This is the authors’ final peer reviewed (post print) version of the item published as:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30070676

Reproduced with the kind permission of the copyright owner

Copyright: 2014, IEEE
Abstract - The demographics of the modern day student (shorter attention span, multimodal access to learning resources, growing reliance on technology) and highlighted concerns of the traditional teaching methods, such as a lecture, demonstrate a need for a more innovative teaching practice. The traditional lecture in higher education is often delivered in single-directional ‘transmission’ style with the information presented with little to no interactivity between teacher and student. This study looks at the utilization of interactive technologies within lectures, and looks at the effects that these may have on students’ perceptions of lectures, lecture effectiveness, and preferences. Students completing an Information Technology degree at Deakin University, Australia, were chosen for the trial run of two different interactive technologies. To provide comparisons of student’s opinions and expectations a subject within Information Technology that did not utilise interactive technology was also included as a site for data collection.

I. INTRODUCTION

The way in which students are attending university is changing, with online or ‘cloud-located’ learning a common element in many higher education offerings. Deakin University is one of the leading institutions in Australia to offer online courses. This online approach to education has shifted the learning methods that have been popular in higher education for many years, such as lectures and tutorials, to more practical and problem based styles of class particularly in disciplines such as Information Technology (IT). This shift was also influenced by changes in learning styles of students entering higher education, who require flexible practically oriented content to satisfy their learning needs. Despite the shift within undergraduate IT degrees, lectures are still the traditional method of delivering information to undergraduate IT students [1] [2]. The ‘lecture’ as a style of class remains, however the class dynamic of students and teacher is transforming from a predominantly transmission form of communication to one of dialogue and narrative. In this environment technology plays a part to facilitate and encourage communication. One such method is the utilization of interactive technology within the traditional lecture to increase the learning effectiveness for students through an increased frequency of group discussions, and to break away from the one-to-many approach that traditional lectures have today [3]. Over the last decade many approaches to using interactive technology have been described in the literature [4] [5] [6] [7] [8] with various positive and negative elements associated. Each approach is reflective of the student cohort in which learning takes place. It can be difficult to determine which technology approach will best suit the student cohort. These issues and experiences influenced this research which is looking into how interactive technology impacts on the lecture experience. Through the lens of a small mixed methods study this research will answer the following question:

1. How do the students perceive the use of interactive technologies in the lecture?
2. How does the use of interactive technology affect the lecture paradigm?

Feedback from evaluation of lectures that used interactive technology will be presented, alongside an evaluation of a traditional ‘non-technology’ lecture. This small study focused specifically on teaching and learning within the field of information technology at Deakin University in Australia. The information will add to discussion the on classroom environments, and highlight how interactive technology impacted the student experience.

II. RELATED LITERATURE

The higher education sector in Australia is rapidly evolving. In the 1990’s student participation rates were around 15%, rising to over 40% in many countries by 2009 [10] thus resulting in greater diversity amongst the student population [11]. This change in participation rates require universities to adjust their missions to keep up with the demands of a shift in students attending universities.

With less students attending university for academic purposes and more for career orientated reasons [12] it is important for universities to be listening to the needs of their students. The development of resources for student use outside the classroom would suggest that universities believe that student satisfaction lays in content for use anytime – anywhere. However utilization of resources
within the classroom are also contributing factors for student engagement and should be considered [13].

In addition to student trends and demographic changes there is growing reliance on technology to support higher educational pedagogy [13] [14]. Yet despite this the lecture still remains a somewhat technology minimal space from an audience perspective. In this changing educational landscape the validity of the lecture as an educational experience comes into question. Do we still need face to face lectures at University? With our reliance on technology, perhaps teaching through the use of technology solutions would provide the same, if not a better educational experience? These questions motivated the researchers to investigate the lecture experience, with the particular discipline under consideration being Information Technology.

A. Information Technology Higher Education

Higher educational institutions have recognised that student satisfaction and retention is of very high concern, as they are a service industry thus must look after their customers; their students [16]. The idea of student satisfaction is especially important for Information Technology education in Australia with a current trend of decreased enrolment and retention [23], something that is somewhat in direct contrast to the reported increase of participation rates for universities around the country [10].

Education in Information Technology is different from most areas of study with a heavy reliance on practical application of skills. For example, a practical class in computer programming comprises of students practicing programming problems, having the opportunity to ask questions of a practical teacher or review solutions in person [13]. This reliance on practicals in combination with the use of many resources outside the classroom (lecture recordings, online assessment, discussion boards, etc) the traditional lecture could be seen as of a lower priorities for students at Australian universities. While most Information Technology students are assumed to attend lectures, anecdotal evidence suggests a decline in attendance [1]. To assist in setting the scene for this research, it is important to define the lecture experience.

B. Lectures

The traditional lecture has predominantly been thought of as a manner of delivering information in a single directional style, with little to no student-to-student discussion during [3] [17]. However, it has been proposed that this style of lecture has been losing popularity, instead being replaced by the idea that a more interactive style of teaching where the students have a voice in the classroom and can contribute their own knowledge, thoughts and ideas, can be a more effective way of presenting content to students [3] [19] [26]. Folley [9] notes the benefits of using a lecture to deliver teaching content:

• Be an efficient and economical way of conveying complex information to large student groups in an enthusiastic and engaging way
• Provide a good structure and introduction to complex topics with current information put into an appropriate context for students
• Be tailed made for student’s needs
• Encourage thought and deepen understand, as well as independent learning

However, two areas exist that could hinder the lecture experience, and as such the students ability or desire to learn. Firstly the variable attention spans of students during lectures, with empirical research by Newble and Cannon [18] showing that even in the most interesting of lectures, attention levels naturally tend to drop after the first 20 minutes of the presentation. Secondly the traditional lecture does not easily provide means of discussion [17], despite evidence supporting that dialog and discussion are considered important in creating high-level cognitive processing [19] [26]. In order for learning to occur students must stop listening and process the information given to them, before continuing on to different topics [3].

Many efforts have been created to build upon the traditional lecture. These include flipped classrooms [25], mandatory lecture attendance [28] and the use of interactive technology [3] [24]. An approach used in lecture in IT at Deakin is interactive technology, therefore the focus in this study is on interactive technology as used in a face-to-face lecture scenario.

C. Interactive learning

Interactive learning is a teaching method that allows students to create and build on knowledge though activities such as voting or discussion [3] [26]. In this context this study there are three main categories of interaction to consider; Learner-Learner, Teacher-Learner and Learner-Content [14].

While it can be beneficial for students to learn in a more interactive environment [3] [19] it can be hard to produce in lectures, especially ones large in attendance, with students often being unwilling or lacking in confidence to communicate problems, ideas, answers or questions to the rest of the class [17] [29]. It has been proposed that the use of interactive technology can help facilitate the three types of interaction, with interactive technology being seen as a value-add, on top of the basic notes and presentation of the unit content [6] [30].

D. Interactive Technology for Interactive Learning

The purpose of interactive technology is to allow students to respond and produce questions of the teaching material during a teaching session. Interactive technologies can vary from physical clickers to web-based technologies, with the general aim being to provide and encourage real-time interaction between lecturers and their students, in an
unobtrusive or cumbersome manner. Common interactive technologies are often called ‘student response systems’.

E. Student Response Systems

Student response systems (SRS) have already changed the way students learn in the classroom [8] and most students have reported that the use of student response systems has increased their engagement with classroom activities [4] [5] [6] [21] [22]. They are designed to gather information from the students via use of a small, handheld device, that can be easily distributed to the students before the lesson commences [5] [27].

An alternative to physical SRS devices is a web-based SRS, bringing with it the advantage of allowing for a much higher range of functions; such as the students being able to ask questions, create custom real-time polling, and the display of comments and short answer questions. Cumulus is one such web-based SRS that offers these advantageous functionality, and is already in use by Deakin University, Australia [20].

The use of Cumulus allows students to use their own personal devices (eg. smartphones, laptops, and tablets), as well as allowing off-campus students to join in the interactive discussion via the internet.

III. METHODOLOGY

The chosen method for this research was a mixed methodology of quantitative and qualitative surveys with qualitative observations. Both data forms are used in a complimentary fashion.

A. Research Site and Participants

To complete this research three different first year undergraduate subjects within the Information Technology course offered at Deakin University are of focus. The subjects were chosen due to the mix of interactive technology utilized within their respective lectures. Table 1 describes the name of the IT subject as well as list the type of technology utilised within the lectures.

<table>
<thead>
<tr>
<th>Subject Interactive Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Information Technology</td>
</tr>
<tr>
<td>Critical Thinking and Problem Solving</td>
</tr>
<tr>
<td>Games Fundamentals</td>
</tr>
</tbody>
</table>

When collecting data the participant groups were combined into two sets; classes with interactive technology and those without as demonstrated in table 2.

B. Data Collection Techniques and Tools

To collect data on student perceptions of interactive technology in lectures three different research instruments were used: A pre-lecture and post lecture survey and lecture observations. Each data collection instrument is described.

C. Survey 1: Pre-Lecture Survey

A short survey was administered to all participants prior to attending their first lecture to gain an understanding of the participant’s knowledge of interactive technology. The survey contained categorical questions regarding participant’s demographics and what type of devices they bring to lectures. Qualitative questions regarding experiences with interactive technologies were also included. An example of a categorical question from the survey was “what level of importance do you place on lectures?”.

D. Survey 2: Post-Lecture Survey (interactive Technology used)

A post-lecture survey was delivered to the cohort who undertook the interactive technology lectures (as shown in table 2). This survey focused on the student’s experiences with interactive technology in the lecture and collected responses through quantitative and qualitative questions. The main elements of this survey were; the organisation of the technology, the effectiveness of lectures, and what the use of interactive technology provided them. An example of a question from the survey was “did the use of interactive technology allow you to feel more connected to your peers?”. 
E. Survey 3: Post-Lecture Survey (no interactive technology used)

A post-lecture survey was delivered to the cohort who undertook the non-interactive technology lectures (as shown in table 2). The questions were divided into two main themes; relevance of lectures and group discussions in lectures, with questions pertaining to the use of interactive technology perhaps improving the lectures. Table 2 outlines the response rate and participant numbers for the pre and post lecture survey that was conducted.

<table>
<thead>
<tr>
<th>Type</th>
<th>Pre-lecture survey</th>
<th>Post-lecture survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive Technology</td>
<td>60/105</td>
<td>11/100</td>
</tr>
<tr>
<td>Non Interactive Technology</td>
<td>7/100</td>
<td></td>
</tr>
</tbody>
</table>

F. Observation

In addition to the quantitative surveys, observations were also conducted with the aim to explore further what is the most effective teaching method for encouraging student interaction; lectures that utilize interactive technology or those that do not. A basic observation protocol was undertaken, with data collection achieved via written notes which captured students’ interaction rate and method, reflective of the scenario presented. The observations were conducted by a research assistant who was not directly involved in the teaching of the subjects, however a key author in this study.

G. Analysis Methods

The quantitative data was analysed using descriptive statistics. The data analysis method of content analysis was chosen for the qualitative data, so as to produce themes. The reason for this it to allow the data to elaborate, enhance, illustrate and clarify results from one method with the results from another method [15].

IV. RESULTS

The quantitative results from the pre and post survey are presented next. The results from the observations and qualitative analysis will be presented in the context of discussion.

A. Pre-Lecture Survey

This results of the pre-lecture survey are presented in table 3. Responses to the categorical questions are demonstrated. In addition the results of the thematic analysis are shown. Thematic analysis techniques were applied to the questions regarding student’s expectations of lectures.

<table>
<thead>
<tr>
<th>Type</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you bring any of these devices to lectures?</td>
<td>60</td>
<td>88%</td>
<td>12%</td>
</tr>
</tbody>
</table>

The results show that the large majority of students in IT lectures at Deakin have in the past experienced interactive technology as a part of their classroom environment. In addition, students place an emphasis on lectures as an important part of their studies and look to gain knowledge about the subject material of the class via a lecture.

B. Post-Lecture Survey Results

This results of the post-lecture survey for the lectures with interactive technology are presented in table 4. The results of the post-lecture survey for the lectures without technology are presented in table 5. Both survey results presented show the categorical questions. Further qualitative comments from students in the post-lecture surveys are include in the discussion. Overall the results are from a student cohort are a small sample of the target population, which impacts the validity of the information presented. However the results contribute to this study as a form of complimentary data, and a way in which to pilot the data collection methods.

<table>
<thead>
<tr>
<th>Type</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often would you participate in class discussion (face to face)</td>
<td>11</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>Always: 1</td>
<td>Sometimes: 6</td>
<td>Rarely: 2</td>
<td>Never: 2</td>
</tr>
<tr>
<td>The use of interactive technologies strengthened my connections with my classmates</td>
<td>Agree: 3</td>
<td>Neutral: 3</td>
<td>Disagree: 5</td>
</tr>
</tbody>
</table>
showed mixed results with regards to students’ expectations included. The results in the pre and post lecture survey lectures that did not use interactive technology will be affected lectures. Throughout the discussion a comparison to as well as report on how the use of interactive technology was used at Deakin University, technology during lectures. The discussion will focus on Deakin University of student experience with interactive technologies such as (clickers or web based) would.

### Table V. Post Lecture Survey Results: Interactive Technology Not Used

<table>
<thead>
<tr>
<th>Total</th>
<th>7</th>
<th>Male</th>
<th>57%</th>
<th>Female</th>
<th>43%</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often would you participate in class discussion (face to face)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always:</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes:</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely:</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never:</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group discussions during lectures aided my ability to understand the content being covered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree:</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral:</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree:</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This unit’s lectures were a valuable source of information and added to my understanding of the unit’s overall content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree:</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral:</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree:</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you feel that lectures are still relevant forms of teaching for use in universities?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree:</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral:</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree:</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall I felt satisfied with the lectures in this class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree:</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral:</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree:</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The use of interactive technologies such as (clickers or web based) would have improved the lectures in this unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree:</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral:</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree:</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### V. Discussion

As introduced this study presents a small study from Deakin University of student experience with interactive technology during lectures. The discussion will focus on how interactive technology was used at Deakin University, as well as report on how the use of interactive technology affected lectures. Throughout the discussion a comparison to lectures that did not use interactive technology will be included. The results in the pre and post lecture survey showed mixed results with regards to students’ expectations and experiences with interactive technology in lectures. To supplement the results presented so far and attempt to answer the research questions proposed, the following discussion will include qualitative and observational results.

#### A. Lectures at Deakin: Interaction with Students

The pre-lecture survey demonstrated that students placed lectures as a relevant educational experience, with 53% of respondents noting that lectures provided them with access to knowledge of the subject material. The pre-lecture survey also found that mobile phones were the predominant device brought to lectures by students. This result indicates that any use of interactive technology in a class scenario will require a small/ light software application that can run be on a smart phone.

The observation of the classes demonstrated the differences in teaching approaches when giving a lecture. In the classes with interactive technology, the observations showed the different ways in which the technology was used.

In the game fundamentals class the web based interactive technology was used at certain intervals during the lecture. The web tool would ask questions that were of a polling style or discussion format. Most questions were focused on asking student opinion, rather than testing content knowledge. The lecturer would stop the class to check the results of the active polls that were constantly running. This meant the students could update their opinions whenever they liked during the lecture. Also, as this was a video link lecture, the class needed a microphone so that students from the different campuses could hear each other.

In the fundamentals of information technology class the use of the clicker SRS encouraged students to ask questions, and reinforced the notion of making queries during class time. During class time students joined into the group discussions while taking notes. The approach of the lecturer in this subject was to ask both directed questions of subject matter, as well as questions that had not been addressed in the subject matter in an effort to gauge previous experience and get students discussing possible answers. From observations it seemed that the use of clickers allowed the students to feel comfortable to ask questions of the lecturer. This was evidenced in that students asked the lecturer questions, outside of the designated question and answer space.

In the critical thinking and problem solving subject the lectures were broken up into two parts; theory and demonstrations. Many students seemed extremely unwilling to answer questions or join in discussions during the theory part of the lecture. There was no interaction between the lecturer and the class during the first part of the lecture. Prior to the demonstration part of the lecture students were given a 10 minute break. It was interesting that some students actually asked questions of the lecturer during the break instead of during actual lecture time. The demonstration part of the lecture was reserved for solving problems with the class and students were encouraged to
participate by the lecturer. During this part the lecturer uses hand rising as a way to gather whether the class understood the example problems. Even though the students were paying more attention they were still unwilling to answer questions in front of the class.

Overall students in both the technology and non-interactive technology lecture put a high to medium importance on the lecture as a valuable component of their university experience. Students also demonstrated in the post survey that they engaged with asking questions ‘sometimes’ and overall felt that lectures were ‘satisfactory’. This outcome reflects on the fact that the degree in which a lecturer is enthusiastic and personable is a contributing factor for students’ perceptions of the quality of lectures [31]. The effect of the interactive technology in improving the lecture scenario for the students at Deakin does not appear clear in the results.

B. Effect of Interactive Technology on Lectures

In the post survey qualitative comments, students’ highlighted that value they see in interactive technology as evidenced in example student comments:

“It adds an interesting dynamic to lectures and keeps people engaged/more attentive”

“Using the technology is fun and breaks up the monotony of traditional lectures”

The ability or encouragement to ask questions is important when trying to create interactivity within lectures. The results of the quantitative post-lecture survey results indicated that interactive technology had a mixed impact on strengthening connections between lecturer and students. While the results for the lectures with interactive technology demonstrated that group discussion was facilitated, communication between lecturer and student was not reported as largely different over a traditional lecture. While students commented in the survey that:

“I like to see classmates opinions on topics, as it allows me the gauge how well I’m doing”

The quantitative results do not clearly support. Further qualitative comments highlighted other themes in that students liked how the interactive technology experience provided them with a way in which to contribute anonymously.

“this helps to interact in classes anonymously which helps with my learning”

This is further emphasised by one student who commented that interactive technology in class allowed them to avoid:

“speaking up in class and getting the answer wrong”

This result was supported by the observations, which demonstrated that in both classes that used interactive technology the connections between the students and their lecturer, and between students themselves appeared stronger. More interactions between students occurred during class, and the opportunity for questions during class prompted a higher degree of communication between lecturer and student. Interestingly in the survey students noted that their connection between classmates was not strengthened by the use of interactive technology. Qualitative comments support this result, with students commenting that when their connection to their classmates was strengthened they:

“lost interest in the course material”

Overall the results indicate that there is some value in using interactive technology in the lecture scenario. However the limited responses provided by students by the post survey impacts any greater viability this study has on the body of knowledge. That being said, the results are still useful to inform future use of interactive technology use at Deakin, and are also useful to inform the Australian context about the perspective and value students place on lecturers as a part of their higher education experience.

VI. Conclusion

The use of interactive technology in lectures has been presented here via a small mixed method study within Information Technology at Deakin University. The limitations of this study are evident within the small sample of data. However, the results do assist with describing experience and are useful for other scenarios where interactive technology is being considered. The qualitative and observational data highlighted that students responded well to the use of interactive technology in the lectures. This could be due to the interactive technology breaking up the lecture scenario and providing an activity which asks the students to be active participants. Conversely the results demonstrate that lectures with no interactive technology are considered useful and provide ways in which students can connect with the teacher.

While the notion of the traditional lecture might be changing in educational literature, the experiences at Deakin demonstrate that much more needs to be done to ensure that alternative teaching techniques can satisfy the learning needs and expectations of the student cohort. Future research aims to explore alternative interactive technologies in addition to the technologies presented in this study for comparison, and greater refinement on their delivery and use within the lecture for increased effectiveness and popularity for students.

REFERENCES


