OF AUDIENCE RESPONSE ACTIVITIES

The design process starts with the analysis and design phase, continuing with development, implementation and concluding with the evaluation phase. Each new iteration uses the successes and failures of the previous cycle and improves on it. The design process delivers a workable prototype, and with each cycle the prototype must be an improvement on the previous one. Just like the spiral starts with a small circle, the first audience response activity should start with an introductory activity, gradually building up until the integration of successful audience response activities as part of active learning has been successfully implemented. What follows is a breakdown of each phase.

6.3.1.1 Analysis and design phase

During this phase the lesson plan is designed, following the chosen design model. The preferred design model for audience response activities as part of active learning will be discussed in the next section.

Goals should be developed and, together with that, the evaluation criteria and standards against which the lesson will be evaluated. A decision should be made if and how learners will be rewarded for participating in the activities.

It is also important to develop a contingency plan for the handling of technology failures. This includes wifi / internet connectivity problems, learners whose phones do not work, and learners who cannot submit answers for any other reason.

6.3.1.2 Development phase

This phase includes the development of the audience response questions, together with any other material that might be used during the lesson. It is important that the audience response activity is tested before the lesson, to ensure that everything is in working order.

6.3.1.3 Implementation phase

This is the phase during which the new lesson plan is implemented. A well planned lesson should still work, even if the technology fails. A show of hands and roughly estimating the responses can substitute for the audience response system. If learners buy into the concept of lesson design built around questions and enabling active participation, they should still be motivated to participate with a show of hands or answering verbally, in the case of technology failure.

6.3.1.4 Evaluation phase

This study found that the evaluation phase is most often neglected, and therefore subsequent lessons are not improved. Evaluation should be conducted after every lesson and this should focus on whether the question contributed to better learning, the effectiveness of the feedback, student motivation, and the success of group discussions. The results of this evaluation are then used to develop a successive prototype.

The goals that were set during the analysis phase are used to evaluate the lesson outcome. Learners should be included in the evaluation process as often as possible. This evaluation can then be used during the next analysis phase to build on the previous lesson.

6.3.2 Design model

Audience response activities are best used when following an integrated pedagogical approach, combining both instructivist and constructivist elements. The instructivist elements provide order in the design model and the inclusion of this approach acknowledges the important role the educator plays in directing the learning process. The constructivist elements enrich the learning activity by allowing for peer learning.

The following diagram displays the workflow of an audience response activity.

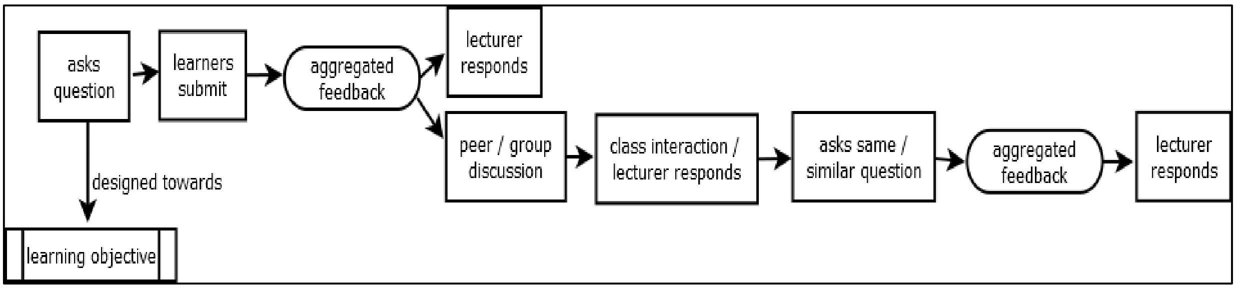

FIGURE 6.2: AUDIENCE RESPONSE ACTIVITY WORKFLOW

The educator asks a question or asks learners to give an opinion. The learners answer the question on their mobile devices. The system gives aggregated feedback. At this point two tracks are introduced. The first track is where the educator simply gives feedback. Sometimes the type of question asked does not lend itself to further discussions or reinforcement of the concepts, so the activity may end if the educator simply responds. The second track indicates that the feedback is followed up by peer or group discussions, after which the educator asks the same or a similar question. The learners answer the question again and the system supplies the aggregated feedback. The educator completes the activity by facilitating discussion or presenting an explanation or making final comments.

Each audience response activity includes the following elements of Gagné's instructional events:

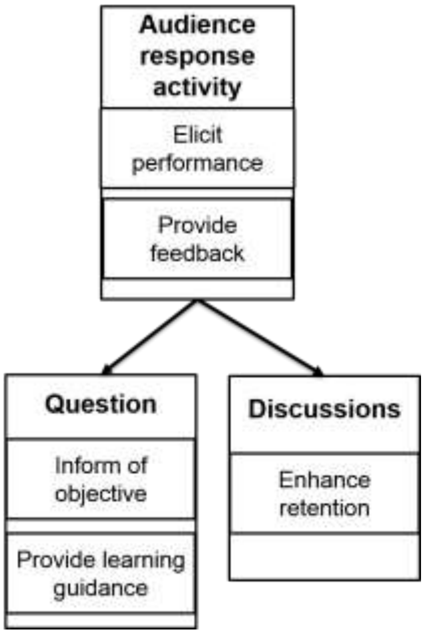

FIGURE 6.3: COMPONENTS OF THE AUDIENCE RESPONSE ACTIVITY

Inherent to any audience response activity is the eliciting of performance, expecting the learner to respond to the question. This should be followed by feedback. Each question asked should be aligned with the learning objectives, and the whole procedure guides the learner in the learning process. Discussions can then be used to enhance retention. The discussions also add the social constructivist elements, allowing for peer learning, and for learners generating content and contributing to the learning activity. The discussions allow learners to articulate the answers they have given, forcing them to think about their decisions and thereby enhancing the learning process. The discussions are crucial if the lecturer wants to ensure that active learning takes place. They change the activity from active participation to active learning.

An audience response activity can be introduced at any point during the lesson. The following model depicts how the audience response activity can be integrated into any of the learning events.

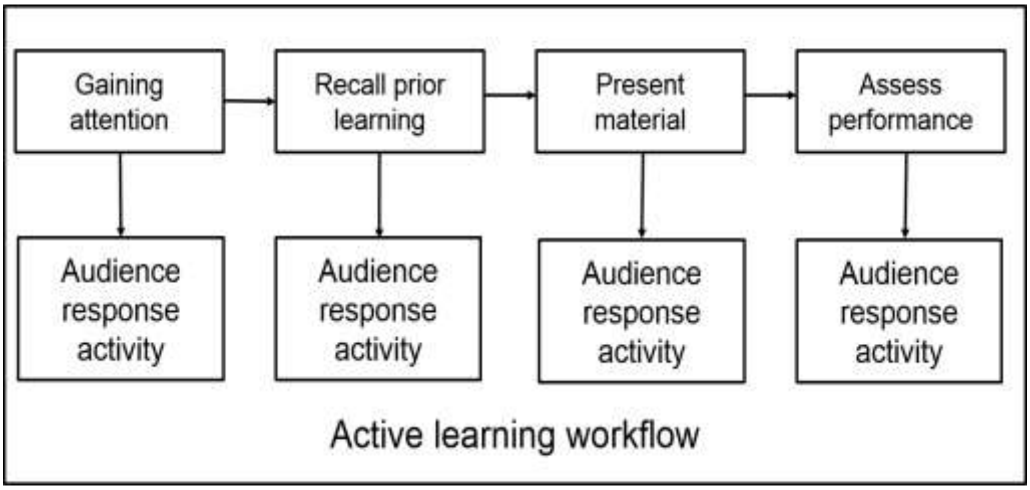

FIGURE 6.4: ACTIVE LEARNING WORKFLOW

An audience response activity can be used to gain attention, to recall prior learning, to present new material or to assess performance. It can also be used to combine two events, e.g. by recalling prior learning, the learner's attention is directed to the specific content that is being discussed. During the presentation of the material, the learner's performance is also assessed. Throughout this process, the learner is expected to participate actively and therefore this design integrates active learning in the learning process.

Whereas the instructivist elements provide order to the lesson design, constructivist elements are inherent to the audience response activity itself. Combining instructivist and constructivist elements in this fashion, allows for a well-designed learning process.

The following components are essential elements of the audience response activity, and whenever an activity is being designed, careful attention should be given to each:

- The question(s)
- The aggregated feedback
- Peer or group discussions
- Motivation

6.3.2.1 The question(s)

A number of researchers stress the fact that the questions asked should facilitate higher order thinking skills and that the questions should add value to the lesson (Beatty & Gerace, 2009; Cambell & Monk, 2015). This can be achieved if educators concentrate on designing these questions according to the three goals as advocated by the question-driven approach, namely a content goal, a process goal and a metacognitive goal (Beatty *et al*., 2006:32). A question's content goal focuses on the core principles or the foundational ideas of the content. A question's process goal aims at determining the cognitive skills we want the learner to implement and the question's metacognitive goal gives the reason for the content to be learnt (Beatty *et al*., 2006:32). In essence, every question should therefore consist of a *what*, *how* and *why*.

The design of the question should also include the mapping of questions against the four categories of motivational design (namely attention, relevance, confidence and satisfaction), ensuring that they speak to at least one or all of the four categories. The question should therefore grab the student's attention; it should be relevant to the subject being studied. Questions should not be so complicated that a student can never get the right answer. In the end the student should be left with a feeling of satisfaction. The student should experience that answering this question contributed to his or her learning process.

6.3.2.2 The aggregated feedback

The forte of audience response technology is the aggregated feedback displayed by the system. The educator should decide at which point the aggregated feedback should be shown to the learners, if at all. Even if the educator should decide not to show the results to the learners, discussing it with the learners is essential, otherwise the whole activity becomes meaningless.

6.3.2.3 Peer or group discussions

The educator should decide whether peer or group discussions will follow the asking of the questions. The aim of adding a discussion should be clearly defined and explained to the learners, so that the discussions can add value to the audience response activity.

Blasco-Arcas, Buil, Hernández-Ortega and Sese (2013:109) state that the introduction of audience response activities leads to the improvement of learner performance, but that this improvement cannot only be attributed to the asking of the questions. They suggest that the group and peer discussions play an important role in the improvement of learner performance. It is worthwhile to consider the introduction of peer and group discussions as part of the audience response activity.

6.3.2.4 Motivation

Meta-level communication, ensuring that the questions are relevant, and recognising participation (by grading the students) are all components that can be added to motivate learners to participate in the audience response activities. At least one or more of these should be included into the lesson design.

6.4 Possible implications for practice

At the time that the study was conducted, there were no strategies at Stellenbosch University guiding the integration of audience response technology as part of teaching and learning. For example, students were not expected to have mobile devices in class that had to be used as part of audience response activities.

This made it very difficult for the educators to enforce the use of mobile devices in class, which had a negative impact on the success of the implementation. Lecturers could not make participation compulsory, and if the activities were not compulsory, it had a negative effect on student motivation to participate in the studies. The requirement to have a working mobile device in class, should be specified before students enrol for a learning programme, so that they can be prepared.

Inadequate technical and pedagogical support are factors mentioned by a number of researchers, including Graham and others (2007), Barnett (2006), and Campbell and Monk (2015). At the time of this study, there was adequate technical support available for lecturers and the University offered workshops on how to work with the audience response software. The software was part of the Learning Management System already familiar to the lecturers and therefore most lecturers could create the activities with ease. However, there was very little pedagogical support on how to integrate audience response activities as part of teaching and learning.

As was discussed in Chapter two, a number of researchers call for a more formal process when new technology is introduced as part of teaching and learning. Adequate project management should form part of any changes made at any institution, higher education institutions included. Introducing new technology at a higher education institution can have far reaching consequences, and therefore cannot be done haphazardly. Project management should include a feasibility study, a project plan, detailed design of the integration, a pilot, and the final integration. Part of project management includes the provision of adequate support, both technical and pedagogical.

It is very difficult for educators to stay up to date with technological developments and their own field of expertise (subject knowledge). A qualified person with a sound understanding of Technological Knowledge, Technological Content Knowledge and Technological Pedagogical Knowledge can make a huge difference in this process and it is important that the support team should include such a person. TK, TCK and TPK relating to audience response activities will now be outlined in more detail.

6.4.1 Technological Knowledge (TK)

TK includes the understanding of the affordances and constraints of the technology being used. In the case of audience response activities, a thorough understanding of how the audience response technology works, is important. Depending on the type of system being incorporated, this knowledge will include an understanding of the specific technological system in use, how data is being transferred and how the audience response software works. If something goes wrong during the development or implementation phase, a person with TK should be able to identify the origin of the problem and offer possible solutions.

6.4.2 Technological Content Knowledge (TCK)

TCK implies knowledge and understanding of how the technology can be applied in a specific discipline or with specific content matter. The type of questions that are possible with the audience response technology should be identified and this should be compared with the type of content that will be taught. It should be determined whether the technological tool can handle the type of content. For example, in the case of mathematical or scientific content, it should be determined if the audience response technology can display formulas or equations.

6.4.3 Technological Pedagogical Knowledge (TPK)

The critical aspects of an audience response activity should be thoroughly understood by the educator. These include the principles of a question-driven approach, interpreting the aggregated feedback supplied by the audience response technology, the value of peer and group discussions and how these can be integrated into the lesson design.

These three aspects are not exhaustive and especially Technological Content Knowledge will differ and can be expanded, depending on the specific discipline concerned, but having this knowledge gives one a solid background, when designing the audience response activities.

Prior to the integration of any new technology, a feasibility study should be conducted. This should be done by every educator, with the aid of the support team. Successful implementation of a new technology by one educator, does not necessarily guarantee success for another.

6.4.4 Feasibility study

If mobile devices are going to be used, then a feasibility study should include surveying the learners to determine the type of mobile devices they own and whether all these devices can access the Internet. The Internet access (wifi or mobile phone carrier lines) must be tested. Class size is very important. The larger the class size, the longer it will take for all learners to submit answers. A decision should be made whether the time delay will still make the whole exercise viable.

Various authors, including Dufresne and others (2000), McClanahan and McClanahan (2002), Beatty and others (2006) and Beatty and Gerace (2009) state the importance of including the learner in meta-level communication and explaining to them how the learning will take place. Therefore the rationale behind the new lesson structure should be explained to the learners, so that they can understand it and, if necessary, adapt their learning methods.

If the integration of audience response activities is found viable, the educator can continue to design and develop the new lessons.

6.5 Limitations and further research

The study was able to identify a number of contradictions that impacted negatively on the implementation of audience response activities. However, contradictions change over time and because the data gathering was conducted over a period of only six months, it was only possible to identify contradictions that occurred during that period. Further studies are necessary which focus on a specific discipline and these studies should ideally be conducted in conjunction with the lecturer, so that any recommendations made by the study will actually be implemented by the lecturer. This study therefore only identified contradictions experienced by the lecturers, but it did not improve the integration of the audience response activities and this is a limitation of this study.

Even though each case study selected for this study implemented audience response technology differently, and thus allowed for the identification of a number of contradictions, the ideal situation would have been to have a more diverse set of subjects, with each case study based in a different faculty.

Another limitation of the study is that it did not analyse the type of questions asked by the lecturers as part of the audience response activities. Adding to the voice of researchers such as Beatty and Gerace (2009) and Cambell and Monk (2015), I would argue that lecturers should ensure that questions asked add value to the lessons, but what this really means in the context of each subject, is not that easy to define. This should be researched separately for each subject.

Even though only five cases were selected, it was still a challenge to investigate each case in enough depth. Time constraints made this difficult. It was important to study a lecturer with a specific class group. All the lecturers did not use the audience response technology during every lesson and the class only ran for one semester. More time should be spent with each lecturer. The proposed framework should be implemented and the questions asked for each subject should be researched, until it becomes clear which questions lead to effective active learning. The follow-up discussions should be analysed and refined, until they make a valuable contribution to the audience response activity. The different aspects of motivation should be investigated with a view to get all students to willingly participate in the activity.

The integration of audience response technology takes time and effort and it is a skill that needs to be developed (Sheikh, 2013:91). The research done in this study was sufficient to identify a number of contradictions in the successful implementation of audience response technology and to develop a possible solution, but ideally this solution needs to be implemented to help lecturers acquire the necessary skills to develop effective audience response lessons. This implementation should then be studied to ascertain the value of the proposed framework.

6.6 Concluding comments

There exists a common assumption that all students, especially if they are generation Y, are familiar with technology and find it easy to use. However, this assumption was not supported in a study conducted by Campbell and Monk (2015). They found that was especially true in cases where students come from diverse backgrounds. They caution lecturers not to assume that students will be able to work with technology, because it might contribute to students' demotivation and result in them not responding in class (Campbell & Monk, 2015:33). Jaffer (2010:281) also cautions educators not to assume that learners will be adept at using technology as part of their education, just because they are efficient users when it comes to social media.

Likewise educators are expected to be competent users of technology and they are increasingly being pressured to integrate technology into their education. They are faced with quotes like "Teachers will not be replaced by technology, but teachers who do not use technology will be replaced by those who do" (Arya, 2015). This places enormous pressure on educators and they are often required to integrate technology without adequate technical or pedagogical support. As was seen in this study, the poor integration of technology can cause more harm than good.

Since the advent of humankind, older generations have conveyed knowledge over to younger generations and, in so doing, ensured that knowledge gets passed on. Today, most of this knowledge can be found in books and on the internet. However, I do not think that this social learning process, which is inherent to humankind across the world, should be underestimated. While I do believe that the social constructivist approach to learners generating their own knowledge and the educator facilitating the process is a worthwhile concept, I do think that the educator plays a more significant role than this theory may suggest.

This chapter illustrated that it is possible to include both instructivist and constructivist elements in the integration of audience response technology, as part of active learning. Adding elements of instructivism allows for more order, streamlining the process and adding the voice of the educator. Constructivism adds a personal, reflective, and transformative process, where ideas, experiences, and points of view are processed into something new (Muir-Herzig, 2004:113).

Training of lecturers should start with the clarification of the pedagogical approach and should further include a process model and a design model. Such an approach to technology training and the design and development of lessons will equip educators to meet the demands of a new technological era.

I end by adding some of my own words to those of Engeström (2001:138), which appear in the quote at the beginning of the first chapter.

> *The integration of technology in education results in unstable times, with new forms of activities that are not clearly defined and that we barely understand. This results in exciting times, enabling possibilities that have been impossible up to now. However, we can create some order in the chaos with adequate planning and by putting effective support structures in place. This will go a long way towards making the process more organised, and in the end, a lot more effective.*

List of references

Abrahamson L.A. 2006. A brief history of networked classrooms: effects, cases, pedagogy, and implications. In Banks, D.A. (ed.). *Audience response systems in higher education: Applications and cases*. Hersey, PA: Information Science Publishing.

Ada, W.W. 2009. Computer supported collaborative learning and higher order thinking skills: A case study of textile studies. *Interdisciplinary Journal of E-Learning and Learning Objects*, 5:145-167.

Allen, D., Karanasios, S. & Slavova, A. 2011. Working with activity theory: Context, technology, and information behavior. *Journal of the American Society for Information Science and Technology*, 62(4): 776–788.

Anderson, L.S., Healy, A.F., Kole, J.A. & Bourne JR, L.E. 2013. The Clicker technique: Cultivating efficient teaching and successful learning. *Applied Cognitive Psychology*, 27: 222–234.

Antoniadou, V. 2011. Using activity theory to understand the contradictions in an online transatlantic collaboration between student-teachers of English as a foreign language. *ReCALL*, 23(3): 233-251.

Archambault, L & Barnett, J. 2010. Revisiting technological pedagogical content knowledge: Exploring the TPACK framework. *Computers & Education*, 55(4): 1656-1662.

Arnseth, H. 2008. Activity theory and situated learning theory: contrasting views of educational practice. *Pedagogy, Culture & Society*, 16(3): 289-302.

Arya, H.K. 2015. "Teachers will not be replaced by technology, but teachers who do not use technology will be replaced by those who do." [Online] Available: http://dailyedventures.com/index.php/2015/03/12/hari-krishna-arya/, [2015, October, 9].

Avis, J. 2009. Transformation or transformism: Engeström's version of activity theory? *Educational Review*, 61(2): 151 – 165.

Ayu, M.A., Taylor, K. & Mantoro, T. 2009. Active learning: Engaging students in the classroom using mobile phones. Proceedings of the Industrial Electronics and Applications Symposium on Industrial Electronics and Applications. Kuala Lumpur, Malaysia. 4-6 October.

Bakhtin, M.M. 1981. *The Dialogic Imagination*. Texas: University of Texas Press.

Bakhurst, D. 1995. Lessons from Ilyenkov. *The Communication Review*, 1(2): 155-178.

Bakhurst, D. 2009. Reflections on activity theory. *Educational Review,* 61(2): 197-210.

Barber, M. & Njus, D. 2007. Clicker evolution: Seeking intelligent design. *Life Sciences Education*, 6:1-20.

Barbour, J. 2014. Consider clicking in: Using audience response systems to spark discussion. *Communication Teacher*, 27(1): 38-44.

Barnett, J. 2006. Implementation of personal response units in very large lecture classes: Student perceptions. *Australasian Journal of Educational Technology*, 22(4): 1–17.

Barth, M., & Thomas.I. 2012. Synthesising case-study research – ready for the next step? *Environmental Education Research*, 18(6): 751–764.

Beatty, I.D. 2004. Transforming student learning with classroom communication systems. *Research Bulletin*, 2004(3): 1-13.

Beatty, I.D. & Gerace, W.J. 2009. Technology-enhanced formative assessment: A research-based pedagogy for teaching science with classroom response technology. *Journal of Science Education and Technology*, 18 (2): 146-162.

Beatty, I.D., Gerace, W.J., Leonard, W.J. & Dufresne, R.J. 2006. Designing effective questions for classroom response system teaching. *American Journal of Physics*, 74(31): 31-39.

Bedny, G.Z. & Karwowski, W. 2004. Activity theory as basis for the study of work. *Ergonomics*, 47(2): 134-153.

Bedny, G., Seglin, M.H. & Meister, D. 2000. Activity theory: History, research and application. *Theoretical Issues in Ergonomics Science*, 1(2): 168-206.

Bergman, M. 2008. *Advances in mixed methods research*. London: SAGE Publications.

Bigge, M.L. 1982. *Learning theories for teachers*. (4th ed.) New York: Harper & Row Publishers.

Bishop, P. 2010. Multi-site case study. In Mills, A.J, Durepos, G. & Wiebe, E. (eds.). *Encyclopedia of case study research*. Thousand Oaks: SAGE Publications, Inc. 588-591.

Black, P. & Wiliam, D. 1998. Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan*, 80(2): 139-144.

Black, P. & Wiliam, D. 2007. Large-scale assessment systems design principles drawn from international comparisons. *Measurement*, 5(1): 1-53.

Black, B., Harrison, C., Lee, C., Marshall, B. & Wiliam, D. 2004. Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan, 86(1):8-22.*

Blackler, F. 2009. Cultural-historical activity theory and organization studies. In Sannino, A., Daniels, H. & Gutiérrez, K.D (eds.). *Learning and expanding with activity theory*. New Your: Cambridge University Press. 1-15.

Blasco-Arcas, L., Buil, I., Hernández-Ortega, B. & Sese, F.J. 2013. Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance*. Computers & Education, 62:102-110.*

Bleijenberg, I. 2010. Case selection. In Mills, A.J., Durepos, G. & Wiebe, E. (eds.). *Encyclopedia of case study research.* Thousand Oaks: SAGE Publications, Inc. 61-64.

Bode, M., Drane, D., Kolikant, Y.B. Schuller, M. 2009. A clicker approach to teaching calculus. *Notices of the AMS, 56(2): 253-256.*

Bonwell, C.C. & Eison, J.A. 1991. A*ctive learning: Creating excitement in the classroom*. ASHE-ERIC Higher Education Report No. 1. Washington, D.C.: The George Washington University, School of Education and Human Development.

Bower, M. Hedberg, J.G. & Kuswara, A. 2010. A framework for Web 2.0 learning design. *Educational Media International*, 47(3):177-198.

Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J. & Amory, A. 2015. Conclusion: towards a transformative higher education pedagogy. In Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J. & Amory, A. (eds.). *Activity theory, authentic learning and emerging technologies. Towards a transformative higher education pedagogy*. New York: Routledge. 234-241.

Brady, M., Seli, H. & Rosenthal, J. 2013. "Clickers" and metacognition: A quasi-experimental comparative study about metacognitive self-regulation and use of electronic feedback devices. *Computers and Education*, 65: 56-63.

Braxton, J.M., Eimers, M.T. & Bayer, A.E. 1996. The implications of teaching norms for the improvement of undergraduate education. *The Journal of Higher Education*, 67(6): 603-625.

Bryan, C. & Clegg, K. 2006. *Innovative assessment in higher education*. London: Routledge.

Burnstein, R.A. & Lederman, L.M. 2001. Using wireless keypads in lecture classes. *The Physics Teacher*, 39: 8-11.

Caldwell, J.E. 2007. Clickers in the large classroom: current research and best-practice tips. *CBE-Life Sciences Education*, 6 (1): 9-20.

Campbell, C. & Monk, S. 2015. Introducing a learner response system to pre-service education students: Increasing student engagement. *Active Learning in Higher Education*, 16(1): 25-36.

Cauley, K. M. & Mcmillan, J. H. 2010. Formative assessment techniques to support student motivation and achievement. *The Clearing House*, 83(1): 1-7.

Chang, M. & Lehman, J.D. 2002. Learning foreign language through and interactive multimedia program: An experimental study on the effects of the relevance component of the arcs model. *CALICO Journal*, 20(1): 81-98.

Cherney, I. 2008. The effects of active learning on students' memories for course content. *Active Learning in Higher Education*, 9(2): 152-171.

Chickering, A & Gamson, Z. 1987. Seven principles for good practice in undergraduate education. *The Wingspread Journal*, 9(2): 1-5.

Chickering, A. & Gamson, Z. 1991. *Applying the seven principles for good practice in undergraduate education.* San Francisco: Jossey-Bass Inc., Publishers.

Clarke, S. & Fisher, S. 2005. *Formative assessment in the secondary classroom.* London: Hodder & Stoughton.

Cohen, L., Manion, L. & Morrison, K. 2011. *Research methods in education*. Seventh edition. New York: Routledge.

Collins, P., Shukla, S. & Redmiles, D. 2002. Activity theory and system design: A view from the trenches. *Computer Supported Cooperative Work*, 11: 55-80.

Corporate Identity. n.d. [Online]. Available: http://www.sun.ac.za/english/corporate-identity/Pages/default.aspx. [2014, January, 25].

Creswell, J.W. 2014. Research design. Qualitative, quantitative, & mixed methods approaches. London: SAGE Publications.

Creswell, J.W. & Plano Clark, V.L. 2011. D*esigning and conducting mixed methods research*. Los Angeles: SAGE Publications.

Creswell, J.W. & Tashakkori, A. 2007. Differing perspectives on mixed methods research. *Journal of Mixed Methods Research*, 1(4): 303-308.

Cronjé, J. 2006. Paradigms regained: Toward integrating objectivism in instructional design and the learning sciences. *Educational Technology Research and Development*, 54(4): 387-416.

Cronjé, J. & Brittz, B. 2005. Programming in the real world. *Education as Change*, 9(2): 131-161.

Crouch, C.H. & Mazur, E. 2001. Peer instruction: Ten years of experience and results. *American Journal of Physics*, 69(9): 970-977.

Culatta, R. 2013a. *Instructional design*. [Online]. Available: http://www.instructionaldesign.org [2015, January, 21].

Culatta, R. 2013b. *Instructional design models*. [Online]. Available: http://www.instructionaldesign.org/models/index.html [2015, January, 21].

Cutts Q., Kennedy G., Mitchell C. & Draper S. 2004. *Maximizing dialogue in lectures using group response systems.* Presented at 7th IASTED International Conference on Computer and Advanced Technology in Education; August 16–18, 2004; Hawaii. [Online] Available: www.dcs.gla.ac.uk/~quintin/papers/cate2004.pdf. [2015, January, 16].

Czerniewicz, L. 2008. Distinguishing the field of educational technology. *The Electronic Journal of e-Learning*, 6(3):171-178.

Czerniewicz, L. 2010. Educational technology – mapping the terrain with Bernstein as cartographer. *Journal of Computer Assisted Learning*, 26:523-534.

Dabbagh, N. 2010. Pedagogical models for e-learning: A theory-based design framework. *International Journal of Technology in Teaching and Learning*, 1(1), 25-44.

Dabbagh, N. & Bannan-Ritland, B. 2005. *Online learning: concepts, strategies, and application*. Upper Saddle River N.J: Pearson/Merrill/Prentice Hall.

Daniels, H. 2004. Activity theory, discourse and Bernstein. *Educational Review*, 56(2): 121-132.

Daniels, H. 2008. *Vygotsky and research*. Routledge: London.

DeBourgh, G.A. 2008. Use of classroom "clickers" to promote acquisition of advanced reasoning skills. *Nurse Education in Practice*, 8:76-87.

Deci, E.L., Ryan, R. M. & Kostner, R. 1999. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6): 727–668.

Diener, C.I. & Dweck, C.S. 1978. An analysis of learned helplessness: Continuous changes in performance, strategy, and achievement cognitions following failure. *Journal of Personality and Social Psychology*, 36(5):452-462.

Diener, C.I. & Dweck, C.S. 1980. An analysis of learned helplessness: II. The processing of success. *Journal of Personality and Social Psychology*: 39(5):940-952.

Dillon, P. 2004. Trajectories and tensions in the theory of information and communication technology in education. *British Journal of Educational Studies*, 52(2):138-150.

Discover Stellenbosch University. n.d. [Online] Available: http://www.sun.ac.za/english/about-us/Why-SU. [2015, September, 23].

Dori, Y.J. & Belcher, J. 2005. How does technology-enabled active learning affect undergraduate students' understanding of electromagnetism concepts? *The Journal of the Learning Sciences*, 14(2): 243-279.

Doyle, L., Brady, A. & Byrne, G. 2009. An overview of mixed methods research. *Journal of Research in Nursing*, 14(2): 175-185.

Draper, S.W. & Brown, M.I. 2004. Increasing interactivity in lectures using an electronic voting system. *Journal of Computer Assisted Learning*, 20: 81-94.

Dufresne, R.J., Gerace, W.J., Mestre, J.P. & Leonard, W.J. 2000. Ask IT / A2L: Assessing student knowledge with instructional technology. Technical Report. University of Massachusetts Physics Education Research Group, 1-28.

Dufresne, R.J., Gerace, W.J., Leonard, W.J., Mestre, J.P. & Wenk, L. 1996. Classtalk: A classroom communication system for active learning. *Journal of Computing in Higher Education*, 7: 3-47.

Duncan, D. 2006. ARSs: A new teaching aid with exceptional promise. *Astronomy Education Review*, 5(1): 70-88.

Dyson, B.J. 2008. Assessing small-scale interventions in alrge-scale teaching. *Active Learning in Higher Education*, 9(3): 265-282.

Ecclestone, K. 2007. Commitment, compliance and comfort zones: The effects of formative assessment on vocational education students' learning careers. *Assessment in Education: Principles, Policy & Practice*, 14(3): 315-333.

Efstathiou, C. & Bailey, C. 2012. Promoting active learning using audience response system in large bioscience classes. *Nurse education today*, 32(1): 91-95.

Eisenberger, R. & Cameron, J. 1998. Reward, intrinsic interest, and creativity: New findings. *American Psychologist*, 53(June): 676–679.

Eisenhardt, K. M. 1989. Building theories from case study research. *The Academy of Management Review*, 14(4): 532-550.

Engeström, Y. 1987*. Learning by expanding: An activity-theoretical approach to developmental research.* Helsinki: Orienta-Konsultit Oy.

Engeström, Y. 1995. Object, contradictions and collaboration in medical cognition: an activity-theoretical perspective. *Artificial Intelligence in Medicine*, 7: 395-412.

Engeström, Y. 1996. Interobjectivity, ideality, and dialectics. *Mind, Culture, and Activity*, 4(3): 259-265.

Engeström, Y. 1999. Expansive visibilization of work: An activity-theoretical perspective. *Computer Supported Cooperative Work*, 8: 63-93.

Engeström, Y. 2000. Activity theory as a framework for analysing and redesigning work. *Ergonomics*, 43(7): 960-974.

Engeström, Y. 2001. Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of education and work*, 14(1): 133–156.

Engeström, Y. 2007. From stabilization knowledge to possibility knowledge in organization learning. *Management Learning*, 38(3): 271 – 275.

Engeström, Y. 2009. The future of activity theory. In Sannino, A., Daniels, H. & Gutiérrez, K.D (eds.). *Learning and expanding with activity theory*. New York: Cambridge University Press. 303-328.

Engeström, Y. 2011. From design experiments to formative interventions. *Theory & Psychology*, 21(5): 598-628.

Engeström, Y. & Blackler, F. 2005. On the life of the object. *Organization*, 12(3): 307-330.

Engeström, Y. & Sannino, A. 2010. Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, 5(1): 1 - 24.

Entwistle, N. J. & Smith, C. A. 2002. Personal understanding and target understanding: mapping influences on the outcomes of learning. *British Journal of Educational Psychology* 72: 321-342.

Fernandez, V., Simo, P. & Sallan, J.M. 2009. Podcasting: A new technological tool to facilitate good practice in higher education. *Computers & Education*, 53(2): 385-392.

Fies, C. & Marshall, J. 2006. Classroom response systems: A review of the literature. *Journal of Science Education and Technology*, 15: 101-109.

Flavin, M. 2012. Disruptive technologies in higher education. Research in learning technology. [Online]. http://www.researchinlearningtechnology.net/index.php/rlt/article/view/19184/html [2015, April, 29].

Fluckiger, J., Tixier y Vigil, Y., Pasco, R. & Danielson, K. 2010. Formative feedback: Involving students as partners in assessment to enhance learning. *College Teaching*, 58(4): 136-140.

Flyvbjerg, B. 2006. Five misunderstandings about case-study research. *Qualitative Inquiry*, 12(2): 219–245.

Fosnot, C.T. & Perry, R.S. 2005. Constructivism: a psychological theory of learning. In Fosnot, C.T. (ed.) *Constructivism: Theory, Perspectives, and Practice*. Second edition. New York: Teachers College Press.

Freshwater, D. 2007. Reading mixed methods research. Contexts for criticism. *Journal of Mixed Methods Research*, 1(2): 134 – 146.

Frith, C. D. 2007. *Making up the mind: How the brain creates our mental world*. Oxford: Blackwell Publishing.

Gachago, D., Morris, A. & Simon, E. 2011. Engagement levels in a graphic design ARS class : students' perceptions around attention, participation and peer learning. *Journal of Information Technology Education*, 10: 254-269.

Gagné, R.M., 1985. T*he conditions of learning and theory of instruction*. Fourth edition. New York: College Publishing.

Gagné, R.M., Briggs, L.J. & Wager, W.W. 1992. *Principles of instructional design.* Fourth edition. Orlando FL: Harcourt Brace Jovanovich College Publishers.

Gagné, R.M., Wager, W.W., Golas, K.C. & Keller, J.M. 2005. *Principles of instructional design*. Fifth edition. Belmont, CA: Wadsworth/Thomson.

Garraway, J. & Morkel, J. 2015. Learning in sites of practice through a CHAT lens. In Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J. & Amory, A. (eds.). *Activity theory, authentic learning and emerging technologies. Towards a transformative higher education pedagogy*. New York: Routledge. 22-31.

Gerring, J. 2007. *Case study research. Principles and Practices*. New York: Cambridge University Press.

Gibbs, G. & Simpson, C. 2004. Conditions under which assessment supports students' learning. *Learning and Teaching in Higher Education*, 1:3-31.

Gilbert L. & Gale V. 2008. *Principles of e-learning systems engineering*. Oxford: Chandos.

Gorsky, P. & Caspi. A. 2005. Dialogue: a theoretical framework for distance education instructional systems. *British Journal of Educational Technology*, 36(2): 137-144.

Graham, C.R., Tripp, T.R., Seawright, L. & Joeckel III, G.L. 2007. Empowering or compelling reluctant participators using audience response systems. *Active Learning in Higher Education,* 8(3): 233-258.

Greene, J., Caracelli, V. & Graham, W. 1989. Toward a conceptual framework for mixed-method evaluation designs*. Educational Evaluation and Policy Analysis*, 11(3): 255-274.

Hakkarainen, P. 2004. Challenges of activity theory. *Journal of Russian and East European Psychology*, 42(2): 3-11.

Halverson, R. 2010. School formative feedback systems. *Peabody Journal of Education*, 85(2): 130-146.

Han, J.H. & Finkelstein, A. 2013. Understanding the effects of professors' pedagogical development with clicker assessment and feedback technologies and the impact on students' engagement and learning in higher education. *Computers & Education*, 65: 64-76.

Harackiewicz, J.M., Manderlink, G. & Sansone, C. 1984. Rewarding pinball wizardry: Effects of evaluation and cue value on intrinsic interest. *Journal of Personality and Social Psychology*, 47(2): 287-300.

Harder, H. 2010. Encyclopedia of case study research. In Mills, A.J., Durepos, G. & Wiebe, E. (eds.). *Encyclopedia of case study research.* Thousand Oaks: SAGE Publications, Inc. 371–372.

Hardman, J. 2007. Making sense of the meaning maker: Tacking the object of activity in a computer-based mathematics lesson using activity theory. *International Journal of Education and Development Using ICT*, 3(4) [Online] Available: http://ijedict.dec.uwi.edu/viewarticle.php?id=423. [2015, September, 2].

Hardman, J. & Amory, A. 2015. Introduction to Cultural-Historical Activity Theory and tool mediation. In Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J. & Amory, A. (eds.). *Activity theory, authentic learning and emerging technologies. Towards a transformative higher education pedagogy*. New York: Routledge. 9-21.

Harper, B. 2009. I've never seen or heard it this way! Increasing student engagement through the use of technology-enhanced feedback. *Teaching Educational Psychology*, 3(3):1-8.

Hatziapostolou, T. & Paraskakis, I. 2010. Enhancing the Impact of formative feedback on student learning through an online feedback system. *Electronic Journal of E-Learning*, 8(2): 111-122.

Heaslip, G., Donovan, P. & Cullen, J.G. 2013. Student response systems and learner engagement in large classes. *Active Learning in Higher Education*, 15(1): 11-24.

Herreid, C.F. 2006. "ARS" cases: Introducing case study teaching into large classrooms. *Journal of College Science Teaching*, 36: 43–47.

Hodges, C.B. 2004. Designing to motivate: Motivational techniques to incorporate in e-learning experiences. *The Journal of Interactive Online Learning*, 2(3): 1-7.

Holland, L., Schwartz-Shea, P. & Yim, J.M.J. 2013. Adapting clicker technology to diversity courses: New research insights. *Journal of Political Science Education*, 9(3): 273-291.

IMS Learning Design Information Model. 2003. [Online] Available: http://www.imsglobal.org/learningdesign/index.html. [2015, January, 21].

Institutional Intent and Strategy, 2013 – 2018. n.d. [Online]. Available: http://www.sun.ac.za/english/management/rector/Documents/Institutional Intent and Strategy 2013-2018.pdf. [2014, January, 25].

Jaffer, S. 2010. Educational technology pedagogy: A looseness of fit between learning theories and pedagogy. *Education as Change*, 14(2):273-287.

Johnson, B. & Christensen, L. 2008. *Education research. Quantitative, qualitative, and mixed approaches*. Los Angeles: SAGE Publications.

Johnson, R., Onwuegbuzie, A. 2004. Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7): 14-26.

Johnson, D. & McLeod, S. 2004. Get answers: Using student response systems to see students' thinking. *Learning & Leading with Technology*, 32(4), 18-23.

Jonassen, D. & Rohrer-Murphy, L. 2013. Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development*, 47(1): 61-79.

Kang, H & Gyorke, A. 2008. Rethinking distance learning activities: a comparison of transactional distance theory and activity theory*. Open Learning: The Journal of Open, Distance and e-Learning*, 23(3): 203-214.

Kaptelinin, V. 2005. The object of activity: Making sense of the sense-maker. *Mind, Culture, and Activity*. 12(1): 4-18.

Kaptelinin, V. & Nardi, B. 2006. *Acting with technology. Activity theory and interaction design*. Cambridge: The MIT Press.

Karaman, S. 2011. Effects of audience response systems on student achievement and long-term retention. *Social Behavior and Personality*, 39(10): 1431-1440.

Kay, R. & LeSage, A. 2009. Examining the benefits and challenges of using audience response systems: A review of the literature. *Computers & Education*, 52(3): 819-827.

Keller, J.M. 2010. *Motivational design for learning and performance: the ARCS model approach*. New York: Springer.

Keller, C., Finkelstein, N., Perkins, K., Pollock, S., Turpen, C. & Dubson, M. Research-based practices for effective clicker use. PERC Proceedings, 2004.

Kizito, R. 2015. Structuring an activity theory-based framework for evaluating a science extended curriculum programme. *South African Journal of Higher Education*. 29(1): 211 – 237.

Knight, J.K., Wise, S.B. & Southard, K.M. 2013. Understanding clicker discussions: student reasoning and the impact of instructional cues. *CBE-Life Sciences Education*, 12:645-654.

Koehler, M.J. 2012. Using the TPACK image. [Online]. Available: http://www.tpack.org [2015, January, 21].

Koehler, M.J., Mishra, P. & Cain, W. 2013. What Is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education*, 193(3): 13-20.

Kuh, G.D. 2001. Assessing what really matters to student learning. *Change*, 33(3):10-17.

Kuh, G.D. 2003. What we're learning about student engagement from NSSE. *Change*, 35(2):24-32.

Lasry, N. 2008. ARSs or flashcards: Is there really a difference? *The Physics Teacher*, 46: 242-244.

Laurillard, D. 1993. *Rethinking university teaching. A framework for the effective use of educational technology*. London: Routledge.

Laurillard D. 2012. *Teaching as a design science: Building pedagogical patterns for learning and technology*. New York: Routledge.

Leiman, M. 1999. The concept of sign in the work of Vygotsky, Winnicott, and Bakhtin: Further integration of object relations theory and activity theory. In Engeström, Y., Miettinen, R. & Punamäki. (eds.). *Perspectives on activity theory*. New York: Cambridge University Press. 419-434.

Leont'ev, A. N. 1978. *Activity, consciousness, and personality*. Prentice-Hall: Englewood Cliffs.

Leontyev, A.N. 1981. *Problems of the development of the mind*. Moscow: Progress.

Lerman, S. 2013: Technology, mathematics and activity theory. *International Journal for Technology in Mathematics Education*, 20(1): 38-42.

Lin, A. 2007. What's the use of "triadic dialogue"?: Activity theory, conversation analysis, and analysis of pedagogical practices. *Pedagogies: An International Journal*, 2(2): 77-94.

Lundeberg, M.A., Kang, H., Wolter, B., delMas, R., Armstrong, N., Borsari, B., Boury, N., Brickman, P., Hannam, K., Heinz, C., Horvath, T., Knabb, M., Platt,T., Rice, N., Rogers, B., Sharp, J., Ribbens, E., Maier, K.S., Deschryver, M., Hagley, R., Goulet, T. & Herreid, C.F. 2011. Context matters: increasing understanding with interactive clicker case studies. *Educational Technology Research and Development*, 59:645-671.

MacLean, P. & Scott, B. 2007. *Learning design: requirements, practice and prospects*. Campus-Wide Information Systems, 24(3): 187-198.

MacLean, P. Scott, B. 2011. Competencies for learning design: A review of the literature and a proposed framework. *British Journal of Educational Technology*, 42(4):557-572.

Maistre, C. & Paré, A. 2004. Learning in two communities: the challenge for universities and workplaces. *Journal of Workplace Learning*, 16(1/2): 44-52.

Marken, J. 2008. An application of activity theory. A case of global training. *Performance Improvement Quartely*, 19(20: 27-49.

Martin, D. & Peim, N. 2009. Critical perspectives on activity theory. *Educational Review*, 61(2): 131-138.

Martyn, M. 2007. ARSs in the classroom: An active learning approach. *Educause Quarterly*, 30 (2): 71-74.

Mazur, E. 2009. Farewell, lecture? *Science*, 323(5910): 50-51.

McClanahan, E. & McClanahan, L. 2002. Active learning in a non-majors biology class: lessons learned. *College Teaching*, 50(3): 92-96.

Meacham, S. J. 2001. Vygotsky and the blues: Re-reading cultural connections and conceptual development. *Theory into Practice*, 40(3): 190-197.

Mertens, D. 2011. Publishing mixed methods research. *Journal of Mixed Methods Research*, 5(1): 3 – 6.

Miettinen, R. 2006. Epistemology of transformative material activity: John Dewey's pragmatism and cultural-historical activity theory. *Journal of the Theory of Social Behaviour*, 36(4): 398-408.

Mironenko, I. 2013. Concerning interpretations of activity theory*. Integrative Psychological and Behavioral Science*, 47: 376-393.

Molden, D.C. & Dweck, C.S. 2000. Chapter 6. Meaning and motivation. In Sansone, C. & Harackiewicz, J.M. (eds*.). Intrinsic and extrinsic motivation. The search for optimal motivation and performance*. San Diego: Academic Press. 131-159.

Molenda, M. 2003. In search of the elusive ADDIE model. *Performance Improvement Quartely*. 42(5): 34-36.

Muir-Herzig, R.G. 2004. Technology and its impact in the classroom. *Computers & Education*, 42(2): 111-131.

National Research Council Committee on Information Technology Literacy. 1999. *Being fluent with information technology literacy*. Washington, DC: National Academy Press.

Ng'ambi, D. & Brown, C. 2015. Mediating learning in a blended postgraduate course. In Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J. & Amory, A. (eds.). *Activity theory, authentic learning and emerging technologies. Towards a transformative higher education pedagogy*. New York: Routledge. 46-58.

Nicol, D. & Macfarlane-Dick, D. 2006. Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2): 199-218.

Niemi, H. 2002. Active learning – a cultural change needed in teacher education and schools. *Teaching and Teacher Education*, 18: 763-780.

Onwuegbuzie, J. & Johnson, R.B. 2006. The validity issue in mixed research. *Research in Schools*, 13(1): 48-63.

Pappas, C. 2013. *The instructional design models and theories journey*. [Online]. Available: http://elearningindustry.com/instructional-design-models-and-theories [2015, January, 15].

Pascarella, E.T. 2001. Identifying excellence in undergraduate education: Are we even close? *Change*, 33(3):18-23.

Perez, K.E., Straus, E.A., Downey, N., Galbraith, A., Jeanne, R. & Cooper, S. 2010. Integrated biology and undergraduate science education: A new Biology education for the twenty-first century? *CBE-Life Sciences Education*, 9: 10-16.

Piaget, J. 1973. *To understand is to invent*. New York: Grossman.

Plowright, D. 2011. *Using mixed methods. Frameworks for an integrated methodology*. London: SAGE Publications.

Powell, C. K. & Kalina, C.J. 2009. Cognitive and social constructivism: Developing tools for an effective classroom. *Education*, 130(2): 241-251.

Pradhan, A., Sparano, D. & Ananth, C.V. 2005. The influence of an audience response system on knowledge retention: An application to resident education. *American Journal of Obstetrics and Gynecology*, 193: 1827-1830.

Pressman, R.S. 2005. *Software engineering: A practitioner's approach*, Sixth edition. Singapore: McGraw-Hill.

Pundak, D., Herscovitz, O. & Shacham, M. 2010. Attitudes of face-to-face and e-learning instructors toward 'active learning' [Online]. Available: http://www.eurodl.org/materials/contrib/2010/Pundak_Herscovitz_Shacham.htm [2015, September, 6].

Ramaprasad, A. 1983. On the definition of feedback. *Behavioural Science*, 28(1): 4-13.

Ramsden, P. 1992. *Learning to teach in higher education*. London: Routledge.

Reigeluth, C.M. & Carr-Chellman, A.A. 2009. Understanding instructional theory. In Reigeluth, C.M. & Carr-Chellman, A.A. (eds.). *Instructional-design theories and* *models. Volume 3. Building a common knowledge base*. New York: Taylor and Francis.

Roschelle, J. 2006. Effective integration of dynamic representations and collaboration to enhance mathematics and science learning. Keynote address at Curriculum Corporation 13th National Conference, Adelaide. [Online]. Available: http://www.curriculum.edu.au/verve/_resources/Roschelle_Paper.pdf [2015, June, 5].

Rochester, S., Kilstoff, K. & Scott, G. 2005. Learning from success: Improving undergraduate education through understanding the capabilities of successful nurse graduates. *Nurse Education Today*, 25: 181-188.

Roth, W. 2004. Activity theory and education: An introduction. *Mind, Culture and Activity*, 11(1): 1-8.

Roth, W. 2007. Emotion at work: A contribution to third-generation cultural-historical activity theory. *Mind, Culture and Activity*, 14(1-2): 40-63.

Roth, W. & Lee, Y. 2007. "Vygotsky's neglected legacy": Cultural-historical activity theory. *Review of Educational Research*, 77(2): 186 – 232.

Ryan, R.M. & Deci, E.L. 2000. When rewards compete with nature: The undermining of intrinsic motivation and self-regulation. In Sansone, C. & Harackiewicz, J.M. (eds.). Intrinsic and extrinsic motivation. The search for optimal motivation and performance. San Diego: Academic Press.

Ryan, R.M., Mims, V. & Koestner, R. 1983. Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology*, 45(4):736-750.

Sadler, D.R. 1989. Formative assessment and the design of instructional systems. *Instructional Science,* 18(2): 119-144.

Sandelowski, M. 2000. Focus on research methods. Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed method studies. *Research in Nursing & Health*, 23: 246-255.

Sannino, A. 2011. Activity theory as an activist and interventionist theory. *Theory & Psychology*, 21(5): 571-597.

Sannino, A., Daniels, H. & Gutiérrez, K.D. 2009. Activity theory between historical engagement and future-making practice. In Sannino, A., Daniels, H. & Gutiérrez, K.D (eds.). *Learning and expanding with activity theory*. New York: Cambridge University Press. 1-15.

Sansone, C. & Harackiewicz, J.M. 2000. Controversies and new directions – is it déjà vu all over again? In Sansone, C. & Harackiewicz, J.M. (eds.). *Intrinsic and extrinsic motivation. The search for optimal motivation and performance*. San Diego: Academic Press. 444-452.

Scanlon, E. & Issroff, K. 2005. Activity theory and higher education: Evaluating learning technologies. *Journal of Computer Assisted Learning*, 21: 430 – 439.

Sheikh, A. 2013. Clicker use as an instructional strategy: Effects on student engagement and achievement in a college-level digital literacy course. Unpublished PhD dissertation, Graduate School Valdosta State University, Georgia.

Shellnut, B., Knowltion, A. & Savage, T. 1999. Applying the ARCS model to the design and development of computer-based modules for manufacturing engineering courses. *Educational Technology Research and Development*, 47(2): 100-110.

Simelane, S. & Skhosana, P. 2012. Impact of clicker technology in a mathematics course. *Knowledge Management & E-Learning: An International Journal*, 4(3):279:292.

Simons, H. 2009. Listen, look, document: methods in case study research in *Case Study Research in Practice.* London: SAGE Publications, Ltd. 43-67.

Smagorinsky, P. 2001. If meaning is constructed, what is it made from? Toward a cultural theory of reading. *Review of Educational Research*, 71(1): 133-169.

Smith, M.K., Annis, S.L., Kaplan, J.J. & Drummon, F. 2012. Using peer discussion facilitated clicker questions in an informal education setting: Enhancing farmer learning in science. *PLoS ONE*, 7(10):1-9.

Spratt, C., Walker, R. & Robinson, B. 2004. *Module A5: Mixed research methods*. Commonwealth of Learning. [Online] Available: http://hdl.handle.net/11599/88. [2015, September, 23].

Stellenbosch University Institutional Plan: 2012 – 2016. n.d. [Online] Available: http://www.sun.ac.za/english/Documents/Strategic_docs/InstitusionelePlan_e.pdf [2015, April, 28].

Strategy for the use of ICT in learning and teaching at Stellenbosch University. 2013. [Online]. Available: http://www.sun.ac.za/english/Documents/Rector/ICT in Teaching and Learning.pdf. [2014, January, 25].

Streb, C. C. K. 2010. Exploratory case study. In Mills, A.J., Durepos, G. & Wiebe, E. (eds.). *Encyclopedia of Case Study Research.* 372–374.

Summaries of learning theories and models. 2014. [Online]. Available: http://www.learning-theories.com/ [2014, December, 6].

Tamrakar, B. 2008. *Modern approaches to digital learning – dll project's results*. Hämeenlinna: Julkaisija.

Tashakkori, A., Creswell, J. 2007. Editorial: The new era of mixed methods. *Journal of Mixed Methods*, 1(1): 3 – 7.

The activity system. n.d. [Online]. Available: http://www.helsinki.fi/cradle/activitysystem.htm. [2015, September 20].

The White Paper on e-Education. 2004. [Online]. Available: http://www.education.gov.za/LinkClick.aspx?fileticket=Keu0%2FBkee%2BM%3D&. [2015, March, 2015]

Thomspon, M. 2004. Some proposals for strengthening organizational activity theory. *Organization*, 11(5): 579-602.

Toomela, A. 2000. Activity theory is a dead end for cultural-historical psychology. *Culture & Psychology*, 6(3): 353-364.

Twetten, J., Smith, M.K., Julius, J. & Murphy-Boyer, L. 2007. Successful clicker standarization. *Educause Quarterly*, 4:63-67.

Van Rooij, S. 2010. *Project management in instructional design: ADDIE is not enough*. British Journal of Educational Technology, 41(5): 852-864.

Viadero, B. 2005. 'Mixed methods' research examined. *Education Week*, 26 January, 20.

Vygotsky, L. 1962. *Thought and language*. Cambridge: Massachusetts Institute of Technology Press.

Vygotsky, L. S. 1978. *Mind in society: The development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.

Vygotsky, L. S. 1981. The instrumental method in psychology. In J. V. Wertsch (ed.). *The concept of activity in Soviet psychology*. Armonk, N.Y.: Sharpe. 134-143.

Vygotsky, L.S. & Cole, M. 1978. Mind in society: the development of higher psychological processes. Cambridge: Harvard University Press.

Walker, R. & Baets, W. 2008. Instructional design for class-based and computer-mediated learning: creating the right blend for student-centered learning. In Donnelly R. & McSweeney, F. (eds.). *Applied e-learning and e-teaching in higher education*. Hershey: Information Science Reference. 241-261.

Wells, G. 2002. The role of dialogue in activity theory. *Mind, Culture and Activity*, 9(1):43-66.

What is instructional design? n.d. [Online]. Available: http://www.instructionaldesigncentral.com/htm/IDC_instructionaldesigndefinitions.htm . [2014, January, 25].

Wiliam, D. 2007. Keeping learning on track: classroom assessment and the regulation of learning. In Lester, F.K. (ed.) *Second handbook of mathematics teaching and learning*. Information Age Publishing: Greenwich. 1051-1098.

Wongwiwatthananukit, N. & Popovich, N.G. 2000. Applying the ARCS model of motivational design to pharmaceutical education. *American Journal of Pharmaceutical Education*, 64(2): 188-196.

Wood, D., Tedmanson, D., Underwood, B., Minutjukur, M & Tjitayi, K. 2015. The Anangu tertiary education program in remote northwest South Australia: a CHAT perspective. In Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J. & Amory, A. (eds.). *Activity theory, authentic learning and emerging technologies. Towards a transformative higher education pedagogy*. New York: Routledge. 32-45.

Yin, R. K. 1993. *Applications of case study research. Applied social research methods series.* Volume 34. Newbury Park: SAGE Publications.

Yin, R. K. 2014. *Case study research. Design and methods*. Fifth Edition. Thousand Oaks: SAGE Publications.

Yusop, F.D. & Correia, A. 2012. The civic-minded instructional designer's framework: An alternative approach to contemporary instructional designers' education in higher education. *British Journal of Educational Technology*, 43(2): 180-190.

Zhao, C. & Kuh, G.D. 2004. Adding value: Learning communities and student engagement. *Research in Higher Education*, 45(2): 115-138.

Zhao, C., Kuh, G.D. & Carini, R.M. 2005. A comparison of international student and American student engagement in effective education practices. *The Journal of Higher Education*, 76(2): 209-231.

List of addenda

Addendum A – Approval by Ethics Committee

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
Jou kennisvennoot • your knowledge partner

Approval Notice
New Application

13-Nov-2013
Van Rooyen, Marinda M

Proposal #: DESC_Vanrooyen2013
Title: Using clickers to promote active learning among undergraduate students: case study at a higher education institution.

Dear Ms. Marinda Van Rooyen,

Your DESC approved **New Application** received on **08-Oct-2013**, was reviewed by members of the **Research Ethics Committee: Human Research (Humanities)** via Expedited review procedures on **12-Nov-2013** and was approved.

Please note the following information about your approved research proposal:

Proposal Approval Period: **12-Nov-2013 -11-Nov-2014**

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** (**DESC_Vanrooyen2013**) 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.

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 0218839027.

Included Documents:
Research proposal
Informed consent form students
Informed consent form clickers
Interview schedule and others
Questionnaire
DESC form

Sincerely,

Susara Oberholzer
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

Addendum B – Institutional permission

UNIVERSITEIT • STELLENBOSCH • UNIVERSITY
jou kennisvennoot • your knowledge partner

23 October 2013

Ms Marinda van Rooyen
Department of Curriculum Studies
Stellenbosch University

Dear Ms van Rooyen

Re: *Using clickers to promote active learning among undergraduate students: case study at a higher education institution*

The researcher has institutional permission to solicit the participation of Stellenbosch University staff and students for this research project as stipulated in the research proposal. Institutional permission is granted on the following conditions:

- the researcher must obtain permission from the relevant department heads to proceed with this research study,
- the researcher must obtain ethical clearance from the SU Research Ethics Committee,
- the researcher must obtain the participants' full informed consent for all the facets of their participation,
- participation is voluntary,
- persons who choose not to participate may not be penalized as a result of non-participation,
- participants may withdraw their participation at any time, and without consequence,
- data must be collected in a way that ensures the anonymity of all participants,
- individuals may not be identified in the results of the study,
- data that is collected may only be used for the purpose of this study,
- the privacy of individuals must be respected and protected.

Best wishes,

Jan Botha
Senior Director Institutional Research and Planning Division

Afdeling Institusionele Navorsing en Beplanning • Institutional Research and Planning Division
Privaatsak/Private Bag X1 • Stellenbosch • 7602 • Suid-Afrika/South Africa
Tel. +27 21 808 3967 • Faks/Fax +27 21 808 4533

Addendum C – Lecturer consent

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

STELLENBOSCH UNIVERSITY

CONSENT TO PARTICIPATE IN RESEARCH

Using clickers to promote active learning among undergraduate students: case study at a higher education institution

You are asked to participate in a research study conducted by Marinda van Rooyen, from the Information Technology Department at Stellenbosch University. The results of this study will contribute to a PhD in Curriculum Studies and research papers. You were selected as a possible participant in this study because you have used / are using the Stellenbosch University clicker system.

1. **PURPOSE OF THE STUDY**

In keeping with international trends, Stellenbosch University has adopted as one of its strategies in its new Institutional Intent and Strategy for the years 2013 – 2018 increasing the use of technology in teaching and learning. The aim is to "blend information and communications technologies with a sound tertiary educational pedagogy, with a focus on learning and not just on teaching, which will contribute to easier, more effective and affordable learning opportunities." (Institutional Intent and Strategy, 2013 – 2018).

One example of such a technological tool that can be used to promote many of the above-mentioned principles for good practice in teaching is the clicker system.

The clicker system and the learning activities associated with it will be analysed using activity theory as an analytical basis. Activity theory differentiates between activities, actions and operations. The rules of the community also play an important role in the acting out of an activity.

The study will focus on three general views of the activity framework: (1) the importance of the clicker as a mediated object as part of active learning; (2) the role of systemic contradictions in the perceived cognition of the clicker system. The identification of contradictions in an activity system helps experts to focus their efforts on the root causes of problems. Such collaborative analysis and modelling is a crucial precondition for the creation of a shared vision for the solution of the contradictions. The study will identify the lecturer and student contradictions which prevent the successful implementation of the clicker system as part of the learning process; and (3) cognition redefined as collaborative achievement.

PROCEDURES

Data capturing will include this survey and if you wish to continue participation at most two interviews with lecturers and observation of lessons so that the different activities around the use of the clicker can be identified and modelled and disturbances can be identified and analysed.

2. **POTENTIAL RISKS AND DISCOMFORTS**

There are no risks or discomforts involved in the participation of this study.

3. **POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

The aim of the study is to analyse the use of clickers as part of active learning and to map out learning strategies to explore the most effective use of clickers as part of teaching and learning.

4. **PAYMENT FOR PARTICIPATION**

No remuneration will be given as part of this participation.

5. **CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of the following: All data will be stored on my computer and on Sharepoint where it will be protected by a password. Only my supervisors, Prof Magda Fourie-Malherbe and Prof Johannes Cronje (CPUT) will have access to it.

Due to the nature of the study, faculties, departments and in some cases, courses will be identified but lecturer names will not be disclosed. Results will be displayed in such a manner that lecturers cannot be identified.

6. **PARTICIPATION AND WITHDRAWAL**

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

7. **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about the research, please feel free to contact Marinda van Rooyen, 021 808 9385, vrooyen@sun.ac.za; Prof Magda Fourie-Malherbe, 021 808 3714, mfourie@sun.ac.za; and Prof Johannes Cronje (CPUT), +27825585311, johannes.cronje@gmail.com.

8. **RIGHTS OF RESEARCH SUBJECTS**

You may withdraw your consent at any time and discontinue participation without penalty. 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.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to *me* by Marinda van Rooyen in *English* and *I am* in command of this language or it was satisfactorily translated to *me*. *I* 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 the subject/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/this conversation was translated into* ___________ by _______________________].

____ _______________

Signature of Investigator Date

Addendum D – Lecturer Interview

The following questions will be asked to lecturers and will be followed up by more detailed questions if necessary.

1 Please give a short description of the method you used to incorporate the clicker. At which point in the lesson did you use the clicker system and how did you use it? Gee asseblief 'n kort beskrywing van die metode wat u gebruik het om die klieker te inkorporeer. Tydens watter stadium van die les het u die klieker stelsel gebruik en hoe het u dit gebruik?

2 Did you change the structure of you lesson plan when you started using the clicker system? / Het u u bestaande lesplan verander met die ingebruikneming van die klieker?

3 What did you do with the feedback? (The graphical representation of the answers). Did you show it to the students? Did you alter your lesson structure because of it? Wat het u met die terugvoering gedoen (die opsommende histogram van die studente se antwoorde). Het u dit aan die studente vertoon en het u u lesplan aangepas op grond van die terugvoering?

4 Which aspects of the clicker system did you have a problem with? / Watter aspekte van die klieker stelsel het u mee gesukkel?

5 How do you think can the clicker system be enhanced? / Hoe dink u kan die klieker stelsel verbeter word?

6 Do you think that using a clicker helps the students to understand the work better? Why? Dink u dat die gebruik van die klieker die studente help om die werk beter te verstaan? Hoekom?

7 Do you want the system to be able to mark the assessments as well or are you satisfied only to see the summarized results? Why?/ Wil u hê dat die stelsel punte ook moet toeken of is u tevrede om net die opsomming te sien soos tans vertoon word? Hoekom?

8 Do you think that the use of the clicker enhances your lessons? Why? / Dink u dat die gebruik van die klieker stelsel u lesse verbeter het? Hoekom?

9 How did the students experience the use of the clicker? Are they positive about it? / Hoe het die studente die gebruik van die klieker ervaar? Is hulle positief?

10 What is your assessment policy? E.g. do you use continuous assessment? / Wat is u assesseringsbeleid? Is dit bv. Aaneenlopende assessering?

Addendum E – Student consent and questionnaire

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Studente Vraelys oor Kliekers / Student questionnaire on clickers

Doel van die studie / Purpose of this study

In ooreenstemming met internasionale tendense, het Stellenbosch Universiteit die verhoging van die gebruik van tegnologie in onderrig en leer aanvaar as een van sy strategieë in sy nuwe institusionele opset en strategie vir die jaar 2013 - 2018. Die doel is om inligting-en kommunikasie-tegnologie te meng met 'n goeie tersiêre opvoedkundige pedagogie, met 'n fokus op leer en nie net oor die onderrig, wat sal bydra tot makliker, meer doeltreffende en bekostigbare leer geleenthede." (Institusionele Voorneme en strategie, 2013-2018).

Een voorbeeld van so 'n tegnologiese hulpmiddel wat gebruik kan word om baie van die bogenoemde beginsels vir 'n goeie praktyk in onderrig te bevorder, is die clicker stelsel. Hierdie vraelys en fokus-groep besprekings vorm deel van 'n studie wat die gebruik van clickers aan die Universiteit van Stellenbosch ondersoek.

Die opname is heeltemal anoniem. As jy wil deelneem aan verdere fokus-groep besprekings, verskaf asseblief jou e-posadres in die laaste vraag.

In keeping with international trends, Stellenbosch University has adopted as one of its strategies in its new Institutional Intent and Strategy for the years 2013 – 2018 increasing the use of technology in teaching and learning. The aim is to "blend information and communications technologies with a sound tertiary educational pedagogy, with a focus on learning and not just on teaching, which will contribute to easier, more effective and affordable learning opportunities." (Institutional Intent and Strategy, 2013 – 2018).

One example of such a technological tool that can be used to promote many of the above-mentioned principles for good practice in teaching is the clicker system. This questionnaire and focus-group discussions form part of a study which will investigate the use of clickers at Stellenbosch University.

The survey is completely anonymous. If you wish to participate in further focus-group discussions, please provide your email address in the last question.

Question 1

Ek gee hiermee toestemming dat my antwoorde as deel van die PhD studie gebruik mag word. / I hereby give permission that my answers may be used as part of the PhD study.

- **Yes**
- **No**

Question 2

Watter een van die volgende opsies is vir jou die mees aanvaarbaarste? / Which option do you find the most acceptable?

- Ek sal my selfoon / tablet gebruik as deel van klasaktiwiteite indien dit my sal help om die werk beter te verstaan. / I will use my cell phone / tablet as part of class activities if it will help me to understand the work better
- Ek sal my selfoon / tablet slegs gebruik vir toetse indien die punte tel. / I will use my cell phone /tablet only for assessments if the marks count
- Ek is bereid om my selfoon / tablet in enige van bogenoemde gevalle te gebruik / I am willing to use my cell phone / tablet in both above mentioned cases
- Ek wil nie my selfoon / tablet as deel van klasaktiwiteite gebruik nie. / I do not want to use my cell phone / tablet as part of class activities

Question 3

Indien jy die laast opsie gekies het by die vorige vraag, gee asb 'n rede vir jou antwoord: / If you selected the last option at the previous question, please give a reason for your answer.

Question 4

Watter van die volgende opsies is vir jou die mees aanvaarbaarste? / Which of the following options do you prefer?

- My antwoorde moet heeltemal anoniem wees / My answers should be completely anonymous.
- Die dosent mag weet dat en wat ek geantwoord het, maar nie my mede-studente nie / The lecturer should know that and what I answered but not the other students in class
- Die dosent en mede-studente moet weet wat my antwoord was / The lecturer and the other students in class should know what I answered

Question 5

Dink jy dat die gebruik van die klieker bydra tot beter leer? Gee asb 'n rede vir jou antwoord by vraag 11. / Do you think that the use of the clicker contributes to better learning? Please provide a reason for your answer at question 11.

- Yes
- No

Question 6

Hoe belangrik ag jy die volgende? Wat sal jou motiveer om deel te neem? (1: heeltemal onbelangrik; 5 - baie belangrik).

How important is the following to you? What will motivate you to participate in a clicker activity? (1: completely unimportant; 5 - very important)

- My antwoorde tel vir punte / my answers count for marks
- My deelname tel vir punte / the fact that I participate counts for marks
- Ek kan aktief deelneem aan die klas. / I can actively participate in class
- Dit gee my 'n 'stem'. Ek kan ook 'n bydrae lewer. / It gives me a voice in a large class. My contribution is also counted.
- Anonieme deelname maak dit vir my makliker om te antwoord. / Participating anonymously makes it easier for me to answer a question

Question 7

Enige verdere kommentaar / Any further comments.

Addendum F – Observation schedule

Classroom Observation Schedule: the use of clickers

Semester:…..Year:…..

Section 1: Observation Details Lecturer: ______________________________ Number of Students: ______		
1. Date and Time:	2. Module Observed:	3. Duration of Observation:
Section 2: Mediating artefacts: Tools and signs		
	Comments	
Type of artefact		
One per student / or groups		
Any problems with phones (cannot access internet, etc)		
Number of times artefacts were used		
Section 3: Subject		
Teaching technique		
Lecturer		
How does lecturer handle problems with tool?		
What does lecturer do with feedback?		
Students:		
Student reactions		
% of students who respond		
Section 4: Object		
What is tested? Work prepared for lesson / content delivered during lesson /		
What format is followed?		
Question types used		
Used together with group work / discussions		
Subject matter (theory / calculations / practical work)		
Section 5: Outcome		
Active learning (does the use of the clicker contribute to active learning)		

Test knowledge (is it simply used as an assessment tool)	
Section 6: Rules of the community	
Type of assessment	
Time allocation (is time restrictions a problem)	

____

Observer signature

____

Date