A Lecture Comprehension Indication System

Submitted in partial fulfilment
of the requirements of the degree of

BACHELOR OF SCIENCE (HONOURS)

of Rhodes University

David Kenyon

Grahamstown, South Africa
November 5, 2013

Abstract

Many students resist lecture interaction. They often lack the confidence to ask questions, ask a lecturer to slow down, repeat something, or explain a topic further when they are unsure of the subject matter. A lecture comprehension indication system based on the literature was created to address this matter. Prior to the testing of this system, students were asked to complete a questionnaire to gain insight into interaction in lectures. The results gathered from this showed that students resist interaction for many reasons such as lacking confidence, fearing their peers and lecturers, not wanting to offend the lecturer and other concerns to name a few. The system was tested for 2 weeks during computer science 112 lectures. Subsequently, students were asked to complete a second questionnaire to determine the perceived value of the system. The responses from students showed that they perceived the system as valuable. It gave the students the ability to interact anonymously with a lecturer at any time during class and throughout a course. Students believed that it also gave confidence to shy students and provided students with an easier way to interact in lectures.

ACM Computing Classification System Classification

Thesis classification under the ACM Computing Classification System (1998 version, valid through 2013) :
H.3.5 [Online Information Services]: Web-based services
K.3.1 [Computer Uses in Education]: Computer-assisted instruction (CAI)
General-Terms: Lecture Interaction System

Acknowledgements

This work would not have been possible without the continuous support of Mrs Mici Halse. I am indebted to you for your supervision and guidance throughout the project.

I would also like to thank Mrs Ingrid Siebörger for her advice and contribution towards the project and Mr Rob Benyon for his help with implementing the system.

Finally, I would like to acknowledge the financial and technical support of Telkom, Tellabs, Stortech, Genband, Easttel, Bright Ideas 39 and THRIP through the Telkom Centre of Excellence in the Department of Computer Science at Rhodes University.

Contents

List of Figures

Chapter 1

Introduction

1.1 Problem Statement

Many students resist lecture interaction. They often lack the confidence to ask questions, ask a lecturer to slow down, repeat something, or explain a topic further when they are unsure of the subject matter (Fassinger, 1995). Lecture comprehension indication systems have come about to address this issue. A lecture comprehension indication system can encompass social emotional feedback and task feedback in lectures. Within social emotional feedback there are positive reactions and negative reactions and within task feedback there are questions and attempted answers (Chu *et al.*, 2007). It is a tool that gives students the opportunity to access a networked message board where they are able to post feedback about the lectures at any time during the course. This differs from traditional feedback which tends to be at the end of a semester or at the end of a course. There have been many implementations of these systems; they vary in how they are implemented and the features they offer (MacGeorge *et al.*, 2008) but many have proven to be successful in improving students' experiences of courses (Phoha, 2001).

1.2 Project Outcomes

The purpose of this project is outlined in the following objectives:

- Gain a better understanding of students' interaction in lectures.

- Design and implement a lecture comprehension indication system.
- Test to see whether students perceived the system as valuable or not.

1.3 Approach

A lecture comprehension system was created using a website, mobile phones and a Windows application for the lecturer to view posts. Before the system was tested, a questionnaire was sent out to gain insight into students' interaction in lectures. The system was then tested for two weeks during Computer Science 112 lectures. Students were asked to complete a second questionnaire post system implementation to determine whether they believed it added value to lectures.

1.4 Structure of Thesis

The lecture comprehension indication system is described in this document. Chapter two is dedicated to a basic introduction into the field of e-learning. It also introduces the approaches used in lecture comprehension indication systems and defines the concepts commonly used within these systems. In chapters three and four, the design and implementation of the system is described. This includes the way in which data about the effectiveness of using such a system was gathered. In the fifth chapter, the results are collated and analysed to determine whether the system is considered valuable and whether it can aid in increasing student participation in lectures. Chapter six provides concluding thoughts and a discussion regarding future work in this research area.

Chapter 2

Literature Review

2.1 Introduction

This chapter describes the main concepts used in e-learning, students' interaction in lectures, types of feedback and lecture comprehension indication systems. It also explores and compares implementations of these systems and the literature available on them.

2.2 Traditional Learning Theory

According to Ranson *et al.* (1996) learning is a social creation that is facilitated through discovery and understanding of the world around us and ourselves. Our knowledge is enlarged when something new enters our experience. Learning can also develop skills which will result in an enlarged capacity to interact with the world around us. There are different layers of learning depending on what is discovered, be it, new knowledge, skills, concepts or attitudes. Understanding occurs when one reflects on the knowledge one has obtained. To understand, people need to recognise the complex interdependence of factors and qualities which are distinctive about a subject.

Learning is a conscious activity that depends on the enabling of internal rewards as well as self-motivation. This is due to the fact that we cannot unwittingly acquire new knowledge without using "reflective" energy on it (Ranson *et al.*, 1996). Learning requires some struggle to make sense of a topic even though understanding can sometimes come

easily. People are unable to learn without the sense that it is necessary and purposeful and thus taking the responsibility to achieve what is required in the learning process.

A key characteristic of learning is conversation. Learners are speakers and listeners; they are part of social creation that is conversation. An assumption of this discourse is being open: students have to allow their prejudgments to be challenged and hence have to be open to difference. Students need to develop an understanding of others and admit the existence of better perspectives or options. By challenging other beliefs and understandings, students are shown the shortcomings of their own. Reason and rationality emerge when students partake in dialogue with others.

Institutions such as universities are involved in the process of learning by leaving their mark on the emotions, thoughts and identity of students. Institutions shape students and alter their confidence and sense of place by altering their lives (Ranson *et al.*, 1996).

The capacity to learn is the main characteristic that will determine the quality of people's future. If people keep learning as the main part of our existence then we will continue to increase our capacity for knowledge, the differences amongst communities will be a source of enlightenment, and institutions will be able to respond effectively and openly to change (Ranson *et al.*, 1996).

2.3 E-learning

E-learning is commonly thought of as the use of technology and electronic equipment to aid in the process and execution of education (Sung *et al.*, 2000). It is at the forefront of modern education. e-Commerce and e-Business are commonly spoken about, but e-learning is becoming an increasingly used term in business as gains prominence for economic reasons (Sung *et al.*, 2000). In academia, higher education is faced with the problem of competition. This competition is both local and global and so universities need to stay up to date with educational methods (Jones & Lau, 2009). According to Jones & Lau (2009) e-learning supports a student orientated learning model and it helps support the current changes in education. E-learning also encourages collaboration and symbiosis amongst different professional groups. This increases the respect and understanding of the different groups. It has proven to enrich and improve the development of courses (Jones & Lau, 2009).

According to Tavangarian *et al.* (2004), the use of early e-learning methods was flawed as the primary motivation to incorporate it into training was return on investment (ROI);

this is still the case in many places. Another flaw was that the focus of e-learning was used to map traditional learning activities onto a digital environment. Thus educational process requirements as well as the needs of learners have not been at the forefront of research into this field. Tavangarian *et al.* (2004) is of the opinion that if one states that e-learning is similar to the aforementioned definition, the adoption of electronic media in teaching or education, then it is too broad; this would result in e-learning including ideas such as using a microphone within a lecture.

They suggest a more accurate and tighter definition of e-learning is:

> "All forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media to implement the learning process." (Tavangarian *et al.*, 2004, p. 274)

There are two basic types of e-learning that are commonly compared. They are known as synchronous and asynchronous e-learning and are differentiated by time-difference when using educational resources.

2.3.1 Asynchronous E-learning

Asynchronous e-learning is performed when participants cannot communicate at the same time. It provides flexibility as it allows students to use resources at any time as their use is not limited by time constraints. It is therefore self-paced learning and as such is subject to learners' self-motivation. Asynchronous e-learning can be collaborative and is regularly pre-produced or recorded (Hyder *et al.*, 2007). For example, common formats include e-mail, forums, web-based training, podcasting, DVD, recorded lectures and discussion boards (Hrastinski, 2008).

One of the unique benefits of asynchronous learning is the fact that students are able to control the order in which they access content. Hrastinski (2008) states that learners have more time to process information when using asynchronous methods. Students' answers to questions are not expected to be immediate and so they have more time to comprehend the message given by a lecturer or peer. This method of e-learning works well for students

who learn effectively by thinking and understanding content on their own. Asynchronous e-learning methods are more widely used than synchronous methods and it can be said that their popularity comes from the flexibility given by the fact that the two parties do not need to be available at the same time (Lado, 2009).

2.3.2 Synchronous E-learning

If there is not a noticeable time-delay between participants, then the learning is said to be synchronous (Hrastinski, 2008). Synchronous e-learning can reduce frustration as questions and answers can be asked and answered immediately. According to Hyder *et al.* (2007) all descriptions of synchronous e-learning tend to incorporate the use of Web conferencing software to aid interactive, live events facilitated through the Internet but also includes video calling on phones, teleconferencing etc. Synchronous e-learning can be scheduled or impromptu. It also tends to be collaborative, collective, and learners can use the resource simultaneously. Examples of synchronous e-learning are videoconferencing, Live Virtual Classrooms (LVCs), webinars and live chat.

Synchronous communication increases psychological arousal which increases motivation (Hrastinski, 2008). This is due to the fact that the learning is live. Students felt that synchronous learning was "more like talking" (Hrastinski, 2008) which made them feel more at ease when it came to covering complex issues, but as it is live it gives students less time to process information and prepare responses.

Both synchronous and asynchronous e-learning are effective in reducing the problem of geographical barriers and so are valuable tools for distance education (Lado, 2009) .

2.3.3 Limitations of E-Learning

Not all types of training and education work well with technology as the main medium. According to Maldonado *et al.* (2011), it is very important to have motivation from lecturers, parents, and peers to learn. This is because a large proportion of e-learning uses are based on autodidacticism (self-motivated learning). Students who cannot motivate themselves struggle to use e-learning effectively. E-learning also cannot replace learning where face-to-face interaction is necessary. Technology is changing, and so arises a natural progression in the scope of e-learning and the use of technology to support the learning process (Sung *et al.*, 2000). There are many benefits of e-learning as intranets and the

Internet provide students with forms of learning that they previously would have had to travel to receive; learning can therefore take place in one's home or office whenever the necessity arises. Streaming multimedia makes learning more engaging and the fact that students are allowed to take courses from universities and schools that are at a distant location from them adds great flexibility (Sung *et al.*, 2000).

According to Hrastinski (2008), students can often feel isolated and not part of a learning community when using e-learning which is a problem because community is a vital part of collaboration and learning. Another problem mentioned is that it tends to be difficult to get students to collaborate on online forums when classes are small.

Although synchronous methods are said to increase psychological arousal, both asynchronous and synchronous methods can result in a decrease in interest as students cannot read body language or facial expressions (Hrastinski, 2008); even where live video is present, body language cannot be read as well as is in the case of face to face communication. This can result in students being unsure of responses and reduce their motivation.

2.4 Blended Learning

Blended learning is learning that is done by effectively combining different teaching styles, modes of delivery and types of learning. It is being facilitated by transparent communication amongst everyone that is involved in a course (Draffan & Rainger, 2006). To ensure that this learning method is effective, it is imperative that all learner characteristics such as abilities, attitudes, physical, perceptory and sensory skills, as well as prior knowledge, are taken into account. Blended learning incorporates a variety of environments such as lectures, self-paced study, workshops, simulations, interactive multimedia and online collaboration.

Staker & Horn (2012) suggest four main models of blended learning: the rotation model, the flex model, the self-blend model, and the enriched-virtual model.

The rotation model is a program where students "rotate" on a schedule between learning styles. One of the learning models must be e-learning (Staker & Horn, 2012).

The second model, the flex model, is a program where lecturing and content are delivered mostly by online means. Students can work on a fluid schedule, switching between online content. Students are also able to converse with an on-site lecturer when the need arises (Staker & Horn, 2012).

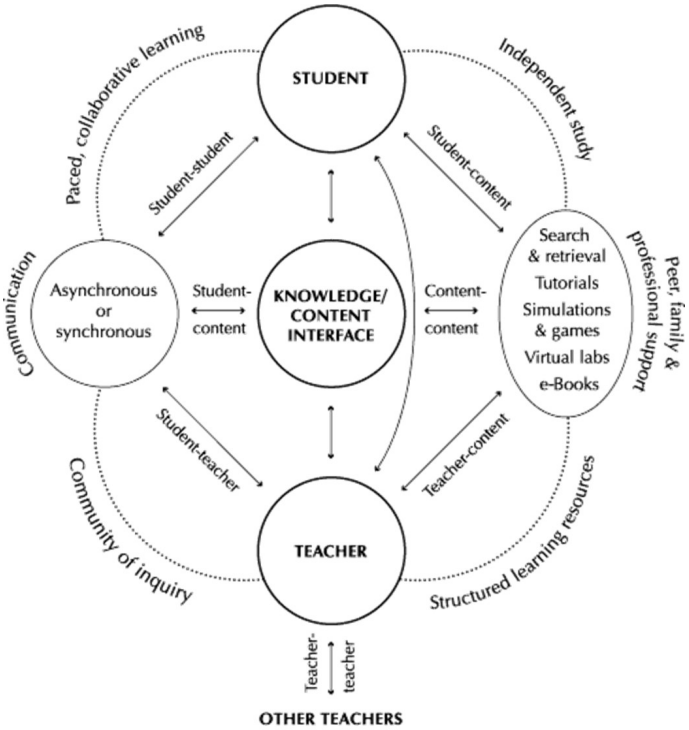


Figure 2.1: A Model of Online Learning

The self-blend model is a program where students take some courses entirely online (with the lecturer only available through online methods), while taking other courses in traditional learning environments (Staker & Horn, 2012).

The enriched-virtual model is a learning experience where students take all their courses online but do have some lectures in a traditional learning environment. These models are not the only way that blended learning can take place, and often learning is facilitated through a combination of these (Staker & Horn, 2012).

A model of blended online learning is shown in Figure 2.1.

Figure 2.1 shows that there are two main actors in online learning, the teachers and the learners. It also shows their interaction with one another and with content. Learners can either interact with content on the Internet found in multiple formats or have their education facilitated by a teacher. This can occur in a community with many students so that collaboration can occur (Anderson, 2008).

2.5 Large Lecture Classes

Wolfman (2002) states that it is a common opinion that large lecture classes are born

owing to economic restrictions. They are an economic result of a problem that results in a difficult task to overcome. With many students enrolling in a course, lecture venues have become exceedingly barren and uninviting. Other problems that have arisen are that lecturers find it difficult to become acquainted with students, and students often seem bored due to the impersonal and one-sided environment (Hensley & Oakley, 1998).

Large lecture class sizes have also added to the social pressure that affects student interaction in lectures. It is due to these problems that innovative methods of education need to be incorporated into traditional education (Wolfman, 2002).

2.6 Student Interaction in Lectures

There is often a lack of student interaction when lecturing is the main method of instruction (Robb, 2012). According to Robb (2012, p.48) "Within this environment, the student is a passive recipient of information, and dependent learning is promoted." Lecturers who encourage student interaction foster greater motivation among students, but it can be difficult to entice students to interact.

As it stands, lecturers are often unaware of how well students are grasping concepts in a lecture. This is because there is often not a large amount of engagement by students during the class. Students rarely have the confidence to ask questions, ask a lecturer to slow down, repeat something or explain a topic further when they are unsure of the subject matter (Fassinger, 1995). Many students at universities fill in student feedback questionnaires towards the end of a semester for a range of subjects. According to Kember *et al.* (2002), these questionnaires are used to improve the quality of the education. Educators can note their faults in teaching through these questionnaires and can make improvements to their teaching styles to address these faults. This should result in a better quality education and learning experience. It is also sometimes seen as an obligation by university administrators to gain the opinions of students (Groombridge, 2013). The problem is, this is just hypothetical and according to Kember *et al.* (2002), there is no evidence to prove that these questionnaires actually help or make any contribution to overall learning or education quality. Another issue is that the students are offering feedback on their experience of the course at the end and so, the knowledge the lecturer gains from the feedback can only be used the next time s/he lectures. This does not benefit the class that gives that feedback, only the next group of students.

2.7 Types of Feedback in Lectures

There are two main types of feedback in lectures, namely social emotional feedback and task feedback (Chu *et al.*, 2007). Within social emotional feedback there are positive reactions and negative reactions. Positive reactions occur when students either show solidarity, agree with other participants, or show passive acceptance. Negative reactions occur when students disagree, show tension, show antagonism, ask for help, or assert themselves (Chu *et al.*, 2007).

In task feedback, there are questions and attempted answers. Attempted answers include suggestions, opinions, confirmation or giving topic-related information. In contrast to this, questions occur when students ask for orientation, information, confirmation, repetition, topic technical information, evaluation, analysis, or suggestion (Chu *et al.*, 2007).

2.8 Lecture Comprehension Indication Systems

A lecture comprehension indication system can encompass social emotional feedback and task feedback in lectures. It can take the form of synchronous e-learning or asynchronous e-learning or both depending on when the feedback is given. If the system is used during the lecture then it is said to be synchronous whereas if it is not used in real-time then it is said to be asynchronous. Lecture comprehension indication systems can take a variety of forms, for example, a tool that gives students the opportunity to access a networked message board where they are able to post feedback about the lectures at any time during the course, or tools which incorporate clicker or audience feedback technology such as the option by MacGeorge *et al.* (2008) This differs from traditional feedback which tends to be at the end of a semester or just at the end of a course. A system such as this has proven to be successful in improving course content (Phoha, 2001).

The different approaches taken when creating one of these systems is illustrated in the next section. All of the following systems mentioned have commonalities. Some of the features of lecture indication systems include a live and lecture specific system where students can express whether they are content, engaged, bored, have a question or just have something that they would like to say.

2.9 Past Implementations

2.9.1 Audience Response Technology in Large Lecture Classes

A study was carried out by MacGeorge *et al.* (2008) to determine the effectiveness of audience response technology (ART) within large lecture classes. ART is also commonly known as "audience feedback" or "clicker" technology. The audience response technology is used more as a questioning method than a general feedback method. MacGeorge *et al.* (2008) state that in all the studies that they reviewed, ART was consistent with respect to a positive influence on classroom engagement. A problem arises in the fact that most of the evaluations of ART technology have been carried out within classes composed of engineering, science or maths students. The reason why this is problematic is that these students tend to have an affinity towards technology (MacGeorge *et al.*, 2008).

To begin the study, MacGeorge *et al.* (2008) selected three large classes in the spring of 2005. Students used pads that connected to a signal receiver via radio frequency. The students had to enter a two-digit code on entry into the lecture venue so that the device could connect to the receiver. The ART system was limited in the fact that it could not receive general feedback from the students. Students were asked questions and they could answer anonymously on one of these pads. Results of the answers would then be displayed for the class to see.

During the semester, students were asked to complete online surveys based on their opinions of the ART system. The results of these surveys showed that students found the use of ART enjoyable. They also felt that it was easy to use and resulted in an improved knowledge about student performance, lecturer expectations and course material. The surveys also tested to see whether students felt that the implementation of ART could possibly be hurting their results (grades) and this was seen to be false. Student perception of the system did not change over the semester; however some students did have a negative opinion of the system's effect on their grades towards the end of the semester (MacGeorge *et al.*, 2008).

According to MacGeorge *et al.* (2008) their study was more focused on diversity than previous studies and took factors such as race and gender into account. They did find that these demographics were not statistically significant in the trial and hence did not affect the results. MacGeorge *et al.* (2008) are of the opinion that in future trials, instructors' methods of using ART should be considered. The conclusions drawn from this study

showed that the benefits of using audience response technology in large lecture classes are significant enough to motivate the use of the technology in education.

2.9.2 Backchan.nl

Backchannels are generally instant messaging or text based chat systems that allow dialogue amongst people in a space sharing an experience (Harry *et al.*, 2008). They have a wide variety of purposes and add value to the frontchannel.

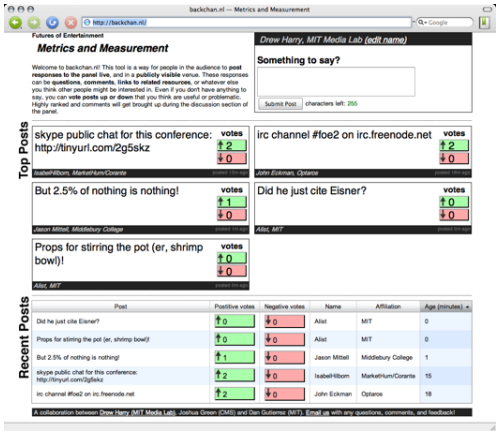
According to Harry *et al.* (2008), backchan.nl is a web based system that allows students to pose questions for the lecturer. Students can vote for the questions that they feel are the most imperative for a lecturer to answer. The questions that had the most votes are then projected onto the screen.

To test the effectiveness of the backchan.nl system, an implementation of the system was carried out during a conference in the department of Comparative Media Studies at MIT. The system was limited in that audience members could only access the system on their laptops. This was problematic as many students do not bring laptops to lectures (Harry *et al.*, 2008).

Posts were ranked on a mathematical formula that created a list of the top ten posts based on quantity of votes and recency. At the time, the current top ten posts were displayed on a screen for all the audience members to see and a monitor for the speaker/moderator. When a user logged in, they had to provide credentials such as their name and affiliation. The system was anonymous but these credentials prevented double-voting (Harry *et al.*, 2008). For clarification on how the interface worked, refer to Figure 2.2.

On occasion, members posted advertisements and publicized their own backchannels. These posts did not score well and hence did not have an effect on the overall working of the system.

During talks, most of the popular postings were content based such as "What's the role of Social Media in advertising and Convergence Culture?" (Harry *et al.*, 2008, p. 1364). Surprisingly there were also posts that were based on public sentiment such as "Can we make sure some more questions from the board get answered this time? xthxbai" (Harry *et al.*, 2008, p. 1364). and a post on the temperature in the lecture venue. Sarcastic and funny questions did not get sufficient votes to be placed in the top ten. This shows that the system was effective as a medium for interaction among the audience and presenters.



(a) Backcha.nl's web interface

(b) Projected top ten posts shown on the small screen.

Figure 2.2: The implementation of Backchan.nl (Harry et al., 2008)

On regular occasions, presenters would combine many questions into one central broader theme but still acknowledge the source of the questions so members could know which questions were being answered (Harry *et al.*, 2008).

Volunteers were asked to give feedback on the system and comments included: the system "gave [audience members] opportunities to participate in direct ways" (Harry *et al.*, 2008, p. 1366). Another audience member stated that "the ability of people to vote for what they were interested in was great" (Harry *et al.*, 2008, p. 1366).

To get people to use a backchannel system is challenging (Harry *et al.*, 2008). To remedy this problem, one must constantly be reminded that the system is in place. In the implementation of backchan.nl at MIT, the reminder was the projection of the top ten questions on the screen.

2.9.3 Backstage

According Pohl *et al.* (2011), passivity is one of the biggest problems in education. As class size increases, social barriers tend to arise that make students feel uncomfortable, for example when commenting on discourse or posing questions. Computer-mediated backchannels solve this problem as students can engage in collaborative activities.

Backstage is a dedicated backchannel which promotes active participation and awareness amongst the students and lecturer similar to the implementation of Harry *et al.* (2008). Pohl et al. quotes Professor Deborah Ball who states that "Students' opportunities for

learning are reduced when their role is mainly that of spectators in large lecture classes" (Pohl *et al.*, 2011, p. 188). This tends to be a problem in large lecture classes. As a result, Pohl et al. used a micro-blog system to overcome this social barrier (Pohl *et al.*, 2011).

A micro-blog is a commonly used form of media for backchannels. Due to the fact that micro-blogs are brief, students write their messages in a concise manner. Students also reflect more on their messages while typing them instead of saying them. This results in a deeper understanding by them and by other students that read them (Pohl *et al.*, 2011).

The Backstage backchannel includes a public, private as well as anonymous form of communication. Students can refer to other students in the class by using the "@" character. This is commonly used in IRC clients and Twitter and so will not be unfamiliar to students. Pohl et al. state that anonymity lowers the barrier to participate in backchannel communication. This is a common opinion in most of the literature on student interaction systems. Students approve or reject messages to the lecturer by use of a rating scheme. This is very similar to Harry *et al.* (2008)'s method. Highest rated messages and messages that are commonly referred to using the "@" symbol will be posed to the lecturer. The decline of relevance will also be subject to an aging process and so older messages will lose points over time if they are not constantly referred to or rated.

Backstage poses a question to the lecturer with a corresponding percentage. This percentage stipulates the quantity of students that asked the question. Not only is this rating used to determine which messages are the most relevant but also to give students' status. When students messages are given a high rating, their status on the system increases. The student's status can then be used as a weighting on the backchannel (Pohl *et al.*, 2011).

The backchannel also gives students the chance to give lecturers their opinion on pace. The pace field has two notifications, namely "too slow" and "too fast". During the lecture, these notifications are aggregated and shown on the lecturers' presentation screen (Pohl *et al.*, 2011).

The backchannel system therefore provided lecturers and students with a system of instant feedback. It could have possibly been beneficial to add in more of these generic feedback features such as understanding indicators.

Figure 2.3: Lecture Comprehension Enhancement Application Interfaces (Zhan et al., 2006)

2.9.4 Lecture Comprehension Enhancement Application

Zhan *et al.* (2006) created a lecture comprehension application that incorporates auto-grouping and question sharing. The problems that Zhan *et al.* (2006)'s system intended to solve included test results not being returned in time, instructors not being aware of students' levels of understanding, students' insecurity about their learning level, students lacking the confidence to ask questions and text-based questioning taking too long for students to write and lecturers to view. The application gave students the ability to post questions anonymously and for lecturers to quickly grasp the students' understanding.

Students could view lecture material within an interface created for them on their laptops. Questions that were related to certain slides could be posted. This results in the lecturer being immediately aware of which slide students were referring to and thus which topic. The lecturer receives slide number frequencies so that slides that are commonly misunderstood can be addressed first. Lecturers can receive text messages that are also grouped by slide number. While the lecturer gives a presentation, they have the option of an "always-on-top" mini version that occupies a corner of the screen with only slide number frequency information. This prevents wastage of space and time as lecturers do not have to minimize the presentation to view a summary of which slides are commonly misunderstood. If necessary, the lecturer can then view details of the queries afterwards (Zhan *et al.*, 2006). The three interfaces available are shown in Figure 2.3.

The application also has the functionality to allow real-time questioning so that students' answers to quizzes can be graded immediately. Not only does this allow for real-time quizzing, but also the option of lecturers being evaluated (Zhan *et al.*, 2006).

Due to the aforementioned functions, Zhan *et al.* (2006)'s application has the benefit of being effective as well as convenient. To evaluate this, they tested the application in mock lectures and contrasted the average test results. The results showed that the incentive to interact in class improved lecture quality which resulted in higher marks. Once again, due to the fact that the application created was intended for computer use, the system was limited to students who brought their laptops to class (Zhan *et al.*, 2006).

2.9.5 NATA

Not Afraid to Ask (NATA) is a computer based system created by Chu *et al.* (2007) that is used to encourage students to ask questions in lectures by reducing the pressure and embarrassment.

Due to the fact that questioning is "critical to the development of reflective and meta-cognitive thinking" (Chu *et al.*, 2007, p. 601) people examine the knowledge that they have received to improve their learning. Students are not able to truly think, learn and understand unless they question (Elder & Paul, 2004). It is therefore problematic that students do not ask questions in class.

According to Chu *et al.* (2007), the main reason that students do not ask questions in class is that there is severe pressure. The pressure stems from four sources, namely cultural background, teachers, peers and personality. For cultural background, it is said that certain social-cultural perceptions prevent students from questioning lecturers as it is seen to be rude. In contrast, students sometimes do not have the opportunity to ask lecturers questions as the lecturers' teaching style does not give students the opportunity. The problem of peers stems from the fact that students sometimes receive unpleasant feedback from classmates and so they do not want to ask questions for fear of what their peers will say. Students who are self-conscious or shy also tend to not participate as they feel anxious speaking in public (Chu *et al.*, 2007).

It was for these reasons that Chu *et al.* (2007) created a prototype of a questioning system to reduce the pressure of asking questions. The NATA system includes "Question Input, Questioning Race, Statistics Report, and Data Record" phases.

In the Question Input phase, students have the ability to enter questions at any time during a lecture. Usually, students wait for an opportunity to ask questions and during this period of time, the students often forget what they were going to ask. Students can

decide whether they would like to ask a question and better formulate it as they have more time to decide the correct wording of their question. During this process, students are encouraged to reflect on their questions and this results in improved critical thinking and meta-cognitive abilities (Chu *et al.*, 2007).

During the Questioning Race phase, students press the bell next to the question on the interface. The reason why this phase is framed as a race is because it encourages students to be the first one to ask the question (Chu *et al.*, 2007).

In the Statistics Report phase, students and teachers are able to view the questioning performance of all students. Only students' identification numbers are shown so the system is still anonymous. Lecturers do have a record of which student correlates to which number so that if needs be, the lecturer can find out who posed the question (Chu *et al.*, 2007). This tends to be different from all the other implementations mentioned as they are focus greatly on anonymity.

The Data Record phase stores details of questions so that students and lecturers can review these questions after the lecture. Lecturers can identify where students are having difficulties so that they can adjust their teaching style or pace accordingly. If students read the questions, it might stimulate their question asking (Chu *et al.*, 2007).

The NATA system was tested at a private university in Taiwan. Students used the system to pose questions in lectures during midterm presentations. 56 students were split up into 17 groups. Each group gave a presentation of approximately 20 minutes in length. Half of the groups used traditional questioning methods during the presentations and the other half used the NATA system. A study was performed to test the effectiveness of NATA. The results showed that there was a significantly higher number of questions asked when using NATA compared to the traditional questioning process. The quantity of students who clicked the bell to pose their question was significantly higher than the quantity of students who raised their hands to ask a question. Ninety percent of students felt that the NATA system made it less stressful to ask questions. It was also felt by 87.5% of students that they learnt more about how to ask questions when using the NATA system (Chu *et al.*, 2007).

The fact that over 95% of the students felt that they would like to use the system again in the future, indicated that NATA is an effective method to increase students' willingness to ask questions.

Some could say that a possible flaw of the system was that it was not used for general

feedback such as in the Backstage system or the Backchan.nl system depending on what the requirements were.

2.9.6 Classroom Performance system

A powerful and revolutionary support tool as described by Ward (2003) is the Classroom Performance System (CPS). Unpublished results by Ward showed that the "technology-empowered classroom" was more interactive than the traditional classroom by a large proportion. This statistic seems questionable, but if there is any degree of truth in it, it may be a definite indicator of interactivity in a technology-empowered classroom. The CPS is a clicker based system where students are given a response pad that connects with the lecturer's computer. Students can use these response pads to answer verbal questions asked by the lecturer when they feel the need. This can be done without embarrassment.

Currently, there are 7000 classes in the United States, United Kingdom, Puerto Rico, Canada, Australia, Singapore and the Netherlands that incorporate the CPS into their education scheme (Ward, 2003). The CPS has the following characteristics that positively augment a lecturers' teaching style; provides both delayed and immediate feedback to the lecturer, it provides a tool for the teacher to engage all students in the class and reduces the effort of analyzing classroom interactivity (Ward, 2003).

The CPS is more focused on questioning students than on receiving general feedback from them. It does have the functionality for general feedback but the purpose of the review of this technology was mainly to test if the questioning method aided learning. When testing, Ward (2003) noted that question repetition improved students' results by up to 29%.

The main benefit was that student engagement increased. This was due to the fact that peer pressure resulted in students answering the questions posed by the lecturer. This peer pressure is subtle; if most of the class is answering questions, quieter students tend to join in and answer the questions as well. Group incentives were also added to the questioning scheme. This does not seem like a relevant addition to the classroom performance system but it did lead to improved motivation. This was done for example by informing students that homework would be reduced if more than 80% of the class participated (Ward, 2003).

In comparison to the backchannel implementations, the CPS seemed to have more focus on questioning students than on them providing feedback or inquiring about the subject matter.

2.9.7 Mobile Lecture Interaction

According to Cruz e Costa *et al.* (2008) the lecturing method of education has had the lowest retention rate of all methods of teaching, namely 5%. This is partly due to the low student-lecturer interaction.

A system very similar to Harry *et al.* (2008)'s Backchan.nl system was created by Cruz e Costa *et al.* (2008) at the university of Oulu, Finland. This system is known as the Mobile Lecture Interaction (MLI) application.

The similarity lies in the fact that students could pose questions on their mobile phones to the lecturer and the other students could support them by voting for their questions. Unlike the client-side of Harry et al.'s implementation, students ran Java applications on their phones where they could submit, view and vote for questions. The interface for the student application is shown in Figure 2.4.

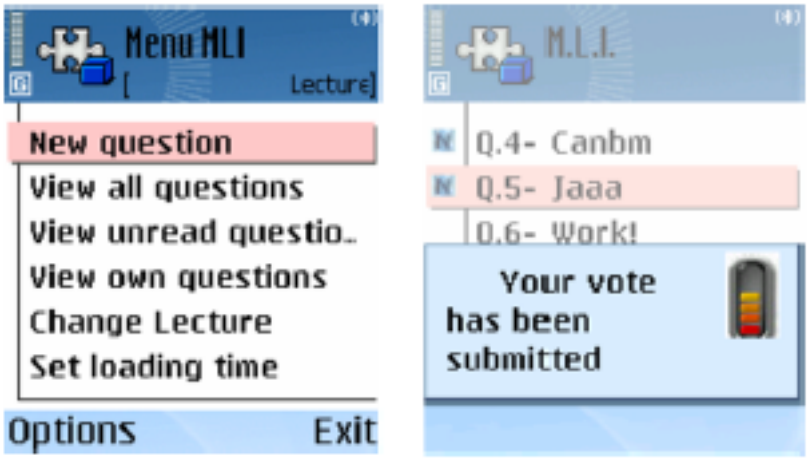


Figure 2.4: Mobile Lecture Interaction student application

The Java application connected to a website which then sent the posed questions to the lecturer on their PC, who could subsequently answer them as s/he felt the need. The website running on the teacher's PC is shown in Figure 2.5.

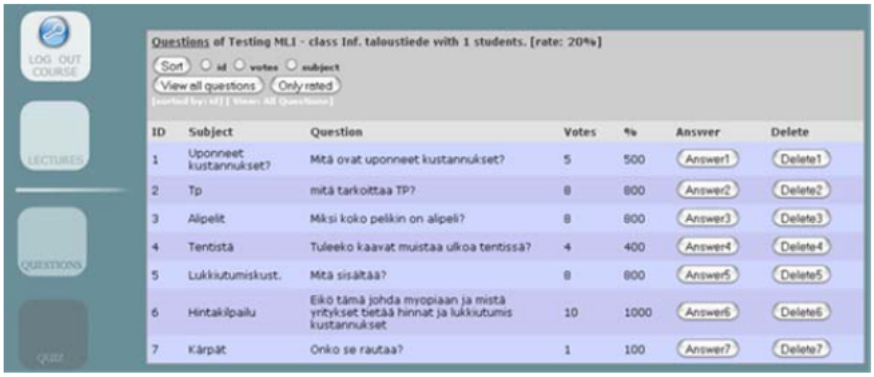


Figure 2.5: Mobile Lecture Interaction teacher application (Cruz e Costa *et al.*, 2008)

When tested on 8 lectures using Java-enabled cell phones running the MLI application, lecture interaction improved in a meaningful manner. Owing to the fact that the application ran on students' personal devices, the university does not need to invest in expensive clicker technology such as in The Classroom Performance system. Ward (2003)

Even though students appreciated the opportunity to interact with the lecturer anonymously, many students were not sure whether this system was a better way to interact with the lecturer. This implementation (in 2008) used phones that ran the Java Micro Edition (ME). The running of Java ME games and applications that are downloaded in the form of a .jar or .jad files (Chowdhury, 2012) is slowly becoming obsolete. Most smartphones now run their own executables such as .ipa files on iPhone, .apk files on Android, and .cod files on Blackberry (Apple, 2013; RIM, 2010; Morril, 2008). Some of these phones are still able to run JAVA ME applications but it is not commonly done. Therefore, the technology used in this implementation is no longer commonly used unlike in (Harry *et al.*, 2008; Pohl *et al.*, 2011; Zhan *et al.*, 2006) where the applications were created for computers which still have the ability to run this software.

2.10 Conclusion

Based on the literature, it is arguable that a good implementation in our context would be one that students could use on their mobile phones in the lecture that would connect to a lecturer's desktop application. The system would allow students to post feedback at any time during the course so that lecturers could understand whether students are content, engaged, bored, have a question or just have something that they would like to say.

Chapter 3

Design of The System

3.1 Approach

The approach taken when creating and implementing the lecture comprehension indication system was to base the system on the strengths of previous implementations such as those discussed in the literature (Harry *et al.*, 2008; Zhan *et al.*, 2006; Pohl *et al.*, 2011; Cruz e Costa *et al.*, 2008; Ward, 2003; Chu *et al.*, 2007; MacGeorge *et al.*, 2008) and customise it to suit the needs of a Rhodes University lecture. The system is intended to be an inexpensive way for students to communicate anonymously with the lecturer during a lecture and throughout the course. This is done by using mobile phones instead of expensive devices such as the clickers or pads described in the literature. The choice between using mobile phones and laptops came down to the question of current usage. According to Shepard *et al.* (2012), smartphone usage overtook client PC usage in 2011. Smartphone sales experienced growth of 62.7% whereas notebook sales experienced a growth of 7.5%. Therefore, using smartphones instead of laptops as target device seemed to coincide with current technology trends. One also needs to think of the fact that the implementation of this system is being undertaken in a developing country and as such, the technology incorporated needs to be technology that is currently being used in South Africa. Only 18% of the South African population do not have cell phones (Tubbs, 2013). Although this is true, one must remember that the implementation will occur in a South African University and as such, the majority of students would use smartphones and not basic cell phones. This statement could be seen as unfounded and as such, the usage share of cell phones in the class was acquired during a lecture prior to the implementation. The

usage share was also formally acquired in the data collection phase which is spoken about later.

Initially, the system was going to be created for Android devices only. After some thought and reflection, this decision was changed; the choice of platform on which the mobile application runs comes down to the market share of smartphones in South Africa. Seeing as South Africa is a developing country, the market share is remarkably different to wealthier countries. There are more than 8 million smartphones in South Africa. There are approximately 300000 Apple iPhones, 2000000 Android devices and 2500000 BlackBerrys (Tubbs, 2013). This means that the interaction system should be available on more than one device.

Students can use their phones to communicate anonymous feedback to a website. The feedback can be directed as: questions, general feedback and answers, interest in the topic, pace of the lecture, level of engagement and feedback that is not time sensitive. This way, the feedback is grouped on the website depending on what students wish to send in. This also gives the students an idea of what is acceptable to send in.

This website sends the feedback to a palette window that stays in front of the slideshow during a lecturer. This term will be used through this report to refer to the aforementioned window. Students' questions or comments appear on this window so that the lecturer can address problems, questions or feedback as they arise. The window displays student feedback in thirty characters or less. This feature is incorporated to encourage students to be succinct, allowing the lecturer to glance at the window and not have to waste time reading long messages. The popularity of Twitter led the researchers to think that a word limit would not be a concern to students (Java *et al.*, 2007). Lecturers can review what feedback was sent in during a lecture by visiting the website. They can also view messages that are sent in that are not time sensitive. This means that if the lecturer missed anything in the lecture they are still able to address it. For example, if a topic is commonly misunderstood and many students are sending in posts at the same time, it is possible for the lecturer to miss some of them. As a result, lecturers are able to view all posts after the lecture as they are saved in a database and viewable on the website.

3.2 Specification of The System

The system is described in the component diagram (Figure 3.1). A component diagram shows the structure of the system and how the components of a system work together. It

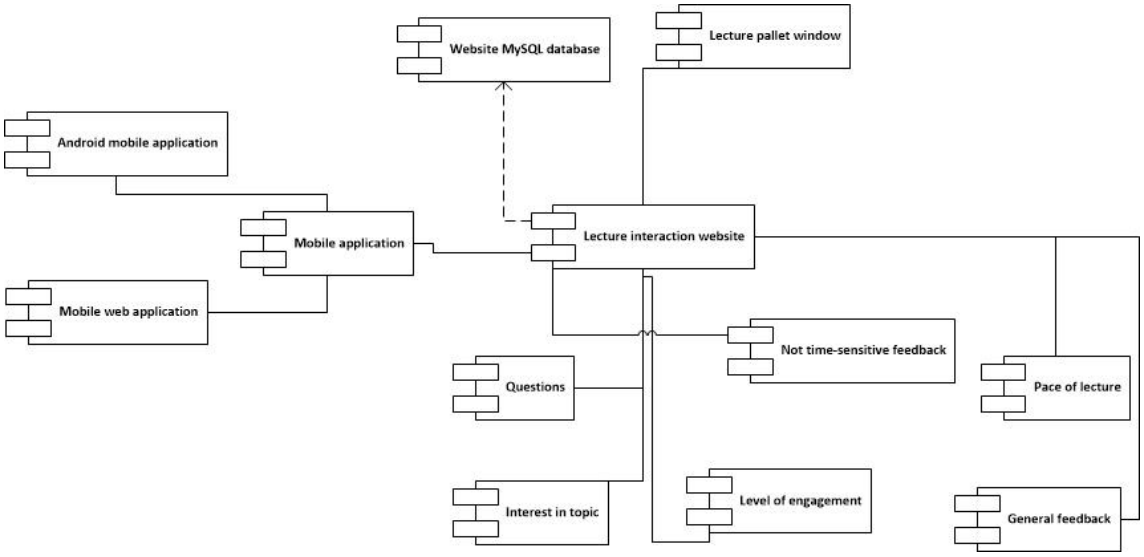


Figure 3.1: Component diagram showing the system

is a UML diagram and hence is standard software development practice (Bell, 2004).

As the diagram shows, the website is the core component of the system. It connects to a MySQL database to store messages that are sent in. The website contains tabs for the different feedback namely questions, interest in topic, feedback that isn't time sensitive, pace of the lecture and general feedback. The website connects to a mobile application that can either be an Android application or a mobile website application. Once posts have been sent in through these applications, they are saved in the database and appear in the palette window.

3.3 Data Collection Method

The data collected will be used to determine whether or not a system such as the one mentioned will increase interaction in lectures and whether or not it is a valuable asset to a lecturer. This will be done by collecting the opinions of the students and lecturer before and after the system has been tested.

A questionnaire containing questions about students' interaction in lectures will be conducted to determine the degree to which students interact in lectures and their motivation. It will be an in-depth inquiry into whether students feel comfortable asking questions, answering them, asking lecturers to change pace or commenting on subject matter during lectures. The students' reasons for their interaction or lack thereof will be collected as

well. The questionnaire will also contain a question to determine the usage share of mobile phones in the class so that insight into how the application needs to be run can be gathered.

Once the first questionnaire has been conducted, a test will be run to determine the effectiveness of this system. For a period of two weeks, students will be able to use this system in lectures, either by downloading the application or by visiting a mobile website. This trial will be conducted in Computer Science 112 lectures. The size of the class is 371 students.

The students can formulate their own opinion of the value of using a system such as this one and whether they believe it to be valuable or not. Once the trial has been conducted, students will be asked to fill in a second questionnaire. In this questionnaire, the perceived value of the system to the students will be ascertained. Students will be asked to explain how valuable they feel it was and why, and what they thought the shortcomings and advantages of using it were.

3.3.1 Evaluation of Questionnaire Websites

The questionnaire needs to be completed by a large number of students and hence it is better disseminated online. The following online questionnaire tools were evaluated (Hockenson, 2012):

3.3.1.1 Google Forms

Google Forms is a free service facilitating the creation of a questionnaire. According to Hockenson (2012) it is the simplest web application for form building. It has seven question formats and responses can be collected and exported to csv or as a spreadsheet. The application records responses, tabulates them and can create visual summaries of them (Hockenson, 2012).

3.3.1.2 Wufoo

Wufoo is commonly used by large companies such as Twitter. A drag-and-drop system makes it easy to use and it is easy to tailor the form with total customization. There

are even options to incorporate CSS code so that it is visually appealing in precisely the way one wants it to be. The downside of Wufoo is that the free service only allows 100 entries per month per form and each user is limited to three forms. One can upgrade to the paid option which starts at $14.95 per month which seems unnecessary when there are free options such as Google Forms available (Patel, 2006; Hockenson, 2012).

3.3.1.3 FormSite

FormSite is a scalable and flexible option. As it is fully-customizable it can be embedded into an existing website or can be hosted on the FormSite website. Some of the features include: more than 40 data fields, QR code integration, storage space for attached files and social sharing. Although this is a great option to create a questionnaire, the free version is limited to 10 results per form. To upgrade to 1000 per form, one is expected to pay $20 per month (Hockenson, 2012; Cohen, 2012).

3.3.1.4 FormAssembly

With FormAssembly one is allowed unlimited forms for free users and then a pay-as-you-go plan to receive results. It costs 5c per response or $14 per month depending on users needs. Unlike the other systems, FormAssembly uses a customizable free-form layout instead of a drag-and-drop interface. It also determines users location and translates the form to one of 30 languages depending on their location (Hockenson, 2012; Dutton, 2012).

3.3.1.5 FormStack

FormStack is a highly integrated and connected form builder. It has a drag-and-drop interface but the difference between this application and others is that it integrates with a large number of third party applications. It can be integrated into content management systems such as WordPress and TypePad. It also has Zendesk, FreshBooks and BatchBook integration for businesses. It is only available for a 14 day free trial and then the starter plan is available for $14 per month (Dutton, 2012; Hockenson, 2012).

3.3.1.6 Gravity Forms

For people who use the WordPress Content Management System, Gravity Forms can be integrated into the system. Once embedded, they provide an unlimited number of forms.

Results are hosted on one's own site which can be beneficial if information is valuable. The price of Gravity Forms is $39 per year excluding prime add-ons. If users wish to integrate the Form with e-commerce then the top-tier service is available for $200 (Hockenson, 2012; Clark, 2010).

3.3.1.7 JotForm

JotForm is best used for users who wish to add e-commerce functionality to their form. It is a drag-and-drop form builder where a payment tool such as PayPal, Google Checkout or Authorize.net can be added to the form. Other features include a wizard and large amounts of storage. This system is available for $10 per month which includes 10GB of storage and 1000 transactions per month (Group, 2013; Hockenson, 2012).

3.3.1.8 ReFormed

ReFormed is an interactive form-builder that has close ties to HTML5 and jQuery. It is for this reason that it is not as simple to use as the other tools mentioned. It requires code knowledge which is useful for a fully customizable creative form but is not beneficial to non-technical people. The system costs $13 once off which seems to be the best price out of the paid for options (Hockenson, 2012).

3.3.2 Choice of Questionnaire Tool

From the above-mentioned choices, Google Forms seems to be best option to create a questionnaire. Although there were options which were more customizable, Google Forms is free with responses coming in an easily readable format. The questionnaire does not need e-commerce integration and does not need to be integrated into existing systems or websites and as such Google Forms provides the best level of functionality for this research study.

3.4 Data Analysis Method

For the purpose of this research, the Statistical software R will be used. It is free and open source and contains the necessary functions to perform analysis of the data (R Core

Team, 2012). Likert scale data can be analysed separately or combined together (Bertram, 2006). Trends amongst responses were individualised and hence the relationships between variables did not need to be shown. It is also more important that inference can be made from the different questions to get a better understanding of why students resist interaction.

Due to the fact that the data collected is ordinal data, not continuous data, it is not acceptable to do analysis such as t-tests on the results. The data is ordinal as one cannot assume that respondents perceive the difference between levels as equal. It is for this reason that bar charts shall be created. The data can also be reduced to nominal levels of disagree vs. agree so that percentages of accord versus discord can be determined. Tests such as the Mann-Whitney U test, Wilcoxon signed-rank test and Kruskal-Wallis test can be performed but the researcher did not think that it was necessary because although these tests might add value, they are used to find differences between two groups, and do not seem appropriate for this research. It can be kept for future work if the necessity arises (Bertram, 2006). The alternate approach of summing the Likert scale data together can be used to measure a single larger variable and parametric tests such as analysis of variance can be performed but once again it does not seem to be necessary. Summing the data would result in less specificity and less understanding than would be apparent from a broader view. The scope of analysis for the data is vast and so, specific choices need to be made.

The data acquired from the questionnaires on Google Forms is appended as Appendix: A.1.1 and Appendix: A.1.2 in the form of a csv file. This is a text file with questions and responses separated with a comma delimiter. To read the data into a data frame in R, the read.csv method is used. This for example will be in the format:

```
responseData = read.csv("interactions.csv").
```

Once the data has been read into a data frame, frequency tables can be created of the responses to each of the questions. Statistical results such as the mean and median will not be used as the responses are not quantitative data. To create frequency tables, the following command can be used:

```
responseFreq <- transform(responseData, cumFreq = cumsum(Freq), relative =
prop.table(Freq))
```

This will give the frequencies, cumulative frequencies and relative frequencies.

Graphical representations of the Likert scale data can be produced by using the Likert function. The Likert function does not come standard with R and hence the Likert package needs to be installed using:

`install.package(“Likert”)`.

Once this has been done, the HH, grid, lattice, and latticeExtra packages need to be imported. The Likert function can then be called using:

```
likert(responseFreq,main='Lecture Interaction System',auto.key=list(space="bottom",
reverse=TRUE,padding.text=2)).
```

This creates stacked diverging style bar charts which is generally accepted amongst statisticians for Likert data.

Graphical representations of the reasoning data can be created using the barplot function. Seeing as the data recorded is frequencies of responses, qqplots or histograms will not be an effective way to represent the data. To use the barplot function, the format will be:

`barplot(table(responseData[[0]]))`.

The zero in the square brackets indicates that it is first column of the data. This will create a bar plot of the first question and the corresponding frequencies of responses. (R Core Team, 2012)

Once frequency tables and graphical representations of the data have been created, inference and conclusions can be drawn. Common trends can be examined and reasoning for results can be acquired. For the free-response questions, the data does not need to be statistically analysed, but rather qualitatively analysed with reference to the other data gathered.

Chapter 4

Implementation of System

4.1 Technical Information

At the base of the system is the website (Figure 4.1); created using Drupal, the content management system. With this system, certain modules are used to ensure that the system works effectively and efficiently. The website is hosted on a virtual machine running Windows Server 2008 with MySQL installed to manage the database. The Android application is written in Java in the Eclipse ADT environment. In contrast to this, the palette window is created using Microsoft Visual C# and XML. The following subsections outline the technical details of the software used.

4.1.1 Website: Drupal Content Management System

The core modules of the Drupal CMS were not sufficient to create the website, therefore the modules listed in the subsequent sections need to be installed to ensure the correct functionality of the CMS.

4.1.1.1 Chaos Tools

Chaos Tools is a module which aids in developing for Drupal. It is a set of application programming interfaces (APIs) which manages and provides tools such as plugins, exportables, the AJAX responder, form tools, object caching, contexts, modal dialog, dependent, content, form wizard and CSS (cascading style sheets) tools (Miles, 2008).

4.1.1.2 Comment RSS

This module is installed to facilitate the sending of RSS feeds when new comments are added to pages on the website. It requires that the comment, text, field and SQL storage modules are enabled. (Reid, 2004)

4.1.1.3 Services

Services provide an API that can be used to create web services. It gives the website the functionality to provide these web services using different interfaces that use the same callback code (Browning, 2012).

4.1.1.4 REST Server

A REST Server gives the functionality of allowing Representational State Transfer (REST) clients to connect to the server. This results in clients being able to create, retrieve, update and delete data on the server. This can be done using the "POST", "GET", "PUT", "DELETE", and "GET" controllers (Loach, 2008). REST allows simple HTTP calls between machines instead of using complex connection mechanisms such as COBRA or SOAP (Costello *et al.*, 2002).

4.1.1.5 Mobile Detect

The Mobile Detect module is based the Mobile Detect PHP library. It extends websites by allowing responsive design for mobile phones and tablets by determining when such a device is accessing the website (Donadio, 2012).

4.1.1.6 Mobile Switch

Mobile Switch gives the website the functionality of switching themes when mobile devices are detected using Browscap or Mobile Detect. This allows more minimalistic themes to be used when a mobile device is detected (Neumann, 2012a).

4.1.1.7 Mobile Switch Block

The Mobile Switch Block module builds on the Mobile Switch module. It is used to enable a switch block; allowing users to manually switch between the mobile theme and the desktop theme by providing links for either. It is configurable and customizable based on what the user requires (Neumann, 2012b).

4.1.1.8 Mobile JQuery Theme

This module is a theme that is based on the JQuery Mobile platform. JQuery Mobile is based on JQuery which is a JavaScript library. It alters the website so that when it is viewed on a mobile website, it is customised for mobile website browsing (Savino, 2011).

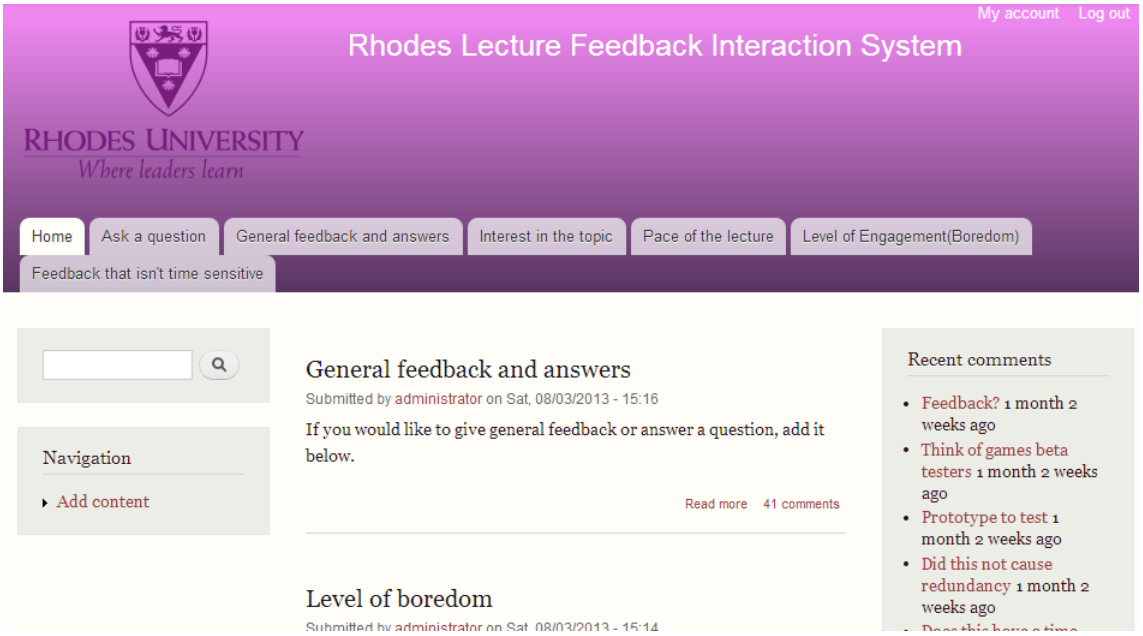


Figure 4.1: Overview of website

4.1.2 Mobile Website

The Mobile Website is created using the Drupal modules mentioned in the previous section. These include Mobile Detect, Mobile Switch, Mobile Switch Block and The Mobile JQuery Theme. The mobile website is a process rather than a web application. Rather than creating a separate web application for use on mobile devices, the website is extended to detect when a mobile device is being used through Mobile Detect, to switch the theme

using Mobile Switch, to customize this switch using Mobile Switch Block and then to apply the Mobile JQuery Theme so that the website meets responsive design principles. This allows the website to be viewed on most smartphones effectively. The Mobile JQuery theme is customizable so that the mobile website only shows parts of the website that are necessary. This is important due to the fact that the mobile website is a minimalist version of the base website and it is focused on push rather than pull. The mobile website allows for students to send in comments/posts during the lecture and allows them to see recent comments/posts from other students in a minimalist manner. (Figure 4.2)

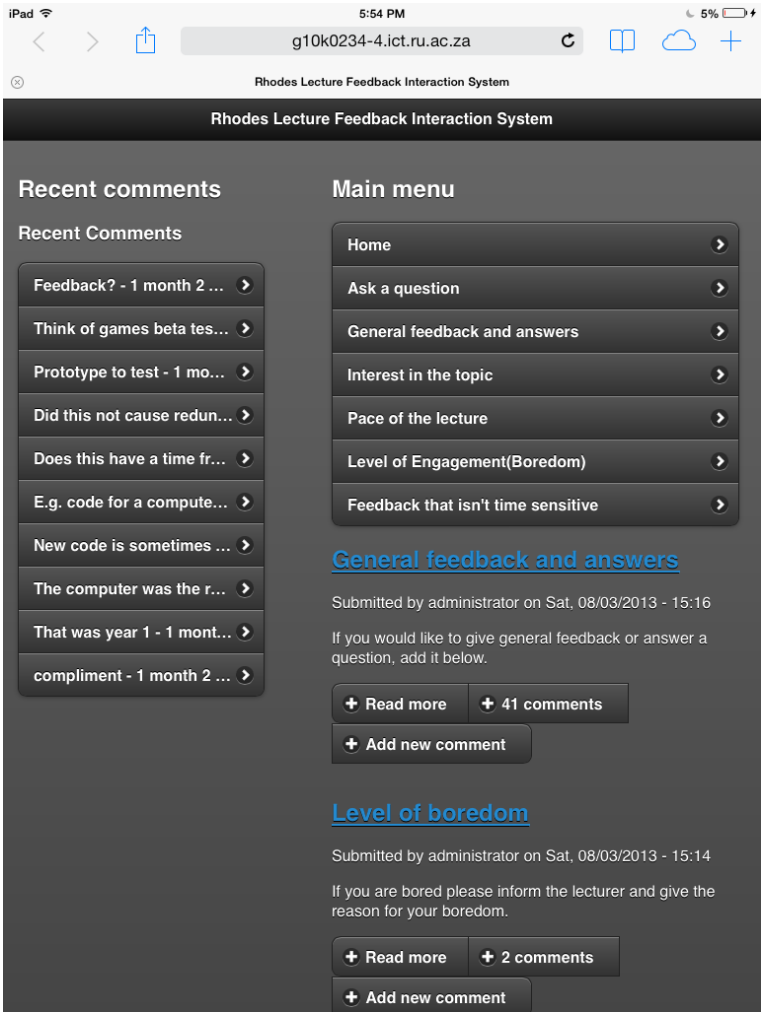


Figure 4.2: Mobile website

4.1.3 Android Application

According to the principles of responsive web design, application design should not be limited to certain devices or tailored towards them. There are too many devices to create

effective designs for all of them. Device platform, resolution, features and specifications differ depending on the device. Therefore, the principles of responsive web design ensure that applications work on different devices. For web applications to work on mobile devices, they must focus on speed; to do this, one should prune their code base. Web applications should also focus on accessibility so that all devices can connect to the application, and should not cater for specific devices (one set of code should be able to work for every device). The web application should also be compliant with possible future devices (Marcotte, 2010). Thus the approach to create the Android application is a hybrid approach. The application can be run on Android phones but will incorporate mobile web facilities. The application is a cross between traditional application and mobile web application. The application will incorporate a web-view control into the interface and connects to the Internet through primarily a WiFi connection. If this is not available, the application can connect through a mobile Internet connection. This makes the application much smaller than traditional applications but does increase the data use by a small amount.

A contrasting approach which was considered and implemented but was not as effective was to use a traditional application with standard Android controls that connects to the web page using the REST server. This approach was not rolled out as the cross-platform compatibility seems to be important in the context of the application. Separate applications would have needed to be created for each mobile platform. This will be explained in the results section of the following chapter.

4.1.4 Windows Palette Application

The Windows palette application is created using Microsoft Visual C# and XML. The application is a small window that has the property of "TopMost" being set to true. This allows for the window to always be on top even when the lecturer is giving a presentation, ensuring that the lecturer and students can read posts to the application without having to switch active applications. The window receives its data from the RSS feed of the website. There are two types of RSS feeds and due to the fact that one needs to be informed of the comments being posted, the RSS comments are used as the source. This source is set to receive data and output it in a combo box. The combo box dynamically adjusts itself so that the most recent comment is sent to the top of the list. The RSS feed restricts the data so that comments are cut off at 30 characters. This is done so that lecturers do not waste time reading comments that are overzealous or unnecessarily long. (Figure 4.3)

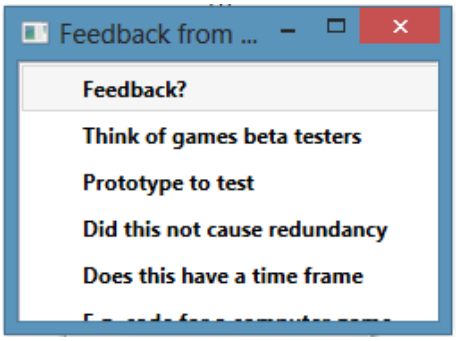


Figure 4.3: Windows palette application

4.2 Hardware Implications

4.2.1 Server

Due to the fact that the website is hosted on a virtual machine (VM), there is no need for a dedicated server. This is adequate when the system is only being run in one class with an average of 15 posts being sent in per lecture. If the lecture was much larger and a greater number of students were accessing the website, then a dedicated server or a virtual server running on a powerful machine would need to be acquired. This would add to the cost of running the system but in theory, one server can host many of a university's course lecture interaction websites. If the system is formally adopted the site could be served off of one of the University Data Management Unit (DMU)'s servers or off of a virtual machine running on one of the University's VM servers.

4.2.2 Student Devices

As mentioned, the use of students' mobile phones is beneficial; it saves students and university funds as clicker devices and other electronic voting tools do not need to be purchased.

4.2.3 Lecture Venue Requirements

The lecture venue is require to be equipped with a projector that is connected to a computer running Microsoft Windows. The fact that the system has a small separate

window that contains the latest comments means that there is no need for a separate monitor to view the website. This reduces requirements to run the system as extra monitors or projectors can be costly.

Chapter 5

Results and Discussion

5.1 Graphical Analysis of Results

Due to the fact that the sample size for the first questionnaire is 78 responses and for the second questionnaire it is 23 responses, the sample size is too small to do parametric testing (Norman, 2010). As mentioned in Chapter 3, Likert Scale data is ordinal data and hence, parametric tests cannot be performed with the Likert data either. It is for this reasoning that graphical analysis has been performed and the inferences made have been limited to drawing conclusions from large differences (Sauro, 2013).

5.1.1 Pre-implementation Questionnaire: Student Engagement

From the eleventh until the sixteenth of August, the pre-implementation questionnaire (Appendix: A.1.1) was run during the Computer Science 112 practicals as planned. The following set of results was collated from responses to the questionnaire (Appendix: A.1.2). As mentioned in the previous chapter, the results are intended to give some insight into students' interaction in lectures.

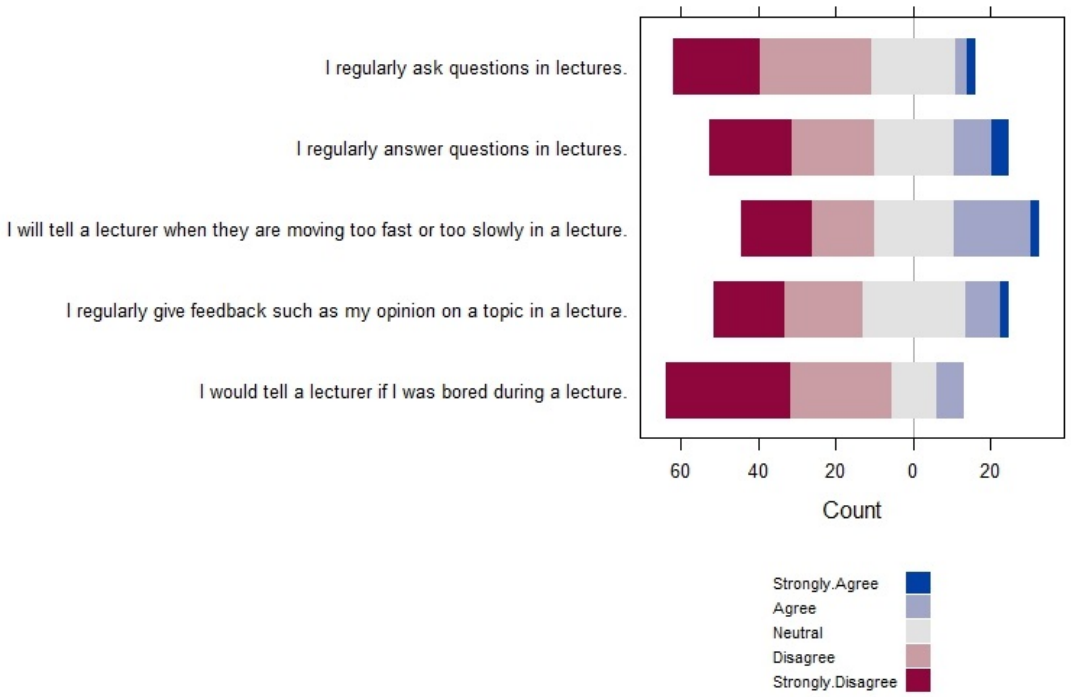


Figure 5.1: Interaction in lectures

Students indicated that their interaction in lectures is limited no matter what type of interaction it is (Figure 5.1). According to the hypothesis in chapter one, students resist interaction in lectures. This substantiates the claim that they often lack the confidence to ask questions, ask a lecturer to slow down, repeat something, or explain a topic further when they are unsure of the subject matter. The diverging bar chart for interaction in lectures shows that there is a proportion of students who interact in lectures but there is a greater proportion who do not. The average percentage of students who do not interact in lectures in different ways is 71.2% which indicates that there is enough evidence to show that students resist interaction in lectures (Figure 5.1). This statistic includes interaction by means of asking questions, answering them, giving feedback, commenting on their level of engagement (boredom) and commenting on the pace of the lecture.

According to the data, the percentage of students who regularly ask questions in lectures and the percentage of students who would tell a lecturer that they are bored during a lecture is statistically small (21% and 16% respectively). On the other hand, the proportion of students who would tell a lecturer if they are moving too fast or too slowly in a lecture seems to be fairly symmetrical with the proportion who would not (42.5%).

Although the proportions for the different types of feedback vary (asking questions, an-

swering questions et cetera), there is one trend amongst all of them; more than half of the class disagrees when it comes to the question of whether they interact in that way during lectures. (Figure 5.1)

The Likert scale data used in (Figure 5.2) and in (Figure 5.3) did not relate to lecture interaction in the same way as the previous data and hence was placed in separate diverging bar charts.

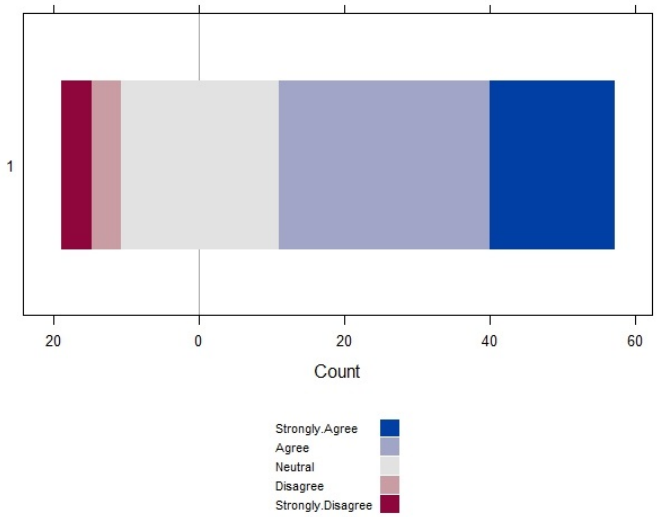


Figure 5.2: Students who think that course and lecturer evaluations are a great way of giving lecturers feedback and improving their education

An interesting point to note is that students tend to believe that course and lecturer evaluations are a great way of giving lecturer's feedback and improving their education. The percentage of students who believe that this is true is 74.5% and hence, most students tend to agree with this notion. (Figure 5.2) This contradicts what was originally thought in Chapter two as it was suspected that students did not feel that these questionnaires benefitted them (Kember *et al.*, 2002). Although these questionnaires are felt to be valuable, there is still need for a system that can be used to give the lecturer feedback immediately instead of only at the end of a course. Leading on to the use of a lecture interaction system, the question of whether students would like a way to interact with lecturers anonymously at any time during a lecture and throughout a course was asked.

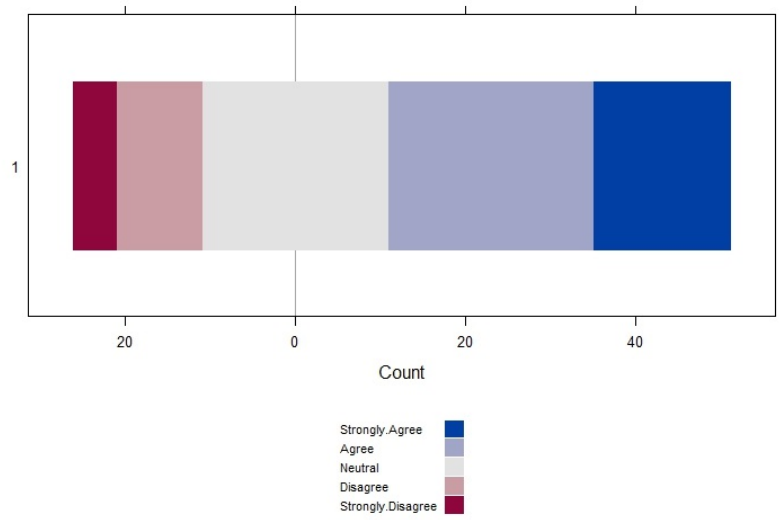


Figure 5.3: The need of an anonymous interaction system

As expected, the data showed that students thought this was a good idea as the percentage of students who liked this idea was 66.5%. There was a large proportion of students who would like such a system and so, getting the students to use the system during lectures is possibly easier than if they felt such a system was not necessary (Figure 5.3). If the students had stipulated that they did not think it was a good idea or that it was not necessary, testing the system would have proven to be problematic as there would be less motivation from the students to use the system.

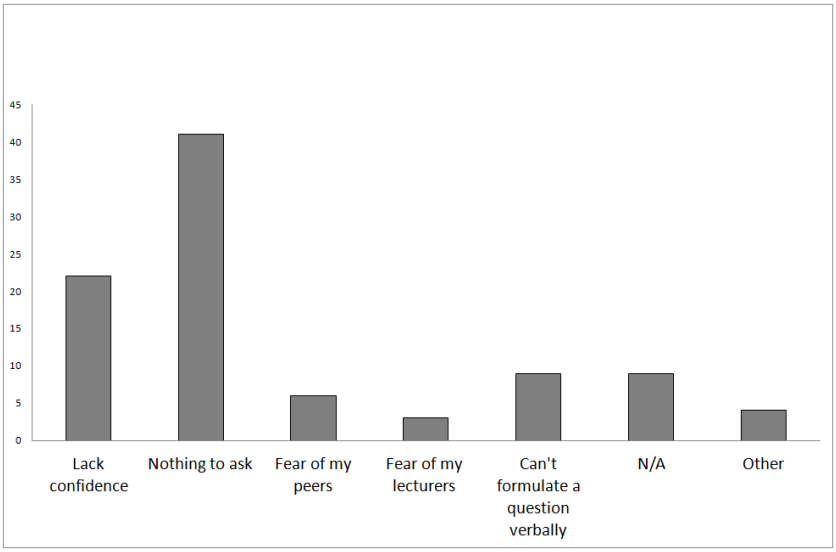


Figure 5.4: Reasons as to why students do not ask questions in lectures

The main reason why students do not answer questions in lectures is that they feel they have nothing to ask (Figure 5.4). If students do not have anything to ask and are not asking questions it could mean that they are not suitably engaged in the lecture (Handelsman *et al.*, 2005). The fact that students lack confidence was the second most cited reason and as such, does indicate that students do not tend to ask questions if they do not have the confidence to do so. One could say that they lack confidence as they are afraid of their peers or lecturers but the results do not tend to show this. There are few students who give the fact that they are scared of their lecturers or peers as reasoning for not asking questions.

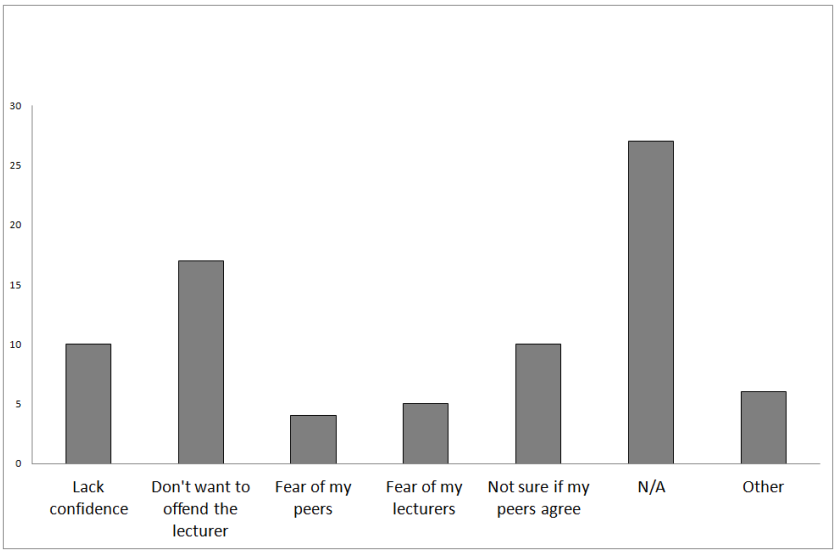


Figure 5.5: Reasons as to why students do not comment on the pace of lectures

As shown previously, students tend to be less afraid of commenting on the pace of the lecture than giving feedback or answering questions etc. Figure 5.5 shows that the students who do resist giving this type of feedback, do so for varying reasons. The main reason is that they do not want to offend the lecturer. This is followed by a lack of confidence and not being sure whether their peers would agree. The flaw in these results is that there is double the number of students who are not sure whether their peers agree versus students who are afraid of their peers. (Figure 5.5) This is possibly due to the fact that students want to feel accepted by their peers but do not necessarily feel that this desire for acceptance equates to a fear of their peers in and of themselves.

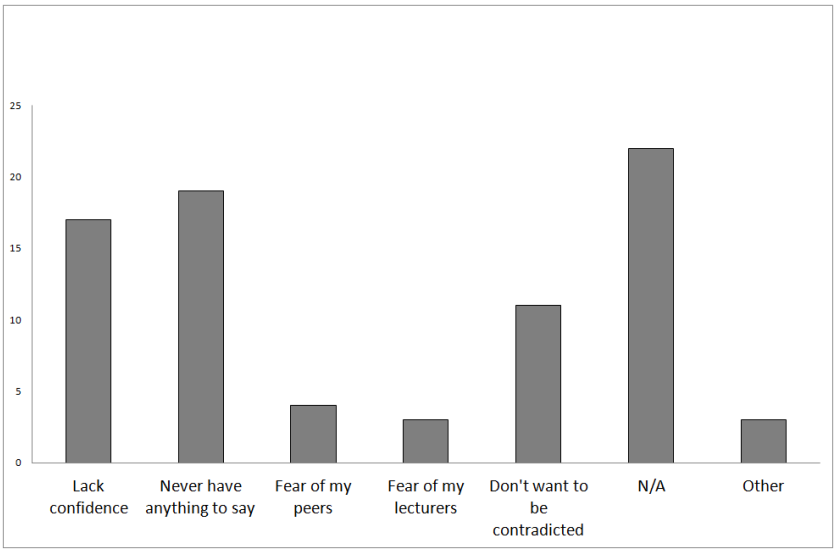


Figure 5.6: Reasons as to why students do not give feedback during lectures

Once again, never having anything to say is the main reason why students do not give feedback such as their opinion during lectures. This is followed by lack of confidence which coincides with the results shown in Figure 5.4. Although there is a large proportion of students who do indicate that they give feedback and a proportion who feel that they have nothing to say, there is still a substantial proportion who lack confidence, fear their peers and lecturers and do not want to be contradicted. (Figure 5.6)

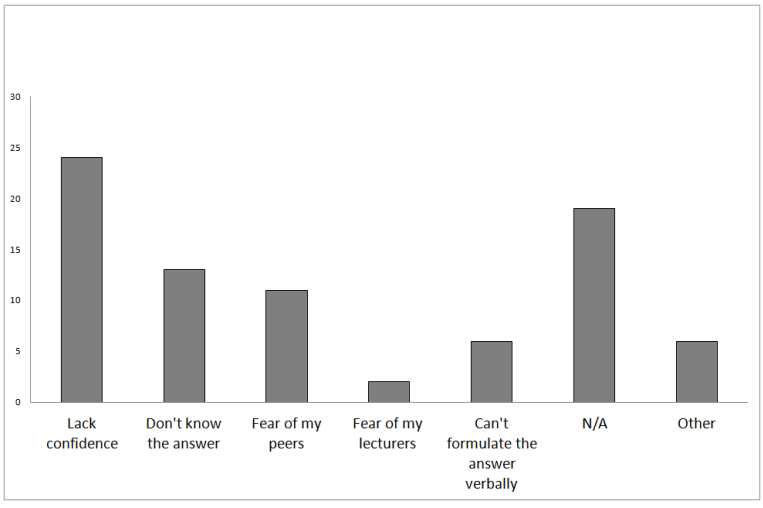


Figure 5.7: Reasons as to why students do not answer questions in lectures

Figure 5.7 substantiates the hypothesis that students resist interaction in lectures for varying reasons with a greater degree than the other results. From this chart, one can

see that lacking confidence is a large factor when students resist the need to answer questions. The chart also shows that students are more afraid of what their peers will think in comparison to what their lecturer will think. This is an interesting result and could show that students value other students' opinions more than that of their lecturers. It could also indicate that students feel less judged by lecturers than they do by other students. One of the problems mentioned in Chapter One was the fact that it is better to give students time to formulate an answer in words than to require them to answer questions rapidly without in-depth thought into the answer. This is shown as a reason to not answer questions in Figure 5.7 .

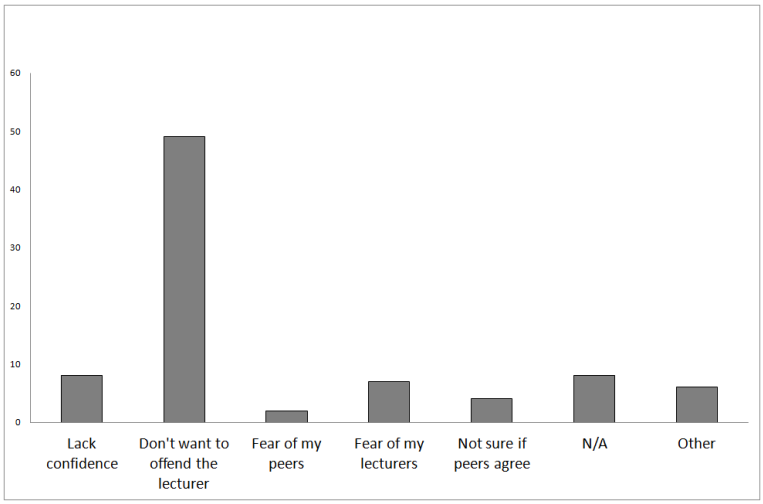


Figure 5.8: Reasons as to why students would not inform a lecture if they were bored

The final set of results for the reasoning for lack of interaction is shown in Figure 5.8. This chart shows students do not want to offend the lecturer by telling them that they are bored, which is understandable as students probably feel that criticism is rude. The problem with this is that it would be better if lecturers were aware of students' boredom levels in class so that they could increase engagement in class. It has been proven that an increase in engagement results in greater achievement amongst students (Klem & Connell, 2004). Therefore, lecturers need to be aware if students are bored during lectures so that they can stimulate them by asking questions and getting them to engage more.

5.1.2 Pre-implementation Questionnaire: Phone Access

Students were asked to indicate which cell phone operating system they used in the questionnaire (Appendix: A.1.1). This could be used to give an indication as to the usage

share of students' cell phones in South Africa. This data was necessary in determining whether having the application running only on Android cell phones would be suitable.

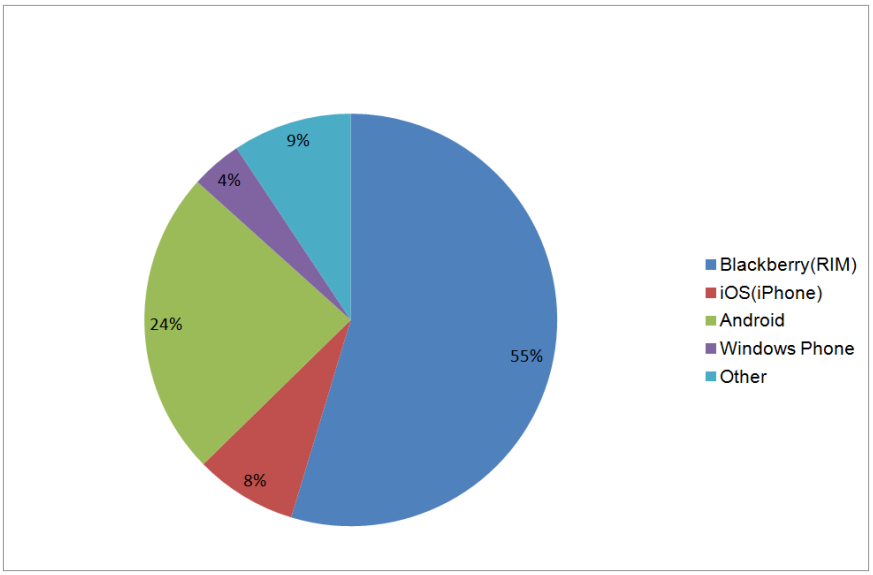


Figure 5.9: Class sample usage share of cell phone operating systems

The results obtained in Figure 5.9 are vital for this study. They do not indicate social reasoning like in the previous section but it is important to understand why students do not have the capability to access the system and this chart gives some indication as to why. Originally, the lecture interaction system was going to be downloadable for Android phones only. This was re-evaluated due to the fact that only 24% of the class use Android phones; this resulted in a mobile website being made available. The class had a disproportionate amount of Blackberry users; Blackberry tends to be the dominant Smartphone in developing countries due to its low cost (Namavar, 2012). As a result, future work could be done to make the system more accessible and create an application for all platforms or use a framework such as PhoneGap to deploy the application on all operating systems (Adobe, 2013).

5.1.3 Post-implementation Questionnaire

Once the system had been implemented in the class for two weeks(26 August - 30 August; 9 September - 13 September), the second questionnaire (Appendix: A.2.1) was made available to students. This questionnaire was accessible from the 16th until the 20th of September during Computer Science 112 practicals. The questionnaire was designed

to assess the value of the system from the students' perspective and help determine its potential value in future classes. According to statistics collated by the website, there were 124 posts/comments sent in during the two week period during which the implentation was rolled out.

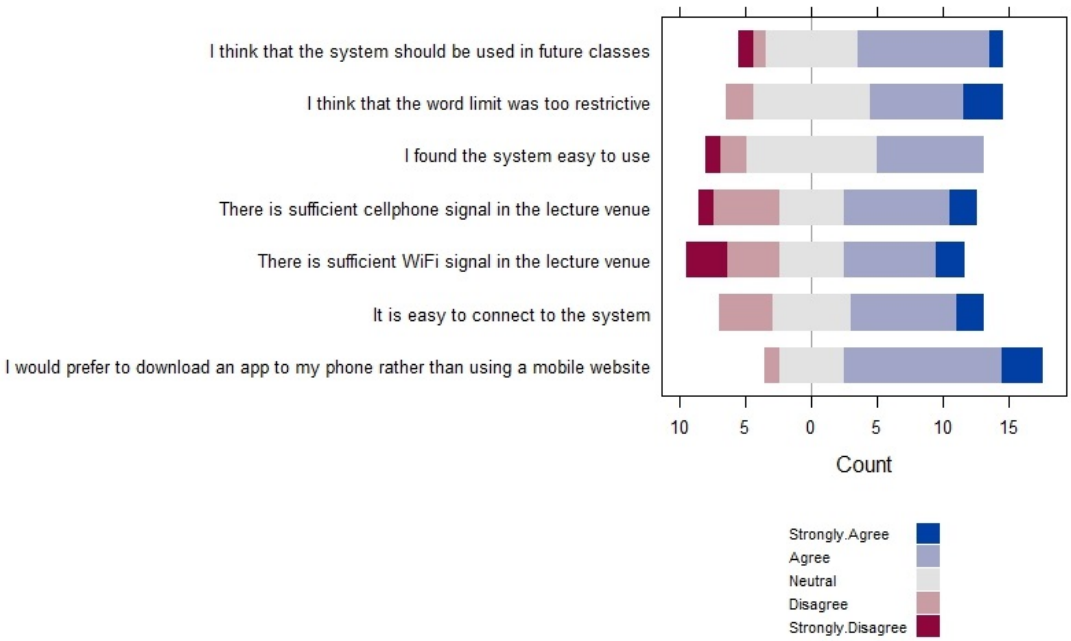


Figure 5.10: Lecture interaction system

The data collected from the evaluation of the system was reassuring and substantiated the hypothesis that such a system could increase lecture interaction for students who resisted it. More than half of the respondents thought that the system should be used in future classes (66%). This is shown in Figure 5.10.

The design feature of having a word limit seemed to be too restrictive for students' liking (66%) and as such, future implementations should address this issue. As mentioned in Section 3.1 of Chapter 3, this design choice was made to ensure that lecturers did not have to read long messages that could be distracting.

Most students found that the system was easy to use and easy to connect to (65%). Although this is true, the students felt that there was not sufficient WiFi and cell phone signal in the lecture venue. The percentage of students who believed there was adequate cell phone and WiFi signal was 56.5%; the fact that just under half of the sample found that the signal was not sufficient is concerning as this could indicate that these students

could not connect at times when they needed to. This could have negatively affected the data as to the extent students wished to use the system. The Rhodes University IT division are working on WiFi signal in lecture venues and so this should be less of a problem in future trials.

The percentage of students wanting to download an application instead of visiting a mobile website was 84.5%. Although this is true, the application created was for Android smartphones only and yet more people used the mobile website than downloading the application. The reasoning for this is shown in the usage share of mobile phone operating systems in Figure 5.10.

The following results explain why students made the choices that they did for the Likert scale questions.

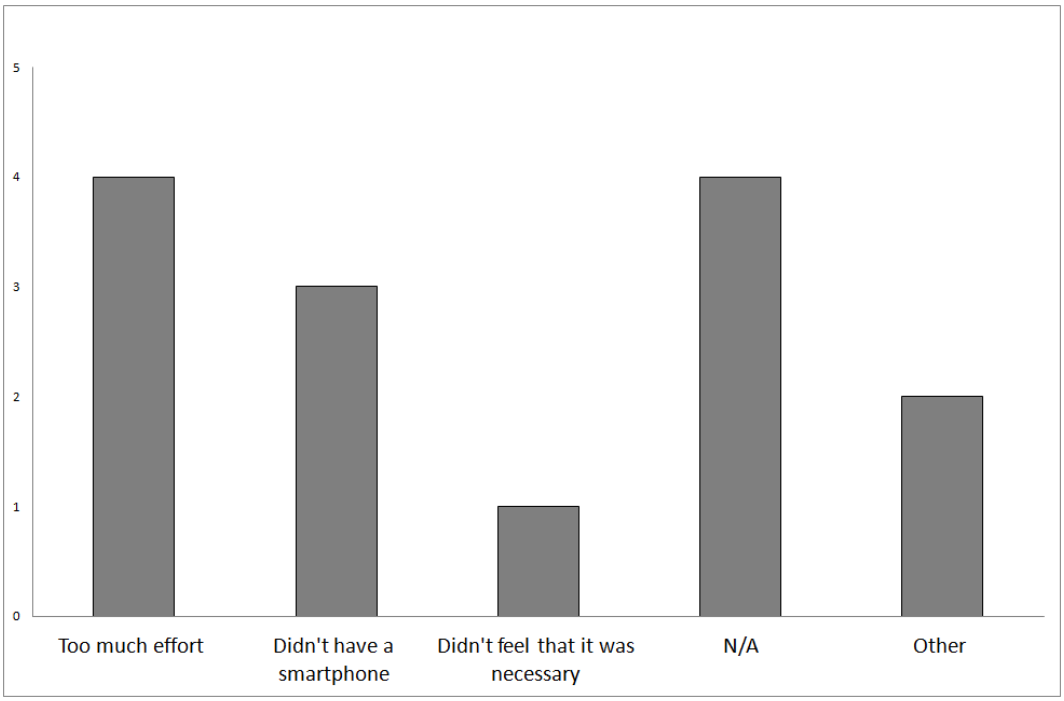


Figure 5.11: Reasons as to why students did not use the system

The bar chart in Figure 5.11 shows that many students found the system too much effort to use. Seeing as only half of the respondents used the system, the half that did not use it did so because it seemed to add unnecessary effort to interacting in classes. This extra effort could come from the fact that these students did not have smartphones. It is interesting to note that only a small proportion of students did not feel that the system was neccessary and hence, if these students had access to smartphones, the results

could be different. Although this may be true, the system was created for students who resist interaction. Therefore if students resist interaction due to the fact that they lack confidence or would prefer to interact anonymously, then its purpose was accomplished. It may add extra effort to interacting but this extra effort means that students who lack confidence or fear their peers can still interact.

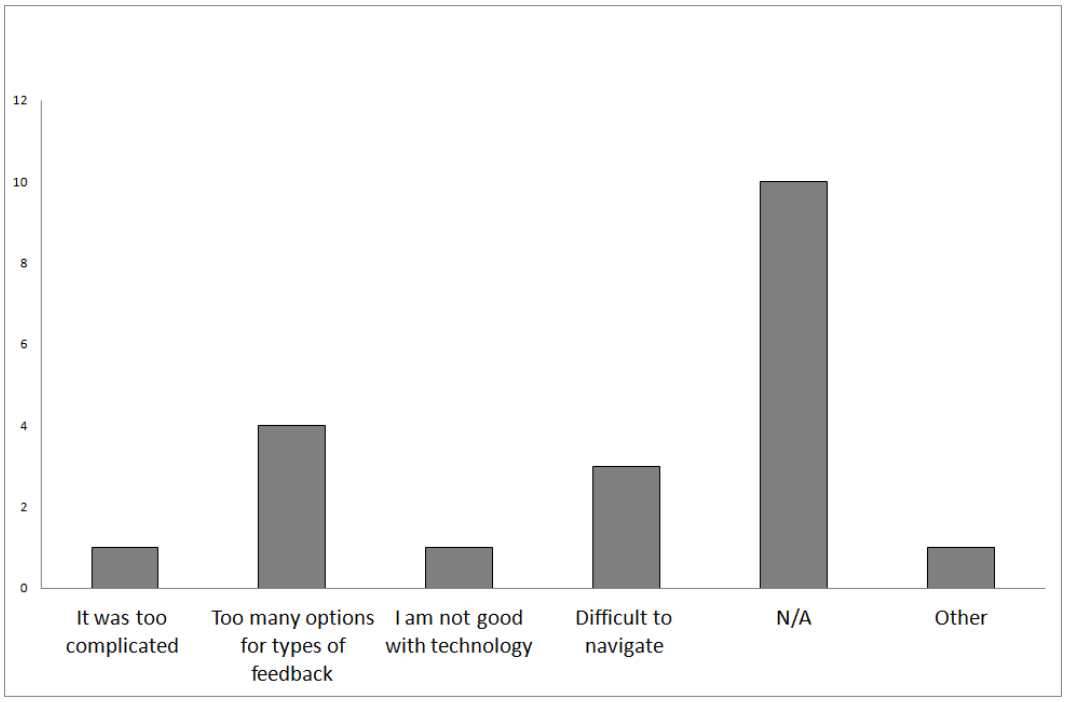


Figure 5.12: Reasons as to why the students found the system difficult to use

Figure 5.12 gives some reasoning as to why students found the system difficult to use. This reasoning does not seem to be necessary as most students thought that the system was easy to use. Although this is true, the main reason that students found the system difficult to use was the fact that there were too many options for types of feedback. Students were not sure under which category their feedback fell. In the researcher's opinion, with no evidence to substantiate this, the types of feedback gave students an indication as to what could be sent in which increased the use of the system. Students would perhaps not have thought of sending in feedback such as their level of engagement (boredom) during lectures. This could be tested in a future trial.

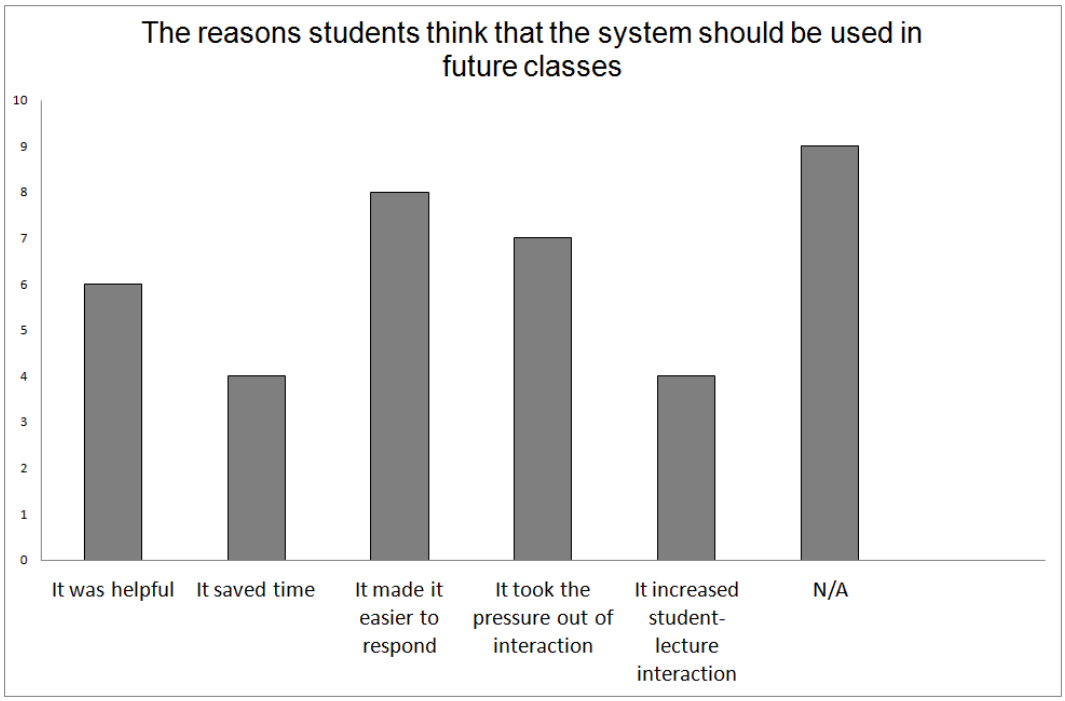


Figure 5.13: Reasons as to why the system should be used in future classes

The results shown in Figure 5.13 are reassuring in that they reinforce what was originally thought. When this project was started, the use of this system was intended to reduce the pressure of student-lecture interaction. The results show that students do believe that the system was helpful, it made it easier to respond, took the pressure out of interaction and increased interaction. Although these results show that there were some students who believed that it saved time, there is evidence that shows that more students believed that it didn't. The results show that some students did not use the system as it added unnecessary effort therefore, this casts doubt as it could not have saved time.

5.1.4 Personal Experience

On Wednesday the 21st of August 2013, further research into the use of the system was performed by partaking in and viewing a lecture. The observations were in agreement with what students believed to be true. The anonymity of the system made it too easy for students to post comments such as *"You look like Ellen DeGeneres."* Although this comment is not offensive, it does not add value to the lecture. Another post with no direct value was *"Chuck Norris climbs FB walls"* which resulted in laughter from the class which students indicated was distracting. On the other hand, value was shown in students

sending in feedback such as *"This should b used in acc[ounting]"* which shows that some students could see the application adding value to other lectures, possibly where they felt more need of anonymity.

5.1.5 Advantages of Using The System

There are many benefits of using the system but according to the students, the main benefits included the fact that it made it easier to interact in lectures. Students' feedback on the system included comments such as :*"The system gives easier interaction between the lecturer and the students."*, *"Allows for lecture interaction without disrupting the lecturer's flow or train of thought"*, and *"It makes student- lecturer interaction easier as students remain anonymous."* The comment *"it is very helpful in the way that we can communicate with the lecturer and provide helpful hints to improve the lecture"* suggests that it also gives the students an easy way to give suggestions to improve the lecture. This kind of feedback can be compared to that contained in a course evaluation. Another benefit that some of the students believed to be true is that the lecturer's train of thought is not disrupted when students interact or ask questions. This reduces the disruption of flow during the lectures. According to the lecturer, this was untrue as the system tended to be distracting at times too.

Anonymity seems to be both beneficial and a liability with the system. It is beneficial as students believe that it allows them to answer questions without their identity being revealed. This results in an easier way to ask questions that they believe to be "silly", and gives confidence to the shy students. Many of the students mentioned this, for example: *"it was easy to communicate a question without your identity being known as some people may be too shy or think their question is silly, therefore made it easier to ask questions"*, *"It could be that shy people were able to ask questions, but then again you can always approach the lecturer or the class rep."*, and *"Students who are too shy to ask questions in class now have a platform in which to do so."* (Table A.1)

5.1.6 Disadvantages of Using The System

There were three main downfalls of the system according to the student's responses in (Table A.1) . The first downfall was that the system seemed to be distracting. Students felt that typing messages meant that they lost track of what was going on in the lecture.

Reading what other students had typed also seemed to distract students and hence they would lose track of what the lecturer was speaking about. This is shown in the following student opinions: "Questions are not filtered for relevance to the lecture material. It distracts the lecturers.", "Too distracting , and people start asking funny questions and we end up losing the value of the lecture. People tend to think it twitter or something and they just go overboard.", "Typing out a message is distracting, ie I miss what the lecturer is saying while my head is down and I'm texting.", and "it is very distracting - end up watching the screen more than listen to the lecturer. Also it hampers the lecturers thoughts/teaching as they get interrupted." This could be remedied with a moderator; a student or teaching assistant could moderate comments before they are sent to the lecturers client. This would prevent distracting and unnecessary posts from appearing. In the literature, posts were voted up and down so that only the most relevant posts were shown to the lecturer (Harry *et al.*, 2008; Cruz e Costa *et al.*, 2008). This would also be a possible solution to the problem.

The second disadvantage was the fact that the posts were anonymous and as such, students could post whatever they wanted. This resulted in funny or offensive posts being sent in. Not only could this have a negative effect such as offending the lecturer or students but it also distracted the class. This was mentioned by a few students: "i personally think that the anonymous part of the app made it easy for students to take advantage of the app and play the fool, i was also present for some very rude remarks made to the lecturer when it had nothing to do with her lecturing and style of teaching or the actual notes" and "Also, the anonymity of the messages allows people to post unproductive things on the message board which is really irritating."

The third disadvantage was accessibility; it seemed as though some students found it difficult to access the system due to cell phone and WiFi signal in the venue. Some students also found the system difficult to use even though there was a large proportion who did not find this so. Students mentioned: "It works using the Internet and reception isn't always good in certain venues." and "The application is too complicated to use and virtually inaccessible." These problems were also shown in the data depicted in Figure 5.10.

5.1.7 Possible Implementation Improvements

The flaws that students mentioned through the questionnaire all seem to be fixable. The distracting comments could be fixed through moderation; the class representative or a

teaching assistant could filter posts so that only questions, answers or comments that add value to the lecture are posted.

Another remedy to the distractiveness of the system could be that instead of posts appearing to the whole class, they could appear on a separate screen only for the lecturer. This could have its downfalls though as students could send in multiple requests that are all similar.

A visual indicator could be used to show level of engagement in the lecture. This way, students could for example adjust a slider on their devices and there can be a visual representation such as a graph or a colour change on the lecturers client. Instead of students sending in posts such as "I am bored", they can show their engagement on a scale. The lecturer can then get the class to answer questions or stimulate them more if the need arises.

Seeing as some students said the application was too complicated, there is scope to simplify it even further. Although this can be done, more insight needs to be acquired into the reasoning as to why they feel this way. It might not be necessary and hence, the value of the system could be taken away by over-simplifying it.

5.2 Summary

The results in this Chapter show that students do resist interaction in lectures. They also show that a lecture comprehension indication system such as the one designed in Chapter Three can add value to lectures by allowing students to interact anonymously throughout a course. These systems need to be customised to the needs of specific universities and as such, there is scope to improve them for the benefit of students and lecturers.

Chapter 6

Conclusion

6.1 Overview

E-learning is a valuable tool when supplementing traditional learning methods. Blended learning has become widely used to ensure that students receive the best education possible with the resources available.

Asynchronous and synchronous methods are equally valuable approaches in e-learning as they both have their strengths depending on the needs of the student. Asynchronous methods tend to work well with students who need to access resources in their own time. In contrast, synchronous methods work well to facilitate understanding and reduce the frustrating effect of waiting for responses.

Due to the economic need for large lecture classes, teaching and lecturing methods need to be adapted to ensure that students receive a valuable education. Students' interaction in lectures is limited due to social pressures and class sizes.

Lecture comprehension indication systems came about to remedy this problem. These systems incorporate many functionalities to ensure that lecturers are aware whether students are grasping concepts or not, and to facilitate the answering of questions. The systems differ in implementation and what they can do because academics have contrasting opinions on what is necessary.

To understand the need for these systems, a greater insight into students' interaction in lectures was acquired. Research data showed that students resist interaction in lectures

for a variety of reasons including lacking confidence, fearing their peers and lecturers, not wanting to offend the lecturer as well as other concerns. The extent to which this resistence occurs depends on the type of interaction occuring (asking questions, answering questions et cetera); in most cases, the proportion of students resisting interaction is above 60%.

Once insight into interaction in lectures was acquired, a lecture comprehension indication system was created. It was implemented in a Computer Science 112 class for a period of two weeks and the perceived value of the system was queried.

The data showed that students perceived the system as valuable, because it gave them the ability to interact anonymously with a lecturer at any time during class and throughout a course. Students believed that it also gave confidence to shy students and provided students with an easier way to interact in lectures.

Although the system was proven to be valuable, there were disadvantages which included the fact that the system was distracting, anonymity allowing posts which did not add value to the lectures and the accessibility of the system restricting students who wished to use it and lacked resources. It is for these reasons that there is scope for future work.

6.2 Goals Achieved

The following objectives were achieved through this research study:

- Gain a better understanding of students' interaction in lectures.
- Design and implement a lecture comprehension indication system.
- Test to see whether students perceived the system as valuable or not.

6.3 Future Work

The following additions can be made to gain greater insight to students' interaction in lectures and to improve the lecture interaction system.

6.3.1 Incorporating A Moderator Into The Use Of The System

Before posts appear on the lecturers' client, moderation could occur. This would ensure that distracting posts and messages that do not add value to the lecture could be filtered out. This would mean that a person would need to be dedicated to reading posts and removing them or letting them through. The problem arises in that it could be seen as unfair to expect a student to do it as it is time-consuming and distracting. As a result a teaching assistant such as a tutor could be asked to perform the task.

6.3.2 Adding Visual Indicators To The System

It has been shown that it is distracting for lecturers to have to read posts sent in whilst lecturing. Therefore, for posts which do not need verbal interpretation such as level of engagement (boredom) and interest in the topic, visual indicators could be used instead. For example, graphs or icons could be used on the palette window to indicate when students are no longer interested in the topic or are bored. The student mobile application would need to be changed to incorporate scales/icons/radio buttons that students could use to communicate this data.

6.3.3 Further Analysis of Statistics

The statistical analysis of the data was sufficient for the research but to gain more insight into the data, further analysis could be done. The system could be implemented in a class with two streams where the one stream uses the system and the other stream does not. Statistics of whether the system was effective could be done by means of statistical tests such as the Mann-Whitney U test, Wilcoxon signed-rank test and Kruskal-Wallis test. These tests are used to determine the differences between groups and hence were not applied seeing as there was only one sample for this research study.

The Mann-Whitney U test is a statistical test which tests for the difference of an ordinal variable of two different groups (McKnight & Najab, 2010). It therefore could be used to determine the difference in statistics between two groups such as gender or different classes etc. This could possibly add understanding if the one group used the system and the other group did not.

Due to the fact that the statistics cannot be assumed to be normally distributed, a Wilcoxon signed-rank test can be performed instead of a t-test. It can be used to determine whether population means differ. It is a non-parametric statistical hypothesis test. Once again, seeing as the data was collected from one group and not divided, the test did not seem to be necessary but for future work, it could be used to determine the difference between perceived value of the system for a group that used it and one that did not (Woolson, 2007).

The final test that could be performed is the Kruskal-Wallis test. This is a non-parametric test to determine whether samples come from the same distribution and hence to test whether three or more samples are related. It can be used to test the differences between these groups (McKight & Najab, 2010).

Although it may be seen as not necessary to do these tests to determine whether the one group benefited from using the system, further analysis can always help to determine whether such a system is actually valuable.

References

Adobe. 2013. Adobe PhoneGap Build. Online. Available from: http://html.adobe.com/edge/phonegap-build/faq.html. Accessed on 22 Sep 2013.

Anderson, Terry. 2008. Towards a theory of online learning. *Theory and practice of online learning,*, 45–74.

Apple. 2013. IPA file extension. Online. Available from: https://developer.apple.com/library/ios/documentation/. Accessed on 25 Oct 2013.

Bell, Donald. 2004. UML basics: The component diagram. Online. Available from: http://www.ibm.com/developerworks/rational/library/dec04/bell/bell-pdf.pdf. Accessed on 15 Aug 2013.

Bertram, Dane. 2006. Likert scales. Online. Available from: http://poincare.matf.bg.ac.rs/~kristina/topic-dane-likert.pdf. Accessed on 10 Sep 2013.

Browning, Kyle. 2012. Services. Online. Available from: https://drupal.org/project/services. Accessed on 14 Sep 2013.

Chowdhury, Rahul. 2012. Evolution of Mobile Phones: 1995 - 2012. Online. Available from: http://www.hongkiat.com/blog/evolution-of-mobile-phones/. Accessed on 16 May 2013.

Chu, Ko-Kang, Li, Ming-Chaun, & Hsia, Yen-Teh. 2007. Not Afraid to Ask. *Pages 600–604 of: Advanced Learning Technologies.*

Clark, Brian. 2010. Gravity Forms Review: Powerful WordPress Forms Made Simple. Online. Available from: http://www.copyblogger.com/gravity-forms-review/. Accessed on 10 Oct 2013.

Cohen, Idan. 2012. FormSite. Online. Available from: http://www.websiteplanet.com/review/formsite/. Accessed on 10 Oct 2013.

Costello, Roger L, *et al.* 2002. REST (Representational State Transfer). *last updated Jun*, **26**.

Cruz e Costa, Joana, Ojala, Timo, & Korhonen, Jani. 2008. Mobile Lecture Interaction: Making Technology and Learning Click. *Pages 119–124 of: IADIS International Conference Mobile Learning.*

Donadio, Matthew. 2012. Mobile Detect. Online. Available from: `https://drupal.org/project/mobile_detect`. Accessed on 15 Sep 2013.

Draffan, EA, & Rainger, Peter. 2006. A model for the identification of challenges to blended learning. *Research in Learning Technology*, **14**(1).

Dutton. 2012. FormAssembly vs Formstack. Online. Available from: `http://apps.aspiratech.net/2012/07/formassembly-vs-formstack.html`. Accessed on 10 Sep 2013.

Elder, Linda, & Paul, Richard. 2004. The role of Socratic questioning in thinking, teaching and learning. www.criticalthinking.org. Available from: `http://www.criticalthinking.org/resources/articles/the-role-socratic-questioning-ttl.shtml`. Accessed on 18 May 2013.

Fassinger, Polly A. 1995. Understanding classroom interaction: Students' and professors' contributions to students' silence. *The Journal of Higher Education*, 82–96.

Groombridge, Michele. 2013. Course, unit and teaching evaluation. Online. Available from: `http://www.teaching-learning.utas.edu.au/planning/evaluation`. Accessed on 25 May 2013.

Group, Blinklist. 2013. JotForm Review: WYSIWYG. Online. Available from: `http://blinklist.com/reviews/jotform`. Accessed on 10 Sep 2013.

Handelsman, Mitchell M, Briggs, William L, Sullivan, Nora, & Towler, Annette. 2005. A measure of college student course engagement. *The Journal of Educational Research*, **98**(3), 184–192.

Harry, Drew, Gutierrez, Dan, Green, Joshua, & Donath, Judith. 2008. Backchan.nl: integrating backchannels with physical space. *Pages 2751–2756 of: CHI '08 Extended Abstracts on Human Factors in Computing Systems.* CHI EA '08. New York, NY, USA: ACM.

Hensley, Thomas R., & Oakley, Maureen. 1998. The Challenge of the Large Lecture Class: Making It More Like a Small Seminar. *PS: Political Science and Politics*, **31**(1), pp. 47–51.

Hockenson, Lauren. 2012. Web Form Builders. Online. Available from: `http://mashable.com/2012/02/16/web-form-builders/`. Accessed on 10 Sep 2013.

Hrastinski, Stefan. 2008. Asynchronous and synchronous e-learning. *Educause quarterly*, **31**(4), 51–55.

Hyder, Karen, Kwinn, Ann, Miazga, Ron, & Murray, Matthew. 2007. Synchronous e-Learning. *The eLearning Guild*.

Java, Akshay, Song, Xiaodan, Finin, Tim, & Tseng, Belle. 2007. Why we twitter: understanding microblogging usage and communities. *Pages 56–65 of: Proceedings of the 9th WebKDD and 1st SNA-KDD 2007 workshop on Web mining and social network analysis*. ACM.

Jones, Norah, & Lau, Alice. 2009. E-learning - a change agent for education? *Journal of Applied Research in Higher Education*, **1**, 40–48.

Kember, David, Leung, Doris Y. P., & Kwan, K. P. 2002. Does the Use of Student Feedback Questionnaires Improve the Overall Quality of Teaching? *Assessment & Evaluation in Higher Education*, **27**(5), 411–425.

Klem, Adena M, & Connell, James P. 2004. Relationships matter: Linking teacher support to student engagement and achievement. *Journal of School Health*, **74**(7), 262–273.

Lado, Adrian. 2009. Asynchronous e-Learning. Online. Available from: `www.rau.ro/websites/e-society/lucrari/adrian%20lado.pdf`. Accessed on 17 Jun 2013.

Loach, Rob. 2008. REST Server. Online. Available from: `https://drupal.org/project/rest_server`. Accessed on 14 Sep 2013.

MacGeorge, Erina L., Homan, Scott R., Dunning, John B., Jr., Elmore, David, Bodie, Graham D., Evans, Ed, Khichadia, Sangeetha, Lichti, Steven M., Feng, Bo, & Geddes, Brian. 2008. Student Evaluation of Audience Response Technology in Large Lecture Classes. *Educational Technology Research and Development*, **56**(2), pp. 125–145.

Maldonado, Ursula Paola Torres, Khan, Gohar Feroz, Moon, Junghoon, & Rho, Jae Jeung. 2011. E-learning Motivation and Educational Portal Acceptance in Developing Countries. *Online Information Review*, **35**(1), 1.

Marcotte, Ethan. 2010. Responsive web design. *A list apart*, **306**.

McKight, Patrick E., & Najab, Julius. 2010. *Kruskal-Wallis Test.* John Wiley & Sons, Inc.

McKnight, Patrick E., & Najab, Julius. 2010. *Mann-Whitney U Test.* John Wiley & Sons, Inc.

Miles, Earl. 2008. Chaos tool suite. Online. Available from: `https://drupal.org/project/ctools`. Accessed on 15 Sep 2013.

Morril, Dan. 2008. Inside the Android Application Framework. Online. Available from: `https://sites.google.com/site/io/inside-the-android-application-framework`. Accessed on 25 Oct 2013.

Namavar, Reza. 2012. Blackberrys secret weapon. Online. Available from: `seekingalpha.com/article/819291-blackberrys-secret-weapon`. Accessed on 22 Sep 2013.

Neumann, Siegfried. 2012a. Online. Available from: `https://drupal.org/project/mobile_switch`. Accessed on 14 Sep 2013.

Neumann, Siegfried. 2012b. Online. Available from: `https://drupal.org/project/mobile_switch_block`. Accessed on 14 Sep 2013.

Norman, Geoff. 2010. Likert scales, levels of measurement and the laws of statistics. *Advances in health sciences education*, **15**(5), 625–632.

Patel, Raj. 2006. *Make powerful online forms easily with Wufoo.* Tech. rept. TechCrunch. http://techcrunch.com/2006/07/05/make-powerful-online-forms-easily-with-wufoo/.

Phoha, Vir V. 2001. An interactive dynamic model for integrating knowledge management methods and knowledge sharing technology in a traditional classroom. *SIGCSE Bull.*, **33**(1), 144–148.

Pohl, Alexander, Gehlen-Baum, Vera, & Bry, Francois. 2011. Introducing Backstage - a digital backchannel for large class lectures. *Interactive Technology and Smart Education*, **8**, 186–200.

R Core Team. 2012. *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0.

Ranson, Stewart, Martin, Jane, Nixon, Jon, & McKeown, Penny. 1996. Towards a Theory of Learning. *British Journal of Educational Studies*, **44**(1), pp. 9–26.

Reid, David. 2004 (July). *Comment RSS*. https://drupal.org/project/commentrss.

RIM. 2010 (May). *BlackBerry Java Plug-in for Eclipse*. 1.1 edn. Research in Motion, 295 Phillip Street Waterloo, ON N2L 3W8 Canada.

Robb, Meigan K. 2012. Managing a large class environment: Simple strategies for new nurse educators. *Teaching and Learning in Nursing*, **7**(2), 47 – 50.

Sauro, Jeff. 2013. Best Practices For Using Statistics On Small Sample Sizes. Online. Available from: `http://www.measuringusability.com/blog/small-n.php`. Accessed on 29 Oct 2013.

Savino, Jason. 2011. Mobile JQuery Theme. Online. Available from: `https://drupal.org/project/mobile_jquery`. Accessed on 15 Sep 2013.

Shepard, Tim, Jones, Chris, & Cunningham, Pete. 2012. Smart phones overtake client PCs in 2011. Online. Available from: `http://www.canalys.com/newsroom/smart-phones-overtake-client-pcs-2011`. Accessed on 10 Sep 2013.

Staker, Heather, & Horn, Michael B. 2012. Classifying K–12 blended learning. *Mountain View, CA: Innosight Institute*, **22**.

Sung, Tina, Rosen, Anita, Hall, Brandon, Falkowski, Thomas, Howard, Barry, Major, Howard, Levenburg, Nancy, Carrier, Kathy, Berge, Zane, Rodenburg, Dirk, & Willis, Barry. 2000. *e-learning: Expanding the Training Classroom through Technology*. Rector Duncan & Associates.

Tavangarian, Djamshid, Leypold, Markus E, Nölting, Kristin, Röser, Marc, & Voigt, Denny. 2004. Is e-learning the Solution for Individual Learning. *Electronic Journal of E-learning*, **2**(2), 273–280.

Tubbs, Bonnie. 2013. SA's cellphone market defined. Online. Available from: `http://www.itweb.co.za/index.php?option=com_content&view=article&id=57235`. Accessed on 10 Sep 2013.

Ward, Darrell. 2003. The Classroom Performance System: The Overwhelming Research Results Supporting This Teacher Tool and Methodology. www.wlu.ca. Available from: `http://www.tsp-av.com/wp-content/uploads/2011/01/cps-score-increase.doc`. Accessed on 12 April 2013.

Wolfman, Steven A. 2002. Making lemonade: exploring the bright side of large lecture classes. *Pages 257–261 of: Proceedings of the 33rd SIGCSE technical symposium on Computer science education*. SIGCSE '02. New York, NY, USA: ACM.

Woolson, R. F. 2007. *Wilcoxon Signed-Rank Test.* John Wiley & Sons, Inc.

Zhan, Fei, Kawahara, Yoshihiro, Morikawa, Hiroyuki, & Aoyama, Tomonori. 2006. Lecture Comprehension Enhancement Application Utilizing Real-time Question Sharing and Auto-grouping Capabilities. *Page 186 of: Proceedings of the IEICE General Conference (Institute of Electronics, Information and Communication Engineers)*, vol. 2006.

Appendix A

Questionnaires

A.1 Pre-implementation Questionnaire

A.1.1 Questions

Your interaction in lectures

For reasoning, you may pick more than one answer
This questionnaire is not compulsory but it is strongly encouraged.
It will be used to understand feedback in lectures.

1. **Gender**
   Mark only one oval.

   - ◯ Male
   - ◯ Female
   - ◯ Other

2. **Is your phone connected to the rhodes WiFi network?**
   Mark only one oval.

   - ◯ Yes
   - ◯ No

3. **What is your phone's operating system?**
   Mark only one oval.

   - ◯ Android
   - ◯ iOS (iPhone)
   - ◯ RIM (Blackberry)
   - ◯ Windows Phone
   - ◯ Other: .....

4. **I regularly ask questions in lectures.**
   Mark only one oval.

   - ◯ Strongly Disagree
   - ◯ Disagree
   - ◯ Neutral
   - ◯ Agree
   - ◯ Strongly Agree

5. **If not, why?**
   Check all that apply.

   - [ ] Lack confidence
   - [ ] Nothing to ask
   - [ ] Fear of my peers
   - [ ] Fear of my lecturers
   - [ ] Can't formulate a question verbally
   - [ ] N/A
   - [ ] Other: .....

6. **I regularly answer questions in lectures.**
   Mark only one oval.

   - ◯ Strongly Disagree
   - ◯ Disagree
   - ◯ Neutral
   - ◯ Agree
   - ◯ Strongly Agree

7. **If not, why?**
   Check all that apply.

   - [ ] Lack confidence
   - [ ] Don't know the answer
   - [ ] Fear of my peers
   - [ ] Fear of my lecturers
   - [ ] Can't formulate the answer verbally
   - [ ] N/A
   - [ ] Other: .....

8. **I will tell a lecturer when they are moving too fast or too slowly in a lecture.**
   Mark only one oval.

   - ◯ Strongly Disagree
   - ◯ Disagree
   - ◯ Neutral
   - ◯ Agree
   - ◯ Strongly Agree

9. **If not, why?**
Check all that apply.

- [ ] Lack confidence
- [ ] Don't want to offend the lecturer
- [ ] Fear of my peers
- [ ] Fear of my lecturers
- [ ] Not sure if my peers agree
- [ ] N/A
- [ ] Other: .....

10. **I regularly give feedback such as my opinion on a topic in a lecture.**
Mark only one oval.

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree

11. **If not, why?**
Check all that apply.

- [ ] Lack confidence
- [ ] Never have anything to say
- [ ] Fear of my peers
- [ ] Fear of my lecturers
- [ ] Don't want to be contradicted
- [ ] N/A
- [ ] Other: .....

12. **I would tell a lecturer if I was bored during a lecture.**
Mark only one oval.

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree

13. **If not, why?**
Check all that apply.

- [ ] Lack confidence
- [ ] Don't want to offend the lecturer
- [ ] Fear of my peers
- [ ] Fear of my lecturers
- [ ] Not sure if peers agree
- [ ] N/A
- [ ] Other: .....

14. **I feel that course and lecturer evaluations are a great way of giving lecturers feedback and improving my education.**
Mark only one oval.

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree

15. **If not, why?**
Check all that apply.

- [ ] Don't think that they get used
- [ ] Don't want to offend the lecturer
- [ ] Done too late
- [ ] Only help future students doing that course
- [ ] I never take them seriously
- [ ] N/A
- [ ] Other: .....

16. **I would like a way to interact with lecturers anonymously at any time during a lecture and throughout a course.**
Mark only one oval.

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree

17. **If not, why?**

Check all that apply.

- [ ] I never have anything to say
- [ ] Don't want to offend the lecturer
- [ ] Too much effort
- [ ] Lack of personal interaction
- [ ] Takes longer than face to face interaction
- [ ] N/A
- [ ] Other: .....

A.1.2 Results

	A	B	C	D	E	F	G
1	**Timestamp**	**Gender**	**Is your phone connected to the rhodes WiFi network?**	**What is your phone's operating system?**	**I regularly ask questions in lectures.**	**If not, why?**	**I regularly answer questions in lectures.**
2	8-11-2013 11:10:16	Male	Yes	Android	Disagree	Nothing to ask	Disagree
3	8-12-2013 14:14:53	Female	No	RIM (Blackberry)	Disagree	Nothing to ask	Neutral
4	8-12-2013 14:16:25	Female	No	RIM (Blackberry)	Neutral	Lack confidence, Fear of my peers	Neutral
5	8-12-2013 14:27:30	Female	No	RIM (Blackberry)	Disagree	N/A	Disagree
6	8-12-2013 14:28:26	Male	No	RIM (Blackberry)	Agree	N/A	Agree
7	8-12-2013 15:25:21	Female	Yes	RIM (Blackberry)	Strongly Disagree	Nothing to ask	Strongly Disagree
8	8-12-2013 15:33:29	Male	No	RIM (Blackberry)	Strongly Disagree	Fear of my peers	Disagree
9	8-12-2013 15:33:29	Male	No	RIM (Blackberry)	Disagree	Nothing to ask	Neutral
10	8-12-2013 15:38:22	Female	Yes	Android	Disagree	Nothing to ask	Disagree
11	8-12-2013 15:51:38	Female	No	Windows Phone	Disagree	Nothing to ask	Disagree
12	8-12-2013 15:53:19	Male	Yes	RIM (Blackberry)	Neutral	Can't formulate a question verbally, N/A	Neutral
13	8-12-2013 15:55:10	Male	Yes	Android	Disagree	Nothing to ask, preference to listen; introverted personality	Disagree
14	8-12-2013 16:10:19	Female	No	RIM (Blackberry)	Strongly Disagree	Nothing to ask	Strongly Disagree
15	8-12-2013 16:11:48	Male	Yes	iOS (iPhone)	Neutral	Nothing to ask	Agree
16	8-12-2013 16:12:11	Male	No	RIM (Blackberry)	Neutral	Nothing to ask	Strongly Disagree
17	8-12-2013 16:14:35	Male	Yes	Android	Strongly Disagree	Nothing to ask	Strongly Disagree
18	8-12-2013 16:18:31	Female	No	iOS (iPhone)	Disagree	Nothing to ask	Neutral
19	8-12-2013 16:29:12	Male	No	RIM (Blackberry)	Neutral	Lecturer is stupid and arrogant (worst combination)	Strongly Agree
20	8-12-2013 17:01:31	Female	No	RIM (Blackberry)	Strongly Disagree	Lack confidence	Strongly Disagree
21	8-12-2013 17:18:29	Female	Yes	Nokia	Strongly Disagree	Lack confidence	Strongly Disagree
22	8-12-2013 17:27:18	Female	No	Android	Neutral	N/A	Agree

	A	B	C	D	E	F	G
1	**Timestamp**	**Gender**	**Is your phone connected to the rhodes WiFi network?**	**What is your phone's operating system?**	**I regularly ask questions in lectures.**	**If not, why?**	**I regularly answer questions in lectures.**
23	8-12-2013 17:53:54	Female	No	iOS (iPhone)	Strongly Disagree	Nothing to ask	Neutral
24	8-12-2013 23:31:13	Male	No	Android	Disagree	Lack confidence	Disagree
25	8-13-2013 12:32:52	Female	No	iOS (iPhone)	Strongly Disagree	Nothing to ask	Strongly Disagree
26	8-13-2013 13:52:03	Male	No	RIM (Blackberry)	Neutral	Nothing to ask	Neutral
27	8-13-2013 13:53:12	Male	No	RIM (Blackberry)	Disagree	Nothing to ask	Disagree
28	8-13-2013 15:29:58	Female	No	RIM (Blackberry)	Disagree	Can't formulate a question verbally	Disagree
29	8-13-2013 15:39:35	Male	No	Windows Phone	Disagree	Lack confidence	Strongly Disagree
30	8-13-2013 16:37:31	Male	Yes	Android	Strongly Disagree	Nothing to ask	Strongly Disagree
31	8-13-2013 16:44:55	Male	No	RIM (Blackberry)	Disagree	Lack confidence, Nothing to ask	Disagree
32	8-13-2013 16:49:15	Female	Yes	iOS (iPhone)	Neutral	Nothing to ask	Neutral
33	8-13-2013 18:42:46	Female	No		Disagree	Can't formulate a question verbally	Disagree
34	8-13-2013 21:54:55	Male	Yes	iOS (iPhone)	Strongly Disagree	Lack confidence	Strongly Agree
35	8-14-2013 12:40:53	Male	No	Android	Strongly Disagree	Lack confidence	Strongly Disagree
36	8-14-2013 14:14:44	Female	No	Nokia	Agree	Lack confidence	Agree
37	8-14-2013 14:15:05	Female	Yes	nokia	Strongly Disagree	Lack confidence	Strongly Disagree
38	8-14-2013 14:15:19	Female	No	RIM (Blackberry)	Strongly Disagree	Lack confidence, Nothing to ask	Strongly Disagree
39	8-14-2013 14:51:35	Male	No	RIM (Blackberry)	Disagree	Nothing to ask	Neutral
40	8-14-2013 15:39:52	Male	No	RIM (Blackberry)	Strongly Disagree	Nothing to ask	Disagree
41	8-14-2013 16:07:41	Male	No	RIM (Blackberry)	Neutral		Neutral
42	8-14-2013 16:07:58	Male	No	RIM (Blackberry)	Agree	N/A	Agree
43	8-14-2013 16:44:31	Male	Yes	Android	Disagree	Lack confidence	Disagree
44	8-14-2013 23:51:31	Male	No	Android	Neutral	Nothing to ask	Disagree
45	8-15-2013 8:38:39	Female	No	RIM (Blackberry)	Disagree	Lack confidence, Nothing to ask	Disagree
46	8-15-2013 9:43:21	Male	No	Android	Neutral	Nothing to ask, Can't formulate a question verbally	Agree

	A	B	C	D	E	F	G
1	**Timestamp**	**Gender**	**Is your phone connected to the rhodes WiFi network?**	**What is your phone's operating system?**	**I regularly ask questions in lectures.**	**If not, why?**	**I regularly answer questions in lectures.**
47	8-15-2013 11:10:01	Male	No		Disagree	Lack confidence, Fear of my peers, Can't formulate a question verbally	Disagree
48	8-15-2013 11:12:03	Male	No	RIM (Blackberry)	Disagree	world balances out, some ask questions, some dont	Disagree
49	8-15-2013 12:03:15	Male	Yes	Android	Strongly Disagree	Nothing to ask	Strongly Disagree
50	8-15-2013 12:53:42	Female	Yes	RIM (Blackberry)	Strongly Disagree	Lack confidence	Strongly Disagree
51	8-15-2013 12:58:51	Male	Yes	RIM (Blackberry)	Neutral	Nothing to ask, N/A	Neutral
52	8-15-2013 12:59:13	Male	Yes	Android	Neutral	Can't formulate a question verbally	Neutral
53	8-15-2013 14:00:46	Female	No	RIM (Blackberry)	Strongly Disagree	Nothing to ask, N/A	Strongly Disagree
54	8-15-2013 15:24:59	Male	No	RIM (Blackberry)	Neutral		Agree
55	8-15-2013 16:38:01	Female	No	RIM (Blackberry)	Strongly Disagree	Fear of my peers	Strongly Disagree
56	8-15-2013 16:59:15	Female	No		Disagree	Nothing to ask, N/A	Neutral
57	8-15-2013 17:13:15	Female	No	RIM (Blackberry)	Strongly Disagree	Lack confidence, Nothing to ask, Fear of my peers, Fear of my lecturers, Can't formulate a question verbally	Strongly Disagree
58	8-15-2013 18:19:51	Female	No	RIM (Blackberry)	Disagree	Nothing to ask	
59	8-15-2013 18:26:59	Female	No	Windows Phone	Disagree	Lack confidence, Fear of my peers, Fear of my lecturers, Can't formulate a question verbally	Strongly Disagree
60	8-15-2013 19:59:25	Female	No	NOKIA	Strongly Disagree	Fear of my lecturers	Strongly Disagree
61	8-15-2013 21:19:09	Male	No	RIM (Blackberry)	Disagree	Nothing to ask	Agree
62	8-15-2013 22:47:12	Male	No	RIM (Blackberry)	Disagree	Nothing to ask	Neutral
63	8-15-2013 23:36:07	Female	No	RIM (Blackberry)	Neutral	Nothing to ask	Neutral
64	8-16-2013 10:59:29	Male	Yes	RIM (Blackberry)	Neutral	Nothing to ask	Strongly Disagree
65	8-16-2013 11:00:25	Male	No	Android	Neutral	Nothing to ask	Agree
66	8-16-2013 13:13:34	Female	Yes	RIM (Blackberry)	Neutral	Nothing to ask	Neutral
67	8-16-2013 14:32:45		No	RIM (Blackberry)	Neutral	Nothing to ask	Disagree
68	8-16-2013 15:22:40	Female	Yes	Android	Disagree	Lack confidence	Disagree

	A	B	C	D	E	F	G
1	**Timestamp**	**Gender**	**Is your phone connected to the rhodes WiFi network?**	**What is your phone's operating system?**	**I regularly ask questions in lectures.**	**If not, why?**	**I regularly answer questions in lectures.**
69	8-16-2013 15:30:50	Female	No	Android	Strongly Disagree	Lack confidence	Strongly Disagree
70	8-16-2013 16:45:47	Female	No	RIM (Blackberry)	Disagree	Nothing to ask	Disagree
71	8-16-2013 16:52:32	Male	No	RIM (Blackberry)	Disagree	Nothing to ask	Disagree
72	8-17-2013 17:46:13	Female	No	nokia 100	Disagree	Can't formulate a question verbally	Neutral
73	8-18-2013 23:47:33	Male	No	opera mini	Neutral	I usually ask my tuto r	Neutral
74	8-19-2013 9:28:53	Other	Yes	RIM (Blackberry)	Neutral	N/A	Neutral
75	8-22-2013 8:54:02	Male	No	Series 40 UI	Neutral		Agree
76	8-27-2013 15:18:29	Male	No	Android	Strongly Disagree	Lack confidence	Neutral
77	9-10-2013 11:44:23	Male	Yes	Android	Disagree	Nothing to ask	Neutral
78	9-12-2013 16:08:41	Female	No	RIM (Blackberry)	Strongly Agree	Lack confidence	Strongly Agree
79	9-12-2013 16:08:48	Female	No	RIM (Blackberry)	Strongly Agree	Lack confidence	Strongly Agree

	H	I	J	K	L	M
1	**If not, why?**	**I will tell a lecturer when they are moving too fast or too slowly in a lecture.**	**If not, why?**	**I regularly give feedback such as my opinion on a topic in a lecture.**	**If not, why?**	**I would tell a lecturer if I was bored during a lecture.**
2	Fear of my peers, Fear of my lecturers	Neutral	N/A	Agree		Strongly Disagree
3	N/A	Agree	N/A	Neutral	N/A	Disagree
4	Fear of my peers	Disagree	Not sure if my peers agree	Disagree	Never have anything to say, Don't want to be contradicted	Disagree
5	Lack confidence	Neutral	N/A	Neutral	N/A	Disagree
6	N/A	Neutral	have not come across one who is too slow or fast	Agree	N/A	Strongly Disagree
7	Don't know the answer	Strongly Disagree	Don't want to offend the lecturer, Not sure if my peers agree	Strongly Disagree	Never have anything to say	Strongly Disagree
8	Don't know the answer	Strongly Disagree	Lack confidence	Strongly Disagree	Fear of my lecturers	Strongly Disagree
9	N/A	Neutral	N/A	Neutral	N/A	Agree
10	N/A	Agree	N/A	Neutral	N/A	Disagree
11	Don't know the answer			Disagree	Never have anything to say	Disagree
12	N/A	Agree	N/A	Neutral	N/A	Agree
13	N/A	Neutral	N/A	Neutral		Neutral
14	Don't know the answer	Agree	N/A	Strongly Disagree	N/A	Strongly Disagree
15		Agree		Neutral	N/A	Disagree
16	Lack confidence	Neutral	N/A	Neutral		Neutral
17	Fear of my peers	Strongly Disagree	Fear of my peers	Strongly Disagree	Never have anything to say	Strongly Disagree
18	N/A	Agree	N/A	Neutral	Never have anything to say, N/A	Agree
19	N/A	Agree	Fear of my lecturers	Strongly Agree	N/A	Disagree
20	Lack confidence, Don't know the answer	Neutral	Don't want to offend the lecturer	Disagree	Lack confidence, Never have anything to say, N/A	Neutral
21	Lack confidence	Neutral	N/A	Strongly Disagree	Lack confidence	Strongly Disagree
22	N/A	Agree	N/A	Agree	Never have anything to say	Neutral

	H	I	J	K	L	M
1	**If not, why?**	**I will tell a lecturer when they are moving too fast or too slowly in a lecture.**	**If not, why?**	**I regularly give feedback such as my opinion on a topic in a lecture.**	**If not, why?**	**I would tell a lecturer if I was bored during a lecture.**
23	I don't like the Q&A format of lecturing. I prefer to receive information and process it in my own style	Disagree	There's no point in asking a lecturer to go faster becuase most members of the class like going slowly	Neutral	Most of my lectures don't really require opinions	Agree
24	Lack confidence	Neutral		Agree		Disagree
25	Don't know the answer	Disagree	Not sure if my peers agree	Strongly Disagree	Never have anything to say	Strongly Disagree
26	N/A	Disagree	use pracs to catch up			
27	Don't know the answer	Disagree	use pracs to catch up	Disagree	N/A	Disagree
28	Lack confidence	Neutral	N/A	Neutral	N/A	Strongly Disagree
29	Can't formulate the answer verbally	Strongly Agree	Not sure if my peers agree	Disagree	Lack confidence	Neutral
30	N/A, I don't think it necessary	Neutral	N/A	Disagree	N/A	Strongly Disagree
31	Lack confidence	Disagree	Don't want to offend the lecturer	Disagree	Lack confidence, Never have anything to say	Strongly Disagree
32	Don't know the answer	Disagree	Not sure if my peers agree	Disagree	Don't want to be contradicted	Disagree
33	Lack confidence	Neutral	N/A	Disagree	Never have anything to say	Disagree
34		Strongly Disagree	Don't want to offend the lecturer	Strongly Disagree	Lack confidence, Fear of my peers	Neutral
35	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree
36	Lack confidence	Agree	Fear of my lecturers	Strongly Agree	Fear of my peers	Disagree
37	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree
38	Don't know the answer	Agree		Strongly Disagree	Never have anything to say	Strongly Disagree
39		Strongly Disagree	Don't want to offend the lecturer, Not sure if my peers agree	Agree		Strongly Disagree
40	Fear of my peers	Strongly Disagree	Don't want to offend the lecturer	Strongly Disagree	Never have anything to say	Strongly Disagree
41		Neutral		Neutral		Neutral
42	N/A	Neutral	N/A	Agree	N/A	Disagree
43	Lack confidence	Neutral	N/A	Neutral	N/A	Disagree
44	Lack confidence	Neutral	Don't want to offend the lecturer	Neutral	Don't want to be contradicted	Strongly Disagree
45	Lack confidence, Don't know the answer, Can't formulate the answer verbally	Neutral		Disagree	Lack confidence, Don't want to be contradicted	Neutral
46	N/A	Agree	N/A	Disagree	Never have anything to say, Don't want to be contradicted	Neutral

	H	I	J	K	L	M
1	**If not, why?**	**I will tell a lecturer when they are moving too fast or too slowly in a lecture.**	**If not, why?**	**I regularly give feedback such as my opinion on a topic in a lecture.**	**If not, why?**	**I would tell a lecturer if I was bored during a lecture.**
47	Lack confidence, Don't know the answer, Fear of my peers	Disagree	Lack confidence, Fear of my peers	Disagree	Lack confidence, Fear of my lecturers, Don't want to be contradicted	Disagree
48	some answer, some dont	Disagree	i always catch up	Neutral		Disagree
49	Don't care	Strongly Disagree	Don't care	Strongly Disagree	Don't care	Strongly Disagree
50	Can't formulate the answer verbally	Disagree	Don't want to offend the lecturer	Strongly Disagree	Don't want to be contradicted	Strongly Disagree
51		Agree		Neutral		Disagree
52	Can't formulate the answer verbally	Agree	N/A	Neutral	Don't want to be contradicted	Agree
53	N/A	Strongly Disagree	N/A	Neutral	N/A	Neutral
54		Neutral		Agree		Disagree
55	Fear of my peers	Strongly Disagree	Don't want to offend the lecturer, Not sure if my peers agree	Strongly Disagree	Never have anything to say	Strongly Disagree
56	N/A	Disagree	Not sure if my peers agree	Neutral	Never have anything to say	Disagree
57	Lack confidence, Fear of my peers, Fear of my lecturers, Can't formulate the answer verbally	Strongly Disagree	Lack confidence, Fear of my peers, Fear of my lecturers, Not sure if my peers agree	Strongly Disagree	Lack confidence, Never have anything to say, Fear of my peers, Fear of my lecturers, Don't want to be contradicted	Strongly Disagree
58		Disagree	Don't want to offend the lecturer	Disagree	Never have anything to say	Disagree
59	Lack confidence, Don't know the answer, Fear of my peers	Strongly Disagree	Lack confidence, Don't want to offend the lecturer, Fear of my peers, Fear of my lecturers	Disagree	Lack confidence, Fear of my peers	Strongly Disagree
60	Lack confidence	Strongly Disagree	Don't want to offend the lecturer	Strongly Disagree	Lack confidence	Strongly Disagree
61	N/A	Agree	N/A	Neutral	N/A	Agree
62		Agree		Neutral		Agree
63	N/A	Strongly Agree	N/A	Disagree	Never have anything to say	Disagree
64	Lack confidence	Agree	N/A	Neutral	N/A	Strongly Disagree
65	N/A	Disagree	Lack confidence, Don't want to offend the lecturer, Fear of my lecturers		N/A	Disagree
66	Lack confidence	Agree		Disagree	Don't want to be contradicted	Disagree
67	Don't know the answer	Agree		Agree		Disagree
68		Neutral	Don't want to offend the lecturer	Neutral	Don't want to be contradicted	Strongly Disagree

	H	I	J	K	L	M
1	**If not, why?**	**I will tell a lecturer when they are moving too fast or too slowly in a lecture.**	**If not, why?**	**I regularly give feedback such as my opinion on a topic in a lecture.**	**If not, why?**	**I would tell a lecturer if I was bored during a lecture.**
69	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree
70	Can't formulate the answer verbally	Neutral	N/A	Agree	N/A	Strongly Disagree
71	don't feel the need to answer	Disagree	N/A	Disagree	Never have anything to say	Disagree
72	Lack confidence	Disagree	Lack confidence	Disagree	Lack confidence	Strongly Disagree
73		Agree		Neutral		Disagree
74	N/A	Neutral	N/A	Neutral	N/A	Neutral
75		Disagree	Don't want to offend the lecturer, Not sure if my peers agree	Neutral		Strongly Disagree
76	Fear of my peers	Strongly Disagree	Lack confidence	Strongly Disagree	Lack confidence	Strongly Disagree
77	Don't care to.	Agree	N/A	Neutral	Don't have any feedback.	Neutral
78	Lack confidence, Fear of my peers	Strongly Disagree	Don't want to offend the lecturer	Disagree	Lack confidence	Strongly Disagree
79	Lack confidence, Fear of my peers	Strongly Disagree	Don't want to offend the lecturer	Disagree	Lack confidence	Strongly Disagree

	N	O	P	Q	R
1	**If not, why?**	**I feel that course and lecturer evaluations are a great way of giving lecturers feedback and improving my education.**	**If not, why?**	**I would like a way to interact with lecturers anonymously at any time during a lecture and throughout a course.**	**If not, why?**
2	Don't want to offend the lecturer	Disagree	Don't think that they get used , Don't want to offend the lecturer, Done too late, Only help future students doing that course	Agree	
3	Don't want to offend the lecturer	Agree	N/A	Disagree	Lack of personal interaction
4	Don't want to offend the lecturer	Agree		Neutral	
5	Don't want to offend the lecturer	Agree	N/A	Strongly Agree	N/A
6	its disrespectful, I could leave the lecture if I felt bored	Disagree	they only help the next person who takes the course e.g G14's and not me because i have went through the objectionable lectures	Disagree	Lack of personal interaction, there needs to be a system of accountability, where a face can be placed next to a problem.
7	Don't want to offend the lecturer	Neutral	I never take them seriously	Neutral	N/A
8	Don't want to offend the lecturer	Agree	N/A	Agree	N/A
9	N/A	Agree	N/A	Neutral	N/A
10	Don't want to offend the lecturer	Disagree	Don't think that they get used	Neutral	I never have anything to say
11	Don't want to offend the lecturer	Neutral	N/A	Neutral	N/A
12	N/A	Neutral	N/A	Neutral	N/A
13		Strongly Agree		Neutral	
14	Don't want to offend the lecturer	Neutral	I never take them seriously	Neutral	Takes longer than face to face interaction
15	Not sure if peers agree	Neutral	N/A	Agree	
16	Don't want to offend the lecturer	Neutral	Done too late	Strongly Disagree	Too much effort
17	Don't want to offend the lecturer	Neutral	Only help future students doing that course	Agree	
18	N/A	Agree	N/A	Agree	N/A
19	Fear of my lecturers	Strongly Disagree	These are not taken seriously by the establishment	Agree	N/A
20	Don't want to offend the lecturer	Strongly Agree	N/A	Strongly Agree	N/A
21	N/A	Agree	Only help future students doing that course	Agree	Lack of personal interaction
22	N/A	Agree	Only help future students doing that course	Disagree	Lack of personal interaction, N/A

	N	O	P	Q	R
1	**If not, why?**	**I feel that course and lecturer evaluations are a great way of giving lecturers feedback and improving my education.**	**If not, why?**	**I would like a way to interact with lecturers anonymously at any time during a lecture and throughout a course.**	**If not, why?**
23		Neutral	Don't think that they get used	Disagree	Takes longer than face to face interaction
24	Lack confidence	Strongly Agree		Strongly Agree	
25	Don't want to offend the lecturer	Strongly Agree	N/A	Agree	N/A
26					
27	Don't want to offend the lecturer	Agree		Neutral	N/A
28	Don't want to offend the lecturer	Strongly Agree		Strongly Agree	
29	Fear of my lecturers	Strongly Agree	N/A	Strongly Agree	N/A
30	That would be very rude	Strongly Agree		Neutral	
31	Don't want to offend the lecturer	Strongly Agree		Neutral	
32	Don't want to offend the lecturer	Agree	N/A	Neutral	N/A
33	N/A	Strongly Disagree	N/A	Strongly Agree	
34	Don't want to offend the lecturer, Not sure if peers agree	Strongly Disagree		Strongly Disagree	
35	Don't want to offend the lecturer	Neutral	Only help future students doing that course	Agree	
36	Don't want to offend the lecturer		Don't want to offend the lecturer	Neutral	Don't want to offend the lecturer
37	Lack confidence	Strongly Disagree	Don't think that they get used	Strongly Disagree	I never have anything to say
38	Don't want to offend the lecturer	Strongly Agree		Strongly Agree	
39	Don't want to offend the lecturer, Fear of my peers, Fear of my lecturers, Not sure if peers agree	Agree		Agree	
40	Don't want to offend the lecturer	Strongly Agree		Agree	
41		Neutral		Agree	
42	Not sure if peers agree	Neutral	N/A	Agree	N/A
43	Don't want to offend the lecturer	Neutral	N/A	Neutral	N/A
44	Don't want to offend the lecturer	Agree		Strongly Agree	
45	Lack confidence, Don't want to offend the lecturer	Agree		Neutral	
46	Don't want to offend the lecturer	Agree	N/A	Disagree	Lack of personal interaction, Takes longer than face to face interaction

	N	O	P	Q	R
1	**If not, why?**	**I feel that course and lecturer evaluations are a great way of giving lecturers feedback and improving my education.**	**If not, why?**	**I would like a way to interact with lecturers anonymously at any time during a lecture and throughout a course.**	**If not, why?**
47	Lack confidence, Fear of my lecturers	Strongly Agree		Strongly Agree	
48	indifferent	Agree		Disagree	i can catch up on my own
49	You gussed it!	Neutral	I never take them seriously	Strongly Agree	We are legion
50	Don't want to offend the lecturer	Strongly Agree		Strongly Agree	
51	Don't want to offend the lecturer	Agree		Agree	
52	N/A	Agree	N/A	Strongly Agree	N/A
53	Don't want to offend the lecturer	Agree	N/A	Neutral	I never have anything to say
54	Don't want to offend the lecturer	Agree		Strongly Agree	
55	Don't want to offend the lecturer, Fear of my lecturers	Strongly Agree		Strongly Agree	
56	Don't want to offend the lecturer	Neutral	Only help future students doing that course	Disagree	I never have anything to say
57	Lack confidence, Don't want to offend the lecturer, Fear of my peers, Fear of my lecturers	Neutral	Don't think that they get used , Done too late, Only help future students doing that course	Neutral	I never have anything to say, Too much effort, Lack of personal interaction
58	Don't want to offend the lecturer	Disagree	Don't think that they get used	Strongly Disagree	Too much effort
59	Lack confidence, Don't want to offend the lecturer	Strongly Agree		Strongly Agree	
60	Don't want to offend the lecturer	Strongly Agree		Agree	
61	Don't want to offend the lecturer	Neutral	N/A	Disagree	Takes longer than face to face interaction
62		Agree		Neutral	
63	Don't want to offend the lecturer	Agree	N/A	Disagree	the lecturer should know who we are as an individual
64	Don't want to offend the lecturer	Agree	N/A	Agree	N/A
65	Don't want to offend the lecturer	Agree	N/A	Disagree	Lack of personal interaction
66	Fear of my lecturers	Agree		Agree	
67	Don't want to offend the lecturer	Agree		Agree	
68	Don't want to offend the lecturer	Neutral	Done too late	Neutral	Too much effort

	N	O	P	Q	R
1	**If not, why?**	**I feel that course and lecturer evaluations are a great way of giving lecturers feedback and improving my education.**	**If not, why?**	**I would like a way to interact with lecturers anonymously at any time during a lecture and throughout a course.**	**If not, why?**
69	Don't want to offend the lecturer	Neutral		Agree	
70	Don't want to offend the lecturer	Strongly Agree	N/A	Strongly Agree	N/A
71	Don't want to offend the lecturer	Agree	N/A	Neutral	N/A
72	not polite way	Agree	Only help future students doing that course	Neutral	Lack of personal interaction
73	Lack confidence	Strongly Agree		Agree	
74	N/A	Neutral	N/A	Neutral	N/A
75	Don't want to offend the lecturer	Agree		Agree	
76	Lack confidence	Neutral	Only help future students doing that course	Strongly Disagree	Lack of personal interaction
77	That's rude.	Agree	N/A	Agree	N/A
78	Don't want to offend the lecturer	Neutral	Don't think that they get used , Done too late	Agree	
79	Don't want to offend the lecturer	Neutral	Don't think that they get used , Done too late	Agree	

A.2 Post-implementation Questionnaire

A.2.1 Questions

Rhodes Lecture Interaction System

This questionnaire will be used to give us an indication whether the lecture interaction system used is valuable and the pro's and con's of using it.

1. **Gender**
   Mark only one oval.

   - ◯ Male
   - ◯ Female
   - ◯ Other

2. **What operating system does your phone run?**
   Mark only one oval.

   - ◯ Android
   - ◯ iOS
   - ◯ Blackberry
   - ◯ Windows Phone
   - ◯ Other: .....

3. **Did you use the Rhodes Lecture Interaction System?**
   Mark only one oval.

   - ◯ Yes
   - ◯ No

4. **If not, why not?**
   Check all that apply.

   - ☐ Too much effort
   - ☐ Didn't have a smartphone
   - ☐ Didn't feel that it was necessary
   - ☐ N/A
   - ☐ Other: .....

5. **If you used the system, how did you do it?**
   Mark only one oval.

   - ◯ Downloaded the Android App
   - ◯ Used the Mobile website
   - ◯ Made a friend do it on their phone
   - ◯ N/A

6. **I think that the word limit was too restricting**
Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

7. **I think that the system should be used in future classes**
Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

8. **If you agree, why?**
You may pick more than one answer
Check all that apply.

- ☐ It was helpful
- ☐ It saved time
- ☐ It made it easier to respond
- ☐ It took the pressure out of interaction
- ☐ It increased student- lecture interaction
- ☐ N/A
- ☐ Other: .....

9. **If you disagree, why?**
You may pick more than one answer
Check all that apply.

- ☐ Makes lectures less personal
- ☐ It is too easy for students to be rude
- ☐ Too distracting
- ☐ Students use it for the wrong reasons
- ☐ N/A
- ☐ Other: .....

10. **I found the system easy to use**
Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

11. **If you disagree, why?**
You may pick more than one answer
Check all that apply.

- ☐ It was too complicated
- ☐ Too many options for types of feedback
- ☐ I am not good with technology
- ☐ Difficult to navigate
- ☐ N/A
- ☐ Other: .....

12. **There is sufficient cellphone signal in the lecture venue**
Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

13. **There is sufficient WiFi signal in the lecture venue**
Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

14. **It is easy to connect to the system**
Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

15. **I would prefer to download an App to my phone than using a mobile website**
Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

16. **If you disagree, why?**
Check all that apply.

- ☐ I don't download App's
- ☐ It is easier to go to a website
- ☐ I do not have a smartphone
- ☐ N/A
- ☐ Other: .....

17. **In your opinion, what are the downfalls of using the system, if any?**

.....

.....

.....

.....

.....

18. **In your opinion, what are the benefits of using the system, if any?**

.....

.....

.....

.....

.....

A.2.2 Results

	A	B	C	D	E	F	G	H
1	**Timestamp**	**Gender**	**What operating system does your phone run?**	**Did you use the Rhodes Lecture Interaction System?**	**If not, why not?**	**If you used the system, how did you do it?**	**I think that the word limit was too restricting**	**I think that the system should be used in future classes**
2	9-9-2013 3:02:21	Male	Android	No	Didn't feel that it was necessary	N/A	Agree	Neutral
3	9-9-2013 5:01:54	Male	Blackberry	Yes		Used the Mobile website	Agree	Agree
4	9-9-2013 5:29:44	Female	Windows Phone	Yes		N/A	Agree	Neutral
5	9-9-2013 5:30:01	Female	Blackberry	No	Too much effort	N/A	Neutral	Agree
6	9-9-2013 5:31:22	Female	Windows Phone	Yes		Used the Mobile website	Neutral	Agree
7	9-9-2013 5:31:36	Male	Android	No	Too much effort	N/A	Neutral	Neutral
8	9-9-2013 6:03:50	Male	Android	No	Phone not present during class	N/A	Strongly agree	Neutral
9	9-9-2013 12:09:49	Female	Android	Yes		Made a friend do it on their phone	Strongly agree	Agree
10	9-10-2013 2:41:34	Male	Android	Yes	N/A	Downloaded the Android App	Agree	Agree
11	9-10-2013 4:47:41	Male	iOS	Yes		N/A	Neutral	Neutral
12	9-10-2013 4:50:28	Female	iOS	Yes		Used the Mobile website	Strongly agree	Agree
13	9-10-2013 4:53:00		Blackberry	No	N/A	N/A	Neutral	Neutral

	A	B	C	D	E	F	G	H
1	**Timestamp**	**Gender**	**What operating system does your phone run?**	**Did you use the Rhodes Lecture Interaction System?**	**If not, why not?**	**If you used the system, how did you do it?**	**I think that the word limit was too restricting**	**I think that the system should be used in future classes**
14	9-10-2013 10:17:54	Female	Blackberry	No	Too much effort	N/A	Neutral	Strongly Disagree
15	9-11-2013 4:54:26	Male	iOS	No	Didn't have a smartphone	N/A	Neutral	
16	9-11-2013 5:08:35	Female	Blackberry	Yes		Used the Mobile website	Agree	Strongly Agree
17	9-11-2013 5:16:52	Male	symbian	Yes		Used the Mobile website	Agree	Disagree
18	9-11-2013 5:34:16	Male	nokia	No	Didn't have a smartphone	N/A	Neutral	Neutral
19	9-12-2013 5:16:56	Female	Blackberry	No	Too much effort	N/A	Agree	Agree
20	9-12-2013 7:02:04	Male	Android	Yes	N/A	Downloaded the Android App	Neutral	Agree
21	9-12-2013 7:11:30	Female	Blackberry	No	Didn't have a smartphone	N/A	Disagree	Agree
22	9-12-2013 10:50:15	Male	Android	Yes	N/A	Used the Mobile website	Disagree	Agree
23	9-13-2013 14:31:00	Female		No	don't know how to use it			
24	9-20-2013 14:43:41	Male	Blackberry	Yes			Agree	Neutral

	I	J	K	L	M	N
1	**If you disagree, why?**	**I found the system easy to use**	**If you disagree, why?**	**There is sufficient cellphone signal in the lecture venue**	**There is sufficient WiFi signal in the lecture venue**	**It is easy to connect to the system**
2	It is too easy for students to be rude, Too distracting	Agree	N/A	Strongly agree	Strongly agree	Strongly agree
3	It is too easy for students to be rude, Too distracting, Students use it for the wrong reasons	Strongly Disagree	It was too complicated, Too many options for types of feedback, Difficult to navigate	Disagree	Disagree	Disagree
4		Neutral		Agree	Agree	Agree
5		Disagree	Too many options for types of feedback, I am not good with technology	Agree	Agree	Disagree
6		Agree		Agree	Agree	Agree
7	It is too easy for students to be rude, Too distracting, Students use it for the wrong reasons	Neutral	N/A	Strongly Disagree	Strongly Disagree	Neutral
8	Too distracting	Agree	N/A	Strongly agree	Strongly agree	Strongly agree
9		Agree		Agree	Disagree	Agree
10	N/A	Neutral	GUI sometimes stops working properly.	Agree	Strongly Disagree	Agree
11	N/A	Neutral	N/A	Agree	Strongly Disagree	Agree
12		Neutral	Too many options for types of feedback, Difficult to navigate	Disagree	Neutral	Agree
13	N/A	Neutral	N/A	Neutral	Neutral	Neutral

	I	J	K	L	M	N
1	**If you disagree, why?**	**I found the system easy to use**	**If you disagree, why?**	**There is sufficient cellphone signal in the lecture venue**	**There is sufficient WiFi signal in the lecture venue**	**It is easy to connect to the system**
14	It is too easy for students to be rude, Too distracting, Students use it for the wrong reasons	Neutral	N/A	Agree	Agree	Neutral
15	N/A	Neutral	N/A	Neutral	Disagree	Neutral
16		Agree		Neutral	Neutral	Neutral
17	Too distracting	Disagree	Difficult to navigate	Agree	Neutral	Agree
18	N/A	Neutral	N/A	Neutral	Neutral	Neutral
19	N/A	Neutral	Too many options for types of feedback	Disagree	Agree	Agree
20	N/A	Agree	N/A	Disagree	Agree	
21		Agree		Neutral	Agree	Disagree
22		Agree	N/A	Disagree	Disagree	Disagree
23						
24		Agree		Disagree	Agree	Agree

	O	P	Q	R
1	**I would prefer to download an App to my phone than using a mobile website**	**If you disagree, why?**	**In your opinion, what are the downfalls of using the system, if any?**	**In your opinion, what are the benefits of using the system, if any?**
2	Agree	N/A		
3	Agree		The application is too complicated to use and virtually inaccessible.	The system gives easier interaction between the lecturer and the students. It is elementarly helpful.
4	Disagree	It is easier to go to a website		
5	Neutral	N/A		
6	Agree			
7	Agree	N/A		
8	Strongly agree	N/A	it is very distracting - end up watching the screen more than listen to the lecturer. Also it hampers the lecturers thoughts/teaching as they get interrupted.	it is very helpful in the way that we can communicate with the lecturer and provide helpful hints to improve the lecture
9	Agree			
10	Agree	N/A	Typing out a message is distracting, ie I miss what the lecturer is saying while my head is down and I'm texting. Also, the anonymity of the messages allows people to post unproductive things on the message board which is really irritating.	Allows for lecture interaction without disrupting the lecturer's flow or train of thought.
11	Strongly agree	N/A		
12	Agree		i personally think that the anonymous part of the app made it easy for students to take advantage of the app and play the fool, i was also present for some very rude remarks made to the lecturer when it had nothing to do with her lecturing and style of teaching or the actual notes.	it was easy to communicate a question without your identity being known as some people may be too shy or think their question is silly, therefore made it easier to ask questions.
13	Neutral	N/A		

	O	P	Q	R
1	**I would prefer to download an App to my phone than using a mobile website**	**If you disagree, why?**	**In your opinion, what are the downfalls of using the system, if any?**	**In your opinion, what are the benefits of using the system, if any?**
14	Agree	N/A	Too distracting , and people start asking funny questions and we end up losing the value of the lecture. People tend to think it twitter or something and they just go overboard. I wouldn't recommend it for future use, although it was meant to be a good thing.	It could be that shy people were able to ask questions,but then again you can always approach the lecturer or the class rep. I wouldn't say there were benefits.
15	Neutral	N/A		
16	Agree		It works using the internet and reception isn't always good in certain venues.	It makes student- lecturer interaction easier as students remain anonymous. Also, students can ask their questions during any part of the lecture without disturbing the lecturer.
17	Agree		Questions are not filtered for relevance to the lecture material. It distracts the lecturers.	Students who are too shy to ask questions in class now have a platform in which to do so.
18	Neutral	N/A		
19	Strongly agree	N/A		
20	Agree	N/A		
21	Neutral	I do not have a smartphone		ver
22	Agree			
23				
24	Agree			

	S
1	**If you agree, why?**
2	N/A
3	It was helpful, It made it easier to respond, It took the pressure out of interaction
4	It made it easier to respond
5	N/A
6	It made it easier to respond
7	N/A
8	N/A
9	It was helpful, It took the pressure out of interaction, It increased student- lecture interaction
10	It was helpful
11	N/A
12	It took the pressure out of interaction, It increased student-lecture interaction
13	N/A

	S
1	**If you agree, why?**
14	N/A
15	N/A
16	It was helpful, It saved time, It made it easier to respond, It took the pressure out of interaction, It increased student- lecture interaction
17	
18	N/A
19	It made it easier to respond, It took the pressure out of interaction
20	It saved time
21	It was helpful, It made it easier to respond
22	It was helpful, It saved time, It made it easier to respond, It took the pressure out of interaction, It increased student- lecture interaction
23	
24	It saved time, It made it easier to respond, It took the pressure out of interaction

A.2.3 Qualitative results

Table A.1: Qualitative results of what students believe to be the advantages and downfalls of using the system

Student	Downfalls	Advantages
1	"The application is too complicated to use and virtually inaccessible."	"The system gives easier interaction between the lecturer and the students. It is elementarly helpful."
2	"it is very distracting - end up watching the screen more than listen to the lecturer. Also it hampers the lecturers thoughts/teaching as they get interrupted."	"it is very helpful in the way that we can communicate with the lecturer and provide helpful hints to improve the lecture."
3	""Typing out a message is distracting, ie I miss what the lecturer is saying while my head is down and I'm texting.Also, the anonymity of the messages allows people to post unproductive things on the message board which is really irritating."	"Allows for lecture interaction without disrupting the lecturer's flow or train of thought."
4	"i personally think that the anonymous part of the app made it easy for students to take advantage of the app and play the fool, i was also present for some very rude remarks made to the lecturer when it had nothing to do with her lecturing and style of teaching or the actual notes."	"it was easy to communicate a question without your identity being known as some people may be too shy or think their question is silly, therefore made it easier to ask questions."

5	"Too distracting , and people start asking funny questions and we end up losing the value of the lecture. People tend to think it twitter or something and they just go overboard. I wouldn't recommend it for future use, although it was meant to be a good thing."	"It could be that shy people were able to ask questions,but then again you can always approach the lecturer or the class rep. I wouldn't say there were benefits."
6	"It works using the internet and reception isn't always good in certain venues."	"It makes student- lecturer interaction easier as students remain anonymous. Also, students can ask their questions during any part of the lecture without disturbing the lecturer."
7	"Questions are not filtered for relevance to the lecture material. It distracts the lecturers."	"Students who are too shy to ask questions in class now have a platform in which to do so."