

## The Distraction of Technology in the Classroom

Sam Goundar<sup>1</sup>

### Abstract

---

Ubiquitous ICT devices of today's tertiary students are far more "cognitively penetrating". They are demanding of one's attention and highly pervasive of the learning environment. They have dramatically changed the ecology of education from "learner-plus-learning-material" into "learner-plus-learning-material-plus-technology-and-distraction". The writing skills and old-fashioned brain have been replaced with ICT devices. Students no longer need to write notes, as online course materials are a click away. They perhaps no longer need to use their brains (and powers of cognition, perception and attention) to the extent they once did in order to understand what is being taught. Given the above, the question that needs to be addressed is: how does the availability of such ubiquitous technology impact on students' learning and our teaching? Formal systematic research on the distraction of ICT devices in tertiary classrooms in New Zealand is relatively limited and this research was conducted to explore the issue. Students reported being highly distracted by the use of ICT devices for non-academic use during lectures by themselves and by their peers. Academics that do not use ICT devices in an integrated way during lectures should consider ways to limit or control its use. Students need to be informed about the distraction ICT devices to themselves and their peers.

---

**Keywords:** Technology & Learning, Computers & Education, Laptops in Lectures

### Introduction

Wireless network connectivity became available at the Bay of Plenty Polytechnic's Campus at the beginning of Semester 1 of 2011.

---

<sup>1</sup>Bay of Plenty Polytechnic, Tauranga, New Zealand

The wireless network connectivity access points are now available from all lecture theatres, tutorial rooms, and computer labs. These wireless network connectivity access points have been outsourced and are managed by "LightWire" – a company that provides fast and simple wireless Internet access on tertiary institute campuses and universities around New Zealand. All students studying business and information technology courses at the Bay of Plenty Polytechnic are able to use their laptops and other Internet-enabled mobile devices to connect to the network and surf the web.

A number of academic staff members noted that the use of personal laptops in class (during lectures and tutorials when access to computers was not required) were increasing and causing disruption to the teaching and learning process. Apart from students on personal laptops, there were others that were using their mobile phones and smart phones to send and receive text messages, emails, surfing the Internet and "checking". "Checking" has a new meaning for those concerned about the unbridled introduction of new cognitively-penetrating technology; *checking* is a new phenomenon for those that cannot seem to endure a day without repeated and regular access to mobile connectivity devices. *Checking* is checking for text messages, checking Facebook updates, checking emails, checking Twitter, checking web sites, and checking whether my friends are checking me. This happens on a regular basis, and can typically be four or more times in one hour. A recent survey in the US indicates that young person's now send or receive as many as 107 texts a day as compared to older adults (around 40). These are startling facts about modern behaviour and its invasion into the classroom should be carefully monitored.

Although many students own a laptop, during the semester, some academic staff members received complaints from students (non-laptop users during lectures) that the use of laptops by other students during lectures was distracting them from paying attention to what was being taught. Other students complained that they were being interrupted by those technology users who were not paying attention and who did not know what was going on in class, what to do next, and how to do it. If the students cared and responded by trying to assist those who were behind, then, they themselves became retarded in their work. Other anecdotal evidence received from students for technology disruptions in the classroom included mobile phones ringing, portable media players playing loud music, network computer games being played in class amongst half a dozen students and being followed and cheered by others.

Informal discussions in the staff room have revealed that the problems were common amongst the cohort of first timers (students attending courses at the polytechnic for the first time), and a few other students in other courses at higher levels. An email was sent by the author of this paper requesting such information, and the email was titled: "What Else Do Students Do In Your Class? (apart from learning what you are teaching)". The responses from colleagues were enough to seriously consider further investigations. There were instances during lectures when I had to tell students that their tapping/typing on the keyboards were disturbing and annoying me. The author tried using LanSchool to block access to lab computers, but the students would disconnect the network cables or switch onto their laptops and mobile phones/smart phones.

Educators are discovering that students are more interested in online resources, such as Facebook, game sites, chat, and YouTube, than classroom lectures and textbook chapters about computer science and other subjects. So, does one spend one's 1 or 2 hour teaching slot to teach, or "police" the students by monitoring their activities and then *stop teaching* to tell them what to do (i.e., what they should have been doing in the first instance)? The author of this research decided that he would *teach*, and those who want to learn *will*, as the learning outcomes from the course prescription needed to be completed by the end of the semester. What would be the outcome in terms of grades of the students distracted by ICT devices at the end of the semester was something that we wanted to find out. How does an instructor compete with tablets, cell phones, netbooks, and text messaging? How do we manage the distractive equalities of technology in schools?

### **Aims of the Research**

1. To identify the extent and purposes for which students are using personal ICT devices like laptops, smart phones, tablet computers, etc during lecture sessions.
2. To determine whether the students use of personal ICT devices offers benefits or barriers to their own, and others' learning in class.
3. To identify the various types of ICT devices related disruptive student behaviour that causes teaching and learning problems in the classroom.

## **Research Questions**

1. How does the increasing prevalence of student access to ICT [information communications technology] devices involving wireless network connectivity and smart phones or laptops in the classroom affect the quality of teaching and learning?
2. What are the consequences, benefits and/or costs to the students themselves, their classmates and their lecturers when students choose to access personal ICT devices in the classroom?

## **Literature Review**

A number of researches indicate that the use of laptops by students during a class or lecture can be a disadvantage. While some research demonstrates that laptops can be an important learning tool, anecdotal evidence suggests more and more faculty are banning laptops from their classrooms because of perceptions that they distract students and affect learning. One disadvantage of wireless networks in the classroom and students' increasing access to and use of laptops is the distraction that the laptop can create. Unless the lecturer specifically prohibits the use of laptops in the classroom, the wireless networks will inevitably provide a source of distraction for students who bring their devices to class.

A study to examine the nature of in-class laptop use in a large lecture course and how that use is related to student learning was conducted by (Fried, 2008). In his research, he had students' complete weekly surveys of attendance, laptop use, and aspects of the classroom environment. Results showed that students who used laptops in class spent considerable time multitasking and that the laptop use posed a significant distraction to both users and fellow students. Most importantly, the level of laptop use was negatively related to several measures of student learning, including self-reported understanding of course material and overall course performance. As Fried explains "this research raises serious concerns about the use of laptops in the classroom. Students admit to spending considerable time during lectures using their laptops for things other than taking notes. More importantly, the use of laptops was negatively related to several measures of learning".

Another study by (Barkhuus, 2005) at the University of California San Diego investigated an undergraduate class of 141 students in computer science that were allowed to use laptops and other mobile devices via networked classroom technology known as "ActiveClass" to interact with their lecturers and ask questions anonymously. They observed the class for the last two thirds of the quarter in each lecture, inquired to students' use of ActiveClass and general classroom behaviour through a questionnaire and interviews with students. The observation resulted in the following: students tended to use laptops in class for web surfing, writing projects and communication with peers. The questionnaires did confirm this as well; students with laptops in class did on average 1.6 different activities, such as surfing the internet, emailing or writing assignments, during a lecture. When comparing their laptop use to their self-reported level of attention, a difference emerges between attentive and less attentive students.

A study to examine the use of wireless laptops for promoting active learning in lecture halls was carried out by (Barak, Lipson & Lerman, 2006). The study examined students' behaviour in class and their perceptions of the new learning environment throughout three consecutive semesters. An online survey revealed that students have highly positive perceptions about the use of wireless laptops, but less positive perceptions about being active in class. Class observations showed that the use of wireless laptops enhances student-centered, hands-on, and exploratory learning, as well as meaningful student-to-student and student-to-instructor interactions. However, findings also show that wireless laptops can become a source of distraction, if used for non-learning purposes. As noted by the researcher in their discussion, "however, the use of wireless laptops also has disadvantages. A fraction of the students (12%) used their laptops for non-directed (i.e., non-learning) purposes, such as surfing the Web or sending e-mail messages. A similar fraction of students (15%) indicated that the wireless laptops distracted their attention in class. This leads to the conclusion that wireless laptops should be employed in class only when the instructor requires the students to do so.

The division of attention demanded by ICT devices further strains the students cognitive abilities, diminishing their learning and weakening their understanding. In 2003, researchers (Hembrooke & Gay, 2003) of Cornell University conducted research into distraction of ICT devices in the classroom. In an experiment, they divided a class of students into two groups.

One group was allowed to use computers, connect to the Internet and browse the web while attending a lecture. The other group attended the same lecture, but was not allowed to use computers. A log of the activity of the group of students with the computer showed that they looked at sites related to the lecture but also visited unrelated sites, checked their emails, shopped online, watched videos and did all the other things that people do online. Immediately after the lecture both groups took a test measuring how well they could recall the information from the lecture. The web surfers “performed significantly poor on immediate measures of memory for the to-be-learned content of the lecture”, according to researchers. The researchers further reported that “it didn’t matter, whether they surfed information related to the lecture or completely unrelated content – they all performed poorly. When the researchers repeated the experiment with another class, the results were the same.

Kansas State University scholars (Bergen, Grimes & Potter, 2005) conducted a similar research on distracted attention. They had a group of university students watch a typical CNN broadcast in which 4 new stories were broadcast while various multimedia elements flashed on the screen and a textual news crawl ran along the bottom. They had a second group of college students watch the same programme but with no multimedia elements flashing and no textual news crawl. Subsequent tests found that students who watched the multimedia version of the news remembered significantly fewer facts from the stories when compared to those that watched a simpler version. “It appears that this multimedia message format exceeds viewers attention and absorbance capacity”, reported the researchers.

Nicholas Carr, author of “The Shallows: What the Internet is Doing to Our Brains”, argues that psychological research long ago proved what most of us know from experience: frequent interruptions scatter our thoughts, weaken our memory, and make us tense and anxious. The more complex the train of thought we are involved in, the greater the impairment the distraction causes. Depending on the how many information streams we subscribe to and the frequency with which they send out updates, we may field a dozen alerts an hour, and for the most connected amongst us, the number can be much higher. Each of them is a distraction, another intrusion on our thoughts, another bit of information that takes up precious space in our working memory.(Carr, 2010).

Every time we shift our attention, our brain has to reorient itself, further taxing our mental resources. According to (Jackson, 2008) in her book, *Distracted* that focuses on multitasking, "the brain takes time to change goals, remember the rules needed for the new task, and block out cognitive interference from the previous, still-vivid activity. Many studies have shown that switching between just two tasks can add substantially to our cognitive load, impeding our thinking and increasing the likelihood that we will overlook or misinterpret simple information.

In another research at UCLA, (Poldrack, et. al., 2006) a group of adults were shown a series of coloured shapes and asked to make predictions based on what they saw while wearing headphones that played a series of beeps. In the first trial, they were told to ignore the beeps and just concentrate on the shapes. In the second trail they were told to count the number of beeps at the same time. After each trial they completed a test that required them to interpret what they had just done. From the test results, it was evident that after the multitasking trial, it was harder to draw conclusions on what they did. The researchers concluded that "learning facts and concepts will be worse if you learn them while you are distracted. Switching between tasks short circuits understanding, you can get the tasks done, but lose its meaning.

A study was conducted by (Aguilar-Roca, et. al., 2012) to determine if laptop use in lecture negatively impacts learning outcomes of surrounding students taking notes on paper. Two sections of a large introductory biology course (>400 students/section) were zoned into a laptop-permitted and a laptop-free area. Two sections in which laptop users could sit anywhere served as the Control. There was a correlation between exam performance and note taking preference: paper note takers scored significantly higher and laptop users scored significantly lower than predicted by pre-class academic indicators ( $p < 0.01$ , paired t-test). The majority of both laptop (64%) and paper users (82%) in the Zoned sections supported a policy restricting laptop use to specific areas. The researchers will further investigate whether the relationship between laptop-use and performance is correlative or causative

Considerable research has been conducted examining the use of laptops in higher education; however, a reliable and valid scale to assess in-class use of laptops has yet to be developed. Lauricella & Kay (2010) conducted a study to develop and evaluate the *Laptop Effectiveness Scale* (LES). The scale consisted of four constructs: academic use and three areas of non-academic use (communication, watching movies, playing games).

Feedback from students suggested that both academic and non-academic constructs assessed by the LES could be expanded to incorporate a wider range of laptop-related behaviour. According to the researchers, "one would also predict that the three non-academic constructs (communication, playing games, and watching movies) would be negatively correlated with average grade and student perceptions of laptop usefulness, and positively correlated with student estimates on non-academic use of laptops in class. These predications were supported by the correlation analysis and help establish convergent validity for the non-academic constructs assessed by the LES".

Significant investments have been made by educational institutions as well as parents and students in purchasing computers and laptops on the pretence that this equipment is as much part of the teaching and learning environment as are pens, books and teachers. The issue as to the 'impact' of this new innovation upon educational practices has generated mixed findings. Teachers at all levels of the education sector are now using (and being expected to use) computers and laptops in their classrooms. Awan (2012), in order to assess the effect of computers/laptops on the dynamics of the teaching and learning environment circulated a questionnaire to teachers undertaking a Masters in Education degree programme in UAE in order to gather teachers' opinions and experiences regarding the use of computers and laptops in their classrooms. One of the main findings was that teachers found computers and laptops in class as creating a barrier to the teaching and learning process. An analysis of teachers' comments suggested that the use of computers and laptops in class tended to distract students and created a greater number of classroom management issues for teachers to deal with. Similar findings have been observed in other studies that have noted the negative effect of laptops and computers on students' learning, with researcher observations and teachers' comments highlighting that students appeared to spend more time multitasking on their laptops and were therefore distracted from the primary lesson itself.

Because of decreased prices, and ubiquitous wireless access, an increasing number of tertiary students in New Zealand are using ICT devices in their classrooms. The critical problem area appears to be the extent to which students are distracted and the frustrations of academics that are being ignored. However, formal research on the benefits and challenges of using ICT devices in tertiary education classrooms in New Zealand is relatively limited. The purpose of this study is to examine the benefits and barriers of using ICT devices in tertiary institution classrooms in NZ.

## **Research Method**

An online survey questionnaire was designed for students studying applied computing and computer science at the Bay of Plenty Polytechnic/University of Waikato to complete. The questionnaires asked students, how their and their classmates use of personal ICT devices during lectures and tutorials distracted them from learning. The online survey questionnaire can be obtained by emailing the researcher or accessed online at: <http://www.surveymonkey.com/s/78DBQR3>

The survey questionnaires underwent five rounds of revisions and were edited to make them neutral and to remove any leading questions and bias. Furthermore, the questions were re-arranged to start off with general questions that lead to specific questions about the research. Questions requesting participant demographics were added to see if there were some commonalities between participants responding with similar answers to questions. Since this research involved students [human participants] ethical approval was sought and granted by the Bay of Plenty Polytechnic Research Committee.

The use of survey questionnaires are cost effective and not time consuming, and do not impose on participants. Participants that volunteer to provide information are able to do that at their own leisure. With online survey questionnaires on Survey Monkey, the participants can remain anonymous and freely express their opinions and respond to questions. The format of data collected from online survey questionnaires are easy to code and analyse using quantitative analysis software like SPSS. Online survey questionnaire responses to open ended questions are ideal for qualitative analysis as well.

## **Research Process:**

Emails were sent to all students studying applied computing [Bay of Plenty Polytechnic] and computer science [University of Waikato] informing them on what the research is about and inviting them to complete the online survey questionnaire with the web link to the survey questionnaires on Survey Monkey.

Students were assured of confidentiality in regards to their responses and anonymity.

After the email invitation to take part in the research survey was sent, the survey remained open for two weeks. When the survey closed at the end of two weeks, responses were received from 54 students.

It was decided not to go ahead with personal interviews and focus groups as the data collected from the online survey questionnaires was sufficient to analyse, generate results, and to conclude the research.

### **Data Analysis:**

Survey Monkey enabled raw data responses to be exported into a Microsoft Excel spreadsheet (or CSV file format) for analysis. This also enabled data to be analysed and manipulated using statistical software such as SPSS for quantitative analysis. Responses to open ended questions were collated, coded and analysed using qualitative analysis. Some charts and graphs used in the results were generated by Survey Monkey.

The type of analysis done on data collected by survey questionnaires depends on whether the results of the survey are expected to be descriptive, normative, or cause-and-effect. Descriptive results are obtained using techniques such as frequency distributions, cross-tabulations, measures of central tendency, and measures of dispersion. Normative results are obtained using techniques such as t-tests, z-tests, F-tests, Chi-square, and analysis of variance. Cause-and-effect results are obtained using techniques such as correlation, regression analysis, and Chi-square. Inferential statistics measure relationships among different variables in the data and may also be used to infer cause and effect.

### **Results**

The survey questionnaire was completed by 55 students out of a total of 115 students studying applied computing [Bay of Plenty Polytechnic] and computer science [University of Waikato]. Survey response rate was 48%. The results are as follows:

**Question 01:**

<b>In general:</b>				
<b>Answer Options</b>	<b>Yes</b>	<b>Percentage</b>	<b>No</b>	<b>Percentage</b>
Do you own a laptop?	43	78%	12	22%
If you owned a laptop, would you like to use it during class?	28	51%	27	49%
Do you own a mobile phone?	55	100%	0	0%
Would you use a mobile phone during class to check for messages?	27	49%	28	51%
Is the following true? The BoPP students' code of conduct states that students' mobile phones must be turned off during class.	35	64%	18	33%

**Table 01: Student's response regarding their ownership of ICT devices****Question 02:**

<b>I think that having access to laptops and other mobile devices in class would:</b>					
<b>Answer Options</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neither Agree Nor Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
Help in my learning during lectures, tutorials, and practical's.	13%	35%	18%	22%	11%
Help in the retention of material I have learned - I would remember it better.	15%	36%	22%	13%	15%
Increase the final grade I receive.	9%	24%	29%	26%	11%
Make me feel more like I am in the "modern world" and in touch with technology.	15%	40%	27%	7%	11%
Distract me from paying full attention in the classroom.	24%	29%	24%	24%	0%
Encourage others to act in an even more distracted manner in the classroom.	20%	27%	33%	15%	4%
Other (please specify)					

**Table 02: Student's response to the impact/effect of having ICT devices in class**

**Question 03:**

<b>I would like to be freely able to:</b>					
<b>Answer Options</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neither Agree Nor Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
Check for text messages and read them on my mobile phone during class	9%	31%	24%	16%	20%
Reply by writing a text message on my mobile phone during class	5%	24%	25%	20%	25%
Use a laptop for taking notes during class	38%	29%	22%	9%	2%
Use a laptop and surf the Internet during class for non-course related activity	7%	9%	24%	27%	31%
Other (please specify)					

**Table 03: Student's response on what they would like to be freely able to do with ICT devices during classes**

**Question 04:**

<b>Please indicate the frequency in which you are distracted by:</b>					
<b>Answer Options</b>	<b>Very Often</b>	<b>Often</b>	<b>Sometimes</b>	<b>Rarely</b>	<b>Never</b>
Using and answering calls to my mobile phone	0%	5%	18%	45%	31%
Checking my mobile phone for text messages	2%	7%	18%	42%	31%
Reading text messages on my mobile phone	2%	9%	16%	47%	25%
Writing text messages on my mobile phone	2%	7%	13%	38%	40%
Reading and replying to emails	2%	5%	16%	33%	44%
Surfing the web	4%	15%	25%	24%	33%
Listening to music	2%	5%	2%	13%	76%
Reading news online	5%	5%	22%	27%	40%
Playing games on the Internet	2%	4%	11%	11%	73%
Doing other assignments on the PC	2%	11%	33%	25%	29%
Other (please specify)					

**Table 04: Student's response on the frequency in which they are distracted by which particular activities**

**Question 05:**

<b>Now, we would like to ask what causes the most distraction. I am often distracted or lose attention:</b>					
<b>Answer Options</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neither Agree Nor Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
At lectures when the lecturer is lecturing	13%	19%	28%	31%	9%
At practical's when doing work on PC	2%	11%	26%	44%	17%
At practical's when lecturer is tutoring	4%	19%	24%	41%	13%
At practical's when working with others	6%	9%	28%	46%	11%
At home when doing my assignments	22%	30%	19%	24%	6%

**Table 05: Student's response on when they are mostly distracted by ICT devices**

**Question 06:**

<b>In Lectures I can be distracted by:</b>					
<b>Answer Options</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neither Agree Nor Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
Other students checking or using mobile phone	24%	25%	9%	20%	22%
Other students using a laptop to type notes	13%	15%	15%	27%	31%
Other students using a laptop to surf web	27%	22%	15%	16%	20%

**Table 06: Student's response on what causes the most distraction during lectures**

**Question 07:**

<b>In Tutorials/Practical's I can be distracted by:</b>					
<b>Answer Options</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neither Agree Nor Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
Other students checking or using mobile phone	18%	22%	13%	25%	22%
Other students using a laptop to type notes	7%	5%	27%	31%	29%
Other students using a laptop to surf web	16%	20%	20%	22%	22%

**Table 07: Student's response on what causes the most distraction during tutorials/practical's**

**Question 08:**

<b>For you, what are the three (3) most distracting student activities in class?</b>				
<b>Mobile Phones Cluster</b>		<b>Number</b>	<b>Percentage</b>	<b>Total</b>
Mobile Phones Ringing		12	23%	52
Talking on Mobile Phones		10	19%	52
Text Messaging		8	15%	52
<b>Laptop Usage Cluster</b>		<b>Number</b>	<b>Percentage</b>	<b>Total</b>
Surfing the Internet		18	35%	52
Laptop Users		11	21%	52
Playing Computer Games		7	13%	52
Listening to Music		4	8%	52
Keyboard Typing Noise		4	8%	52
<b>Non ICT- Related Cluster</b>		<b>Number</b>	<b>Percentage</b>	<b>Total</b>
Talking		31	60%	52
Late Arrivals		9	17%	52
Non Course Related Activity		6	12%	52
Not Paying Attention		3	6%	52

**Table 08: Student's response on what are the three (3) most distracting student activities in class**

**Question 09:**

<b>9. Please tell us your final thoughts on the distractions of ICT devices in the Classroom</b>				
<b>Mobile Phones Cluster</b>		<b>Number</b>	<b>Percentage</b>	<b>Total</b>
Text Messaging (Receiving & Sending)		9	20%	46
Talking on Mobile Phones		2	4%	46
<b>Laptop Usage Cluster</b>		<b>Number</b>	<b>Percentage</b>	<b>Total</b>
Surfing the Internet		10	22%	46
Laptop Users & their Screens		8	17%	46
Playing Computer Games		5	11%	46
Keyboard Typing Noise		3	7%	46
<b>Non ICT- Related Cluster</b>		<b>Number</b>	<b>Percentage</b>	<b>Total</b>
Talking		2	4%	46
Others Not Paying Attention		1	2%	46
<b>No ICT Devices in the Classroom</b>		<b>5</b>	<b>11%</b>	<b>46</b>

**Table 09: Student's response on their final thoughts on the distractions of ICT devices in the classroom**

**Question 10:**

<b>Question 10: Demographics of the research participants</b>				
<b>Age Group</b>	<b>Age Group</b>	<b>Age Group</b>	<b>Age Group</b>	<b>Age Group</b>
	<b>Below 20</b>	<b>Between 21 and 30</b>	<b>Between 31 and 40</b>	<b>Over 40</b>
Demographics	23%	50%	10%	17%
<b>Gender</b>	<b>Gender</b>	<b>Gender</b>	<b>Gender</b>	<b>Gender</b>
	<b>Male</b>	<b>Female</b>	<b>Male</b>	<b>Female</b>
Demographics	47	5	90%	10%
<b>Ethnicity</b>	<b>Ethnicity</b>	<b>Ethnicity</b>	<b>Ethnicity</b>	<b>Ethnicity</b>
	<b>NZ European</b>	<b>NZ Maori</b>	<b>International (Indian)</b>	<b>International (Others)</b>
Demographics	62%	15%	8%	15%

**Table 10: Demographics of the research participants**

## **Discussion and Conclusion**

Technology distractions in classroom are not only confined to the Bay of Plenty Polytechnics classrooms, but are an ongoing global issue faced by many tertiary institutions. This research raises serious concerns about the use of ICT devices in the classroom. Students admit to spending considerable time during lectures using their ICT devices for things other than learning. The responses suggest that ICT devices use interfere with students' abilities to pay attention to and understand the lecture material. It is possible that students who are struggling in class are more likely to bring their ICT devices to pass their time in class.

There are some potential limitations to the interpretation and application of these results. Self-reported responses always raise concerns about social desirability. However, general social desirability when relevant here, would most likely have pushed responses to show a higher percentage of distraction and learning implications. For example, participants should have felt pressure to report that they were doing nothing but using ICT devices to assist their learning. At the same time, they would have reported that their peers were using ICT devices in a manner that was distractive to the rest of the class. If anything, the self-report nature of the data would suggest that the degree and variety of ICT devices use, as well as the distractions posed by one's own ICT devices on attention and learning, were underreported.

Another limitation to the generalisation of these results is the nature of the courses attended by participants. All the participants were IT students. Using ICT devices, especially laptops and other mobile devices are part of the course requirements. How can you not use ICT devices in an IT course? The other important factor here is that for some courses, ICT device use was not controlled while it was controlled in other courses. Obviously, these results are not applicable to every classroom experience. Lecturers who impose rules on the restriction of ICT device use in classrooms may have an entirely different experience and so would the students in the class.

Based on the research findings, the following is suggested:

1. Revising the policy for the use of personal ICT devices in the classroom for courses within the School of Business at the Bay of Plenty Polytechnic. Leaving it to the lecturer's discretion brings forth the issue of "why am I allowed to use my ICT devices in lecturer A's class but not in lecturer B's class? There needs to be a consistent policy and compliance across the school
2. Those lecturers who would like to integrate the use of ICT devices in their teaching need clear guidelines and assistance. The devices are diverse with varied functionality, features and platforms. Lecturers would also need guidelines on how to manage students' use of personal ICT in class time by using the results of this research to show how it impacts the individual, peers and the lecturer.
3. Changes in teaching style will become one of the ways to manage ICT distractions in the classroom. The ICT devices are in the hands of students and will remain there. How we manage the personal use of ICT devices in the classroom should be the focus of future discussion amongst the stakeholders within the School of Business.
4. Changes to the teaching evaluation questionnaires to make it inclusive of the challenges from pervasive new technologies and the ability of students to evaluate impartially. Students fill tutor evaluation forms every semester to evaluate their learning of the courses they are attending. Within the evaluation form, they are required to answer questions that evaluate their tutors based on their learning.

The next research to follow from this would be to measure the level of distraction against the student's final results at the end of the semester. This might be a lengthy and complicated research proposal application and will need approval from the Bay of Plenty Polytechnic Research Committee and the students to be able to check their results and relate it to the level of distraction.

Future research on this topic may also be improved by finding ways to monitor ICT devices use directly. This would avoid the problems of self-reporting and provide a more accurate measure of the distraction of ICT devices in the classroom. This type of data would undoubtedly give a clearer picture of why and when ICT devices use interferes with learning. However, for ethical reasons, students would need to give consent for such monitoring. This in turn may raise additional concerns about the validity of the data (i.e., students may behave differently because they know they are being monitored).

Finally, these results clearly demonstrate that the use of ICT devices in the classroom can have serious negative consequences on students learning, teaching, and classroom management. These results suggest that the negative influence of in-class ICT devices use is two-pronged; ICT device use is negatively associated with student learning and it poses a distraction to fellow students. Lecturers who do not use laptops in an integrated way should consider ways to limit or control their use, or at least inform students about their pitfalls and attempt to limit the distraction ICT devices pose to other students. (Barak, M., Lipson, A. & Lerman, S. (2006); Barkhuus, L. (2005). & Hembrooke, H., & Gay, G. (2003) have suggested that ICT devices should not be used in classes where they are not integrated into the course.

## References

- Aguilar-Roca, N., Williams, A., O'Dowd, D. (2012). The impact of laptop-free zones on student performance and attitudes in large lectures. *Journal of Computers and Education*. ScienceDirect.
- Awan, R. (2012). A study of teacher's opinions and experiences on the use of computers and laptops in classrooms in the United Arab Emirates. *IPEDR vol.37 (2012) © (2012) IACSIT Press, Singapore*
- Aziz, T., Khan, M.B., & Singh, R. (2010). Effects of information technology usage on student learning: an empirical study in the United States. *International Journal of Management, 27(2)*, 205-217.
- Barak, M., Lipson, A. & Lerman, S. (2006). Wireless laptops as means for promoting active learning in large lecture halls. *Journal of Research on Technology in Education, 38(3)*, 245-263.
- Barkhuus, L. (2005). Bring your own laptop unless you want to follow the lecture: alternative communication in the classroom. *ACM SIGGroup Conference on Supporting Group Work*, 140-143.
- Bergen, L., Grimes, T., & Potter, D. (2005). How attention partitions itself during simultaneous message presentations. *Human Communication Research, 31, 3*, 311 – 336.
- Carr, N., (2010). What the Internet is doing to our brains – the Shallows. Chapter 07: The Jugglers Brain, 132. W. W. Norton Publishing Company.
- Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education, 50(3)*, 906-914.
- Gay, G., Stefanone, M., Grace-Martin, M., & Hembrooke, H. (2001). The effects of wireless computing in collaborative learning environments. *International Journal of Human-Computer Interactions, 13*, 257–275.

- Hembrooke, H., & Gay, G. (2003). The laptop and the lecture: the effects of multitasking in learning environments. *Journal of Computing in Higher Education*. Vol. 15 (1), 46 - 64.
- Jackson, M. (2008). *Distracted: the erosion of attention and the coming dark age*. (Amherst, NY: Prometheus, 2008), 79.
- Kraushaar, J.M., & Novak, D.C. (2010). Examining the effects of student multitasking with laptops during lecture. *Journal of Information Systems Education*, 21(2), 241-252.
- Lauricella, S., Kay, R. (2010). Assessing laptop use in higher education classrooms: the laptop effectiveness scale (LES). *Australasian Journal of Educational Technology*. 2010, 26(2), 151-163.
- Mangan, K. (2001). Business schools, fed up with internet use during classes, force students to log off. *Chronicle of Higher Education*, A43.
- Poldrack, R., Foerde, K., & Knowlton, B., (2006). Modulation of competing memory systems by distraction. *Proceedings of the National Academy of Sciences*, 103, 31.