

## **Exploring the Benefits and Challenges of Using Laptop Computers in Higher Education Classrooms: A Formative Analysis**

### **Exploration des avantages et des défis relatifs à l'utilisation des ordinateurs portables dans les salles de cours en éducation supérieure : une analyse formative**

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#### **Abstract**

Because of decreased prices, increased convenience, and wireless access, an increasing number of college and university students are using laptop computers in their classrooms. This recent trend has forced instructors to address the educational consequences of using these mobile devices. The purpose of the current study was to analyze and assess beneficial and challenging laptop behaviours in higher education classrooms. Both quantitative and qualitative data were collected from 177 undergraduate university students (89 males, 88 females). Key benefits observed include note-taking activities, in-class laptop-based academic tasks, collaboration, increased focus, improved organization and efficiency, and addressing special needs. Key challenges noted include other student's distracting laptop behaviours, instant messaging, surfing the web, playing games, watching movies, and decreased focus. Nearly three-quarters of the students claimed that laptops were useful in supporting their academic experience. Twice as many benefits were reported compared to challenges. It is speculated that the integration of meaningful laptop activities is a critical determinant of benefits and challenges experienced in higher education classrooms.

#### **Résumé**

De plus en plus d'étudiants collégiaux et universitaires utilisent un ordinateur portable dans la salle de cours à cause des prix qui ont baissé, de la commodité accrue et de l'accès sans fil. Cette tendance récente a forcé les instructeurs à considérer les conséquences éducatives de l'utilisation de ces appareils portatifs. L'objet de la présente étude était d'analyser et d'évaluer les avantages et les défis liés aux comportements relatifs aux ordinateurs portables dans les salles de cours d'établissements d'enseignement postsecondaire. Des données quantitatives et qualitatives ont été obtenues de 177 étudiants universitaires de premier cycle (89 hommes, 88 femmes). Les principaux avantages observés comprennent les activités de prise de notes, les tâches scolaires

utilisant les portables en classe, la collaboration, une concentration accrue, l'amélioration de l'organisation et de l'efficacité et le traitement des besoins particuliers. Les principaux défis observés comprennent les comportements distrayants des autres étudiants avec leurs portables, la messagerie instantanée, la navigation sur le Web, les jeux, le visionnement de films et une baisse de l'attention. Près des trois quarts des étudiants ont affirmé que les ordinateurs portables étaient utiles pour appuyer leur expérience scolaire. Ils ont rapporté deux fois plus d'avantages que d'inconvénients. Il est conjecturé que l'intégration d'activités significatives sur les portables est un critère déterminant des avantages et des défis qui existent dans les salles de cours d'établissements d'enseignement postsecondaire.

## Introduction

The use of laptops in higher education classrooms appears to be increasing rapidly for at least four reasons. First, today's students have been raised on a steady diet of computers and technology – they are digital natives who expect to use computers on a regular basis for a wide range of educational tasks (Tapscott, 2008). Second, these students demand use of computer technology anytime, anywhere, making a mobile computer an obvious and seemingly necessary choice (Montgomery, 2009; Palfrey & Gasser, 2008; Tapscott). Third, the price of mobile technology appears to have reached a tipping point where almost any higher education student can afford to purchase a laptop or notebook computer (“Laptop,” n.d., Wilen-Daugenti, 2008). In 2009, over 87% of all higher education students owned a laptop computer (Smith, Salaway, & Caruso, 2009). Finally, since many universities offer ubiquitous access to the Internet, a laptop computer allows students to research, collaborate, and collect information almost anywhere within the university environment including the classroom (McCrea, 2010).

This relatively sudden rise in laptop ownership and use has created tension in a number of higher education classrooms. On the one hand, anecdotal reports from the popular media suggest that some professors are frustrated with students who do not pay attention in class and use laptops for non-academic reasons (Kladko, 2005; McWilliams, 2005; Schwartz, 2003; Szaniszló, 2006; Young, 2006). On the other hand, several theorists suggest that laptops can be used effectively in the classroom provided that the traditional lecture-based format is replaced with a more active approach to teaching (Barak, Lipson, & Lerman, 2006; Gay, Stefanone, Grace-Martin, & Hembrooke, 2001).

Because the use of laptops in higher education classrooms is a recent phenomenon, neither instructors nor students appear to understand what is appropriate with respect to laptop behaviour in the classroom (Lindorth & Bergquist, 2010). It is therefore inevitable that both beneficial and challenging behaviours will emerge in this relatively uncertain and ill-defined classroom laptop culture.

### ***Benefits of Using Laptops in Class***

Research on beneficial laptop behaviours in the classroom can be organized into five areas: note-taking, academic activities, access to resources, academic success, and communication. Several research studies reported that a majority of students thought that laptops were effective for *note-taking* (Arend, 2004; Lindorth & Bergquist, 2010; Skolnik & Puzo, 2008). A second benefit involved using laptops for *academic activities* and included searching for supplemental resources (Lindorth & Bergquist) and working with subject-specific software programs (Barak et al., 2006;

Skolnik & Puzo). A third benefit noted by Lindorth & Bergquist was student access to *academic-based resources* during class – students could look up information that would supplement or contribute to classroom learning. In addition, a number of studies reported that students believed laptops helped improve learning or *academic success* (Barak et al.; Mackinnon & Vibert, 2002; Weaver & Nilson, 2005; Skolnik & Puzo). Finally, regarding *communication*, several benefits have been observed including better student-faculty interaction, improved peer collaboration, and instant messaging to peers about concepts covered in class (Kolar, Sabatini, & Fink, 2002; Lindorth & Bergquist; Mackinnon & Vibert; Nicol & MacLeod, 2005; Weaver & Nilson, 2005).

### **Challenges of Using Laptops in Class**

Research on challenging laptop behaviour can be classified into three main areas: other students, communication, and entertainment. One of the biggest challenges noted was the distracting laptop behaviour of *other students* in the class (Barak et al., 2006; Fried, 2008). *Communication-based challenges* were also problematic and involved instant messaging among peers for non-academic reasons and sending personal emails (Barak et al.; Fried; Hembrooke & Gay, 2003; Mackinnon & Vibert, 2002; Skolnik & Puzo, 2008). Finally, *entertainment-related challenges* included playing games, watching movies, listening to music, and surfing the web during class (Barak et al.; Fried; Grace-Martin & Gay, 2001; Hembrooke & Gay; Skolnik & Puzo).

### **Justification for Current Study**

To date, a patchwork of isolated research findings has provided a mixed and somewhat unclear picture of laptop use in higher education classrooms. Research efforts focus on either benefits (e.g., Arend, 2004; Skolnik & Puzo, 2008) or challenges (Barak et al., 2006; Fried, 2008; Grace-Martin & Gay, 2001; Hembrooke & Gay, 2003) but not both. Only one study could be found examining both benefits and challenges in detail; however, the sample size was limited to 16 students (Lindorth & Bergquist, 2010). It is critical to look at a broad set of positive and negative laptop behaviours simultaneously to make comparisons and conduct a more comprehensive analysis. The purpose of the following study was to investigate and compare beneficial and challenging laptop behaviours in higher education classrooms.

## **Method**

### **Context**

This study took place at a laptop-based university of approximately 6500 students located in a large metropolitan area of over six million people. At this university, all students lease a high-end laptop computer with the latest program-specific software. Wireless access to the web is available throughout the campus including classrooms. All faculty members are issued laptop computers and encouraged to use technology in their classrooms.

### **Sample**

The sample consisted of 177 higher education students (89 males, 88 females), in their first (n=74), second (n=59), third (n=30), or fourth (n=13) year of undergraduate study. Seventy-five percent (n=132) of the students were born in Canada and 86% (n=153) reported that English was their first language. Students were enrolled in social science (n=108), business (n=43), engineering (n=11), science (n=12), or health science (n=3). The average grade of first year students before they entered the institution was 78.9% ( $SD = 6.3$ , range 65 to 90). The average

grade at university for second to fourth year students was 74.6% ( $SD = 7.8$ , range 59 to 90). Nearly 85% ( $n=149$ ) of all students reported that they were either proficient ( $n=94$ ) or very proficient ( $n=55$ ) at using computers.

### **Laptop Use**

In the majority of previous laptop-based studies, a lecture format was the dominant teaching strategy (e.g., Demb, Erickson, & Hawkins-Wilding, 2004; Fried, 2008; Grace-Martin & Gay, 2001; Hembrooke & Gay, 2003; Lindorth & Bergquist, 2010; Wurst, Smarkola, & Gaffney, 2008). While the main method of content delivery in the current study was also a traditional lecture using a PowerPoint presentation, a concerted attempt was made to integrate laptops meaningfully into the curriculum.

Sample in-class laptop-based activities included online surveys (e.g., assessing gender roles, outlook on family issues), web-based research on assigned topics (e.g., social factors in historical perspective), interactive case studies to improve communication skills, creation of family genograms using online charting software, viewing online videos, reviewing published articles, consultation and discussion of websites (e.g., hate speech) and online philosophy games (e.g., philosophersnet.com). In addition, all class activities, notes, and PowerPoint presentations were posted on a Learning Management System (LMS).

### **Procedure**

At the conclusion of the final class meeting, students were invited to participate in an anonymous, online survey. Participation was voluntary and participants could withdraw from the study at any time. The instructor was unable to determine who chose to participate and data were not accessed until all marks for the courses were submitted. It took approximately 10-15 minutes for students to complete the survey. The total number of students in both courses was 521, resulting in an approximate coverage rate of 34%. Note that a 34% coverage rate is typical for social science survey research (Shih & Fan, 2009).

### **Data Sources**

**Descriptive data.** All students were asked their age, gender, year of study, and average grade. They were also asked how much time they spent in total on non-academic activities during class and whether, overall, they thought that laptops helped them academically (see Lauricella & Kay, 2009a for the specific questions).

**Laptop use survey.** In-class laptop behaviour was assessed using the Laptop Use Scale. This metric collected information on four benefits based on a review of current research: taking notes; academic activities; academic success; and communication (collaboration and instant messaging) (Table 1). It also collected information on three key challenge areas: other students; communication (non-academic email and instant messaging); and entertainment (internet activities, playing games, watching movies, viewing pornography) (Table 2). See Lauricella and Kay (2010) for a detailed review of the Laptop Use Survey.

**Student open-ended comments.** Students were asked two open-ended questions about (a) how laptops were *helpful* during class time ( $n=240$  comments) and (b) how laptops were *not helpful* during class time ( $n=119$  comments). All question responses were categorized based on the survey data and evaluated independently by two raters. Categories used to assess comments are

presented in Tables 3 and 6. The coding system is available at Lauricella and Kay (2009b). The rating scale used to assess comments ranged from -2 to +2 (-2 - very negative, -1 – negative, 0 - neutral, 1 - positive, 2 - very positive). Items whose categories and/or ratings were not exactly the same were shared and reviewed a second time by each rater. Using this approach, inter-rater reliability estimates ranged from 96% to 98% for categories of benefits and challenges and 99% to 100% for numerical ratings of the positive or negative impact of laptop behaviours.

Some categories of open ended comments such as *efficiency* and *special needs* showed high mean scores but were not reported often. Other categories such as *focusing in class* and *access to resources* showed lower mean scores but were experienced by students relatively frequently. To address the impact of both mean score and frequency, the "total" impact of the category was calculated by multiplying the mean rating by the number of comments made. For example, in Table 2, the impact of *taking notes* was calculated as 93 or a mean rating of 1.21 times 77 comments.

## Results

### ***Overall Laptop Behaviours and Attitudes***

The average daily use of laptop computers reported by students inside and outside of class was 8.8 hours ( $SD = 4.4$ , range 2 to 16). Sixty-percent of the students ( $n=107$ ) reported being logged on to instant messaging most or all of the time. Seventy-two percent of the students ( $n=120$ ) noted that laptops were helpful or very helpful in supporting their academics in class.

### ***Benefits***

***Survey data.*** Students reported that note-taking was the most prevalent and important laptop activity they participated in during class. Almost two-thirds of the students agreed that this activity consumed 50 to 100% of their time. A majority of students (57%) also noted that academic-based laptop activities were conducted over 50% of the time during a standard class. Furthermore, over 70% of the students agreed that laptops were important with respect to their overall academic success. With respect to communication, almost 80% of the students felt that the laptop was important or very important for collaboration or group work. Students also reported using instant messaging for academic endeavours about one third of the time during a usual class. A summary of in-class benefits is presented in Table 1.

**Table 1: In-Class Benefits of Using Laptops in the Classroom (Survey Data)**

Variable	Possible Range	Mean (SD)	Impact
Taking Notes	0 to 8	5.8 (2.1)	65% <sup>1</sup>
Academic Activities	0 to 8	5.5 (2.1)	57% <sup>1</sup>
Academic Success	1 to 5	3.9 (1.0)	72% <sup>2</sup>
Communication			
Important for Collaboration	1 to 5	4.4 (0.8)	78% <sup>3</sup>
Makes Collaboration Easier	1 to 5	4.6 (0.7)	93% <sup>4</sup>
Instant Messaging for Academics	0 to 10	3.4 (2.7)	34% <sup>5</sup>

<sup>1</sup> - % students who said this activity consumed 50 to 100% of a typical lecture

<sup>2</sup> - % students who said laptop was important or very important for supporting their academics

<sup>3</sup> - % students who said laptop was important or very important for supporting collaboration in assignments

<sup>4</sup> - % students who said laptop made collaboration in assignments easier

<sup>5</sup> - % of student who used instant messaging for academic purposes in class

**Open-ended questions.** Students offered twice as many comments about the benefits of laptops versus the challenges experienced. Comments made were consistent with the four categories reported in the online survey. *Note-taking* was reported as the largest benefit of using a laptop in class. Students also reported that laptops provided support for *academic activities* such as being able to access resources, following lecture notes, and participating in computer tasks during class. In addition, students noted that laptops contributed to their *academic success* by helping them to focus better in class, organize themselves, and improve their overall academic efficiency. With respect to *communication*, some students mentioned that laptops helped them share information and notes with their peers. For a smaller subset of students, learning new technology, addressing special needs (e.g., attention deficit or English as a second language), and having access to administrative course information were viewed as beneficial. Table 2 offers a summary of the in-class benefits. Table 3 provides concrete examples of the kind of benefits students experienced.

**Table 2: In-Class Benefits of Using Laptops – Summary of Open-Ended Question (n=240)**

<b>Category</b>	<b>Mean</b>	<b>S.D</b>	<b>n</b>	<b>Total Impact (Mean * n)</b>
Taking Notes	1.21	(0.52)	77	93
Academic Activities				
Access to Resources	1.09	(0.30)	32	35
Following Lecture Notes	1.07	(0.26)	28	30
Activities	1.08	(0.28)	13	14
Academic Success				
Focussing in Class	1.06	(0.23)	35	37
Organization	1.06	(0.23)	18	19
Efficiency	1.25	(0.45)	12	15
Communication				
With Peers	0.91	(0.70)	11	10
Sharing Notes	1.00	(0.00)	5	5
Other Benefits				
Learning Technology	1.00	(0.00)	4	4
Special Needs	1.33	(0.58)	3	4
Administration	1.50	(0.71)	2	3

**Table 3: In-Class Benefits of Using Laptops – Sample Comments (n=119)**

Category	Sample Comments
Taking Notes	“[Using] laptops is much easier and quicker for me to take notes.” “Easier to take notes than writing.”
Academic Activities	
Access to Resources	“I am able to make notes directly on the lecture slides” “I can look at other academic resources online while taking notes on the lecture; if some event I know little about is referenced, for example, I can look it up on Wikipedia.”
Following Lecture Notes	“It is easier to follow the lectures when the professor posts the lecture notes/slides online. More time can be spent adding our own notes to the lecture, and listening to the professor than trying to copy all the professor's notes down on paper.”
Activities	“It is helpful because you need it because all of the work is on WebCT, so if there is an in-class quiz, or a survey being done, you'll miss your chance without it.”
Academic Success	
Focussing in Class	“I think that the laptop is helpful in class because it allows students to follow along with the lecture.” “It allows students to follow along with the lecture slides.”
Organization	“I find the laptop helpful to keep all of my notes organized.”
Efficiency	“I am more likely to take notes with the laptop than I am by hand and I can easily view it anywhere I may be. In addition, it saves me carrying around several binders of notes, saving paper and my back.”
Communication	
With Peers	“I am able to communicate with my group members” “I am able to ask questions to my classmates using instant messaging.”
Sharing Notes	“Helps you get notes you missed - File Sharing and such...”
Other Benefits	
Learning Technology	“It helped me to understand how to use a computer better and allowed better typing skills.”
Special Needs	“I have 'ADD' and I would be beside myself with the length of these courses if not for the laptops. I can distract myself, or multi-task to other things while listening to the lecture. And so I tend to catch more of the classes than I would otherwise.”
Administration	“You can check any grades you have from any courses you are taking.”



## Challenges

**Survey data.** Almost one half of all students reported that they were sometimes or frequently distracted by *other students' use of laptops* in the classroom. With respect to *communication*, one quarter of all students reported they spent over 50% of class time sending personal instant messages to friends. In addition, 10% of students spent over 50% of class time emailing their friends for personal reasons. In terms of entertainment, 43% percent of students agreed or strongly agreed that they would perform better during a lecture without the Internet distracting them. Sixteen percent of students claimed that pornography on another student's computer was distracting or very distracting. Finally, the vast majority of students did not play games or watch movies during a standard class. A summary of in-class challenges is presented in Table 4.

**Table 4: In-Class Challenges to Using Laptops in the Classroom – Survey Data (n=257)**

Variable	Possible Range	Mean (SD)	Impact
Other Students on Laptops	1 to 4	2.5 (0.8)	50% <sup>4</sup>
Communication			
IM – Non Academic	0 to 8	3.8 (2.4)	26% <sup>1</sup>
Email – Non Academic	0 to 8	2.8 (1.9)	11% <sup>1</sup>
Entertainment			
Internet Distraction	1 to 5	3.2 (1.1)	43% <sup>2</sup>
Pornography Distraction	1 to 4	2.5 (1.1)	16% <sup>3</sup>
Playing Games	0 to 8	0.9 (1.4)	1% <sup>1</sup>
Watching Movies	0 to 8	0.3 (1.0)	1% <sup>1</sup>

<sup>1</sup> - % students who said this activity consumed 50 to 100% of a typical lecture

<sup>2</sup> - % students who agreed or strongly agreed that they would perform better without the Internet distracting them

<sup>3</sup> - % students who said pornography on other student computers was distracting or very distracting

<sup>4</sup> - % students who said they were sometimes or frequently distracted by other student's use of laptops in the classroom

**Open-ended questions.** Overall student comments about challenging behaviours were reported far less than benefits by a factor of almost 1:2. The majority of comments were consistent with the three main categories of survey results reported. *Other students' laptop use* was reported as being the largest distraction. *Communication*-based challenges involved instant messaging for personal reasons. *Entertainment*-based distractions included playing games, watching movies, and surfing the web. Finally, a subset of miscellaneous challenges included an inability to focus, the high-cost of laptops, a preference to take notes by hand, serious technological problems, and not having enough discipline to avoid the distractions that a laptop has to offer. Table 5 offers a summary of the in-class challenges gleaned from the open-ended question format. Table 6 presents concrete examples of challenges experienced by students.

**Table 5: In-Class Challenges to Using Laptops – Summary of Open-Ended Question (n=119)**

Category	Mean	S.D	n	Total Impact (Mean * n)
Other Students on Laptops	-1.27	(0.45)	26	-33
Communication				
Instant Messaging	-1.25	(0.61)	24	-30
Entertainment				
Games	-1.19	(0.60)	21	-25
Movies	-1.09	(0.54)	11	-12
Internet/Web	-1.25	(0.71)	8	-10
Other Challenges				
Focus	-1.50	(0.54)	8	-12
Money	-1.60	(0.55)	5	-8
Take Notes	-1.40	(0.55)	5	-7
Technology Problems	-1.25	(0.50)	4	-5
Self-Discipline	-0.40	(1.34)	5	-2
Class Dependent	0.00	(0.00)	2	0

**Table 6: Sample Comments About In-Class Challenges to Using Laptops**

<b>Category</b>	<b>Sample Comments</b>
Other Students	“A lot of people use it for other reasons instead of class work, which can be distracting.”
Communication	
Instant Messaging	“Instant messaging is distracting.” “It is distracting, I'm always on MSN and checking all my sites.”
Entertainment	
Games	“I am personally annoyed when I see people playing games in class. Especially when they ask stupid questions that were addressed in class, that they were too distracted to listen to.” “At times, laptop use is not helpful. I've had classmates say that they'll just play a computer game before class and end up playing all through class.”
Movies	“I do find it kind of distracting when others are watching movies.”
Internet/Web	“If the lecture gets boring and students are not involved, they will just surf the web.”
Other Challenges	
Focus	“When lecture slides are posted online there is sometimes no need to pay attention.” “Laptops is not helpful in class because if everyone close their laptops all in class will listen to professor instead of putting their concentration on laptop.”
Money	“I think Laptops are just a money grab for the school - They are expensive - and why can't you buy your own.”
Take Notes	“I believe in handwriting my notes into a text book. It is much easier for me to learn that way. I truly can say that I hate having to have a laptop.”
Tech Problems	“I have had serious computer issues this term, so the laptop is not helpful to me when it is not working!”
Self-Discipline	“[Having a laptop in class] requires a lot of discipline and maturity, that not a lot of students have.”
Class Dependent	“Some classes such as my Drawing class does not always require the use of a laptop.”

## Discussion

The purpose of this study was to explore beneficial and challenging laptop behaviours in higher education undergraduate classrooms. Both quantitative data and qualitative data were collected to obtain a comprehensive description of the advantages and distractions that students experienced as a result of using a laptop.

### *Benefits*

Four key areas of benefits were predicted by current research on the use of laptops in higher education and included taking notes, academic activities, academic success, and communication. Both survey and open-ended data indicated that note-taking was a prevalent activity among students. This result was consistent with previous research studies (Arend, 2004; Lindorth & Bergquist, 2010; Skolnik & Puzo, 2008); however, comments from students in the current study suggest that note-taking incorporates a broader range of related activities including following and modifying instructor lecture notes and sharing notes with peers. Because the primary method of content delivery in this study was a traditional lecture using PowerPoint, it should not be surprising that note-taking behaviour was frequent.

In-class academic-based activities were reported almost as frequently as note-taking behaviour, possibly reflecting attempts by the instructor to meaningfully integrate laptops into the class by using online surveys, web-based searches, interactive case-studies, online videos, and published articles on the web. It is conceivable that the balance between note-taking and in-class activities could fluctuate depending on the teaching strategies employed. In other words, the prevalence of any one laptop-based activity may be partially dependent on the context of the teaching environment, rather than on the presence of a laptop.

Communication, collaboration among peers, and, to a lesser extent, instant messaging, were acknowledged as important benefits by students in this study and in previous research (Barak et al., 2006; Kolar et al., 2002; Lindorth & Bergquist, 2010; Nicol & MacLeod, 2005). For the most part, communication-based activities were not a planned part of the class curriculum. Students naturally and frequently used communication tools during class. Unlike note-taking or specific academic-based tasks, communication is not necessarily dictated by the teaching strategies used. It could be argued that the presence of a laptop is essential to supporting and perhaps enhancing academic-based communication among students, regardless of the teaching context.

Almost three quarters of the students in this study rated laptops as helpful or very helpful in supporting their academic pursuits in class, a result that is consistent with previous research (Barak et al., 2006; Mackinnon & Vibert, 2002; Skolnik & Puzo, 2008; Weaver & Nilson, 2005). Open-ended responses revealed several key ways in which academic success was supported, including helping students to focus, improving self-organization, and increasing efficiency in completing certain tasks. More detailed research is needed, however, to further explore how laptops contribute specifically to academic success.

The open-ended responses from students identified a set of previously unreported benefits to using laptops in the classroom, including learning new technology, helping students with special needs, and attending to administrative needs. These behaviours were not reported by a majority of students but may be particularly significant for a smaller sub-population. Future qualitative

research in the form of focus groups or interviews might be helpful in fleshing out more nuanced benefits associated with using laptops.

In summary, note-taking, in-class academic tasks, academic success, and communication were key benefits of using laptops in higher education classrooms. Whereas previous research looked at isolated examples of specific benefits experienced while using laptops, the current study provides evidence that multiple benefits are realized by students. It is important to recognize that the prevalence of any one benefit could be directly influenced by the kind of teaching strategies used.

### ***Challenges***

Results from the survey data and open ended responses suggest that students experienced many of the same challenges observed in previous research (Barak et al., 2006; Fried, 2008; Hembrooke & Gay, 2003; Skolnik & Puzo, 2008). Other students' use of laptops was reported as the number one distraction. Communication used for personal reasons via instant messaging or email was also a significant problem. Finally, using laptops for entertainment (games, movies, surfing the web) shifted students' attention away from learning during class. Further research is needed to understand when students shift their attention from academic to non-academic endeavours. As stated earlier, teaching strategies may directly influence the extent to which students are distracted. Passive presentation of PowerPoint lectures might invite multi-tasking and distracting behaviours, whereas active use of laptops for specific academic tasks could increase engagement and academic focus.

Open-ended responses revealed a few challenges that have not been reported extensively in the literature, including a lack of focus, the prohibitive cost of laptops, technology problems, and having enough self-discipline to avoid non-academic activities. As noted previously, it would be advantageous to gather in-depth data from students to access the prevalence of idiosyncratic challenges.

### ***Benefits vs. Challenges***

One advantage of collecting data on both the benefits and challenges of using laptops in higher education classrooms is the opportunity to explore relative impact. In this study, both survey data and open ended responses suggest that the benefits of in-class laptop use outweigh the challenges. A majority of class time was spent on note-taking behaviours, academic laptop activities, and communicating with peers. In addition, students made twice as many comments about the benefits of laptops versus the challenges experienced. While certain challenges were prominent, such as distracting laptop behaviour of peers and instant messaging, almost three quarters of students claimed that laptops were helpful in supporting learning in class.

### ***Pedagogy and Laptop Use***

One critical question remains: "What factors determine whether laptops are beneficial or distracting to students?" Previous research is often diametric about the presentation of in-class laptop benefits or challenges. Most studies appear to focus on either benefits (e.g., Arend, 2004; Skolnik & Puzo, 2008) or challenges (Barak et al., 2006; Fried, 2008; Grace-Martin & Gay, 2001; Hembrooke & Gay, 2003) but not both.

The one clear exception found was a case study conducted by Lindorth and Bergquist (2010). They examined both the benefits and challenges experienced by 16 undergraduate students over a four year period. One of their main conclusions was that more effort had to be made by instructors to use active strategies for integrating laptop technology into the classroom. The results of the current study offer indirect support for this claim. While the principal method of content delivery was PowerPoint-based lectures, a concerted effort was made to integrate laptop-based activities meaningfully into the class resulting in a wide-range of positive learning behaviours. If instructors choose to maintain the status quo by offering lectures, students will likely get distracted and laptops could become a significant challenge and detriment to learning.

### ***Caveats and Future Research***

The purpose of this study was to explore beneficial and challenging laptop behaviours in higher education classrooms. Several procedures were followed to ensure the quality of data including collecting information from a relatively large sample, using a research-based survey (Lauricella & Kay, 2010), and offering inter-rater reliability estimates for assessing qualitative responses. Nonetheless, at least six caveats need to be addressed in order to guide and improve future research on the use of laptops in higher education.

First, the data collected were based on student recollection and self-report about how they used laptops in class over an entire semester. The wording of survey items asked for broad estimates of participation in specific laptop behaviours during class. This approach may have been sufficient to obtain a general overview of student laptop use, however, alternative data collection techniques may be needed to improve the accuracy of reported laptop use. Obtaining this kind of information is challenging because of privacy issues – it is unlikely that students would permit researchers to monitor their computer use electronically. One suggestion would be to use the Experience Sampling Method (Csikszentmihalyi, 1990) where students would be sent random electronic requests during a class asking them what they are doing with their laptops at that moment.

Second, the study took place in a laptop-based university where technology was intended to be used on a regular basis by teachers and students. While it is highly probable that many students and faculty in North American colleges and universities use laptop computers, a culture of laptop use in the classroom may not be present. Therefore, it is important to repeat this kind of study in higher education settings where laptop use is optional.

Third, although efforts were made by faculty to meaningfully integrate laptops into learning, note-taking was a frequent activity leading to the conclusion that content delivery through the use of PowerPoint presentations was prominent. One suggestion for future research is to compare structured (active integration) with unstructured (lecture) use of laptops regarding the benefits and challenges experienced by students. In addition, it would be useful to explore which specific laptop-based strategies are more beneficial than others.

Fourth, this study did not look at the impact of laptop behaviours on learning performance. Ultimately, we would like to know the consequences of specific learning benefits and challenges. A useful next step would be to profile student laptop behaviour and link this profile to summative assessment of concepts taught in class.

Fifth, the range of laptop behaviours observed is partially dependent on the “latest” technological trends and the subject area taught. The scale used could be expanded to assess a wider range of in-class beneficial (e.g., databases, spreadsheets, learning objects, surveys) and challenging (e.g., Facebook, social messaging, Twitter) behaviours.

Finally, the impact of the subject area taught and the use of laptops needs to be explored. Preliminary evidence indicates that effective use of laptops is generally associated with courses that are traditionally linked to technology, including business (Mackinnon & Vibert, 2002), programming (Barak et al., 2006) and engineering (Kolar et al., 2002; Nicol & MacLeod, 2005). On the other hand, social science courses in psychology (Fried, 2008) and communications (Grace-Martin & Gay, 2001) have shown limited success or negative results. It is possible that it is more challenging to integrate laptops effectively into courses where technology does not have an obvious application.

### ***Conclusion***

Previous research provided limited documentation of both beneficial and challenging laptop behaviours in higher education classrooms making it difficult to draw comparisons. The current study provided a comprehensive analysis of positive and negative laptop behaviours using both survey and qualitative data. Beneficial behaviours observed included note-taking activities, in-class laptop-based academic tasks, collaboration, increased focus, improved organization and efficiency, and addressing special needs. Challenges included other students' distracting laptop behaviours, instant messaging, surfing the web, playing games, watching movies, and decreased focus. Almost three quarters of the students claimed that laptops were useful in supporting the in-class academic experience. Beneficial behaviours were reported more often than challenging behaviours by a factor of 2:1. It is postulated that actively integrating meaningful laptop activities into the classroom will increase the frequency of beneficial laptop behaviours.

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