

# Mobile Learning in Computer Science Lectures

Wafaa Alsaggaf, Margaret Hamilton, and James Harland

**Abstract**—An interactive learning environment using mobile devices could help deliver knowledge in an effective manner but there are also some significant challenges in implementing this form of learning. In this research, we surveyed 175 students enrolled in three different computer science subjects to gather their perceptions about the use of mobile devices in lectures. The students' feedback was then subjected to a qualitative analysis. Unlike previous studies that focus only on the strengths and weaknesses, this study also focuses on the threats that hinder good mobile learning opportunities resulting from this intervention. The results indicate that mobile device usage in lectures can improve students' learning experiences, once technological and pedagogical issues have been successfully addressed. Here, the technological aspects included various factors like connectivity; infrastructure and technical support while pedagogical issues included factors like designing the course materials to suit the blended learning mode and the possibilities of active and collaborative learning. Some recommendations are outlined to capitalize on the advantages and mitigate the disadvantages provided by the use of mobile devices in lectures. This research makes a contribution to knowledge that can help both educational institutes and researchers in the area of computer-aided education.

**Index Terms**—Lectures, learning computing, mobile devices, qualitative analysis.

## I. INTRODUCTION

The meteoric rise of mobile device ownership has put higher education institutions in a dilemma about how to adopt these technologies to cater to the expectations of this generation of students for whom mobile devices are an integral part of life. A leading researcher in mobile learning, Traxler defined m-learning as learning involving the use of mobile device [1]. The field of mobile learning is beginning to attract the attention of researchers and educators [2]. However, a lot of work still needs to be done to clarify the connection between classroom technology and student learning [3]. Furthermore, there are only a few studies that have considered the use of mobile learning in the context of computer science education [4]. Therefore, this study aims to investigate the perceptions of computer science students regarding the use of mobile devices, particularly during lectures. It will consider issues impacting the utilization of mobile devices in educational institutions that do not implement any form of mobile learning and offer some recommendations to promote effective use of mobile devices as a learning tool in traditional lectures.

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## II. LITERATURE REVIEW

There is a diversity of opinion over the use of laptops or other portable ICT equipment in learning situations. It has been argued that the use of laptops during lectures improves students' grasp and comprehension of the subject by providing flexible interaction [5], [6]. Barak *et al.* [7] found that students were very positive toward the use of laptops during lectures, as wireless-enabled laptops gave a "student-centred, hands-on, and exploratory learning, as well as meaningful student-to-student and student-to-instructor interactions" (ibid.p.245). But scholars also find that the use of laptops adds complexity to the learning process and those students who use laptops absorb less from lessons given by their instructors [8]-[10]. Indeed, most researchers agree that laptops can distract students during lectures, as they can access non-academic material and their attention can wander from the topic at hand [11], [8], [12]. While Barak *et al.* [7] found positive aspects of laptop usage during lectures they acknowledged that some 15% of students were distracted. There is also possibility of cheating as answers can be swiftly circulated between students by email etc. [13].

Considerable research has focused on either the benefits or the challenges of laptop use in higher education classrooms but very few have considered both these aspects together [14]. This research attempts to present a holistic analysis of laptop-based mobile learning by investigating its strengths, weaknesses, opportunities and threats from a qualitative study of students' perceptions.

## III. RESEARCH METHODOLOGY

This study used both qualitative and quantitative approaches to data collection. This paper however, focuses on the qualitative data collected about the students' perceptions of the use of laptops in lectures. A survey was designed to collect students' views on four aspects of using laptops as learning tools in lectures, namely, advantages, disadvantages, opportunities and challenges. The survey was distributed on paper during lectures to three cohorts of postgraduate and undergraduate students enrolled in the three courses Software Engineering, Software Engineering Process and Tools and Web Programming at an Australian University, which did not use mobile devices as a learning tool. These three courses are core to the computer science curriculum, and so students enrolled in these courses may be considered as typical representatives of the student body of computer science students.

### A. Data Collection and Sample

A total of 370 questionnaires were distributed, of which 175 were returned. The first part of the questionnaire asked

some questions about the demographic profile of the students relating to their study load, gender, age, program and ownership of laptop. Male participants outnumbered female participants, 86 to 14%, whilst attendance, records that of all respondents, 91% were full-time students. The majority of students, i.e. 75% of the respondents were under 25 years of age and 70% were enrolled in an undergraduate course. Data shows that the majority of the students (85%) owned a laptop.

#### IV. SWOT ANALYSIS

SWOT is the acronym of (Strengths, Weaknesses, Opportunities, and Threats); it has long been acknowledged in many industries and educational fields as a useful analytical tool for building strategies [15]. All open-ended question responses were categorized on the basis of the four categories and the survey data was analyzed to extract themes for each category. Then, the themes were subjected to SWOT analysis. First, the responses of the four categories will be described; then, relevant themes for each category are identified.

##### A. Advantages

Students cited many advantages of using laptops during lectures. About 28% of students explained that the main advantage of using laptops during lectures was the ability to access PowerPoint presentations and other visual material as they were being delivered in the lecture. Elaborating this point further, another 5% mentioned that they could not read charts and other visual material from their position in the lecture hall and it was necessary to view this material to understand the point being made. Further, 18% of respondents said that laptops enabled them to access references and supporting material online, while 19% said that laptops made it easy for them to take notes during the lecture. About 10% of the students said that laptops enabled them to access the course material during breaks. Overall, students noted the benefit of receiving on-time information, real-time feedback for their questions, and results of in-lecture testing.

##### B. Disadvantages

Distraction emerged as the most significant disadvantage of laptop use as it was cited by 57% of the students. In addition, 16% of the respondents elaborated that they were distracted by games, music and movies on their laptops especially during self-study periods. While there was possibility of being distracted by such activities during lectures the students said that they would observe more restraint in the environment of the lecture hall. It was especially during self-study periods that they were diverted to non-academic activities on their laptops. A further 17% of the respondents mentioned that while the use of laptops during a lecture may not distract the student who is using it, but there was a possibility that other students could be distracted by the constant typing sounds or flashing of the screen on laptops of the neighboring students.

##### C. Opportunities

Affordability and simplicity of course materials were highlighted as important issues in the opportunities section of the questionnaire. Keyboard and program familiarity were also emphasized as a vital concern. Students said that they feel more comfortable with using their own laptop, and were able to organize their work more efficiently with individualized programs, operating systems, hardware and software. Moreover, others mentioned that they had data stored in a number of places, and with a laptop, they could consolidate university and personal data. Interestingly, 16% of the students mentioned that using laptops was a more environment-friendly method that could help save paper used in making lecture notes. Accessing books, lecture notes, tutorials and other materials electronically instead of purchasing hard copies could also save them money.

##### D. Challenges

Students pointed out battery life on their laptops as the main challenge facing laptop use during classes. For those who did not have wireless for their laptops, there was significant concern about network speed and availability of cable access points. Further, students expressed concern that the physical strain caused by using laptops in tightly packed halls with long lectures was far greater than using a PC on an ordinary table for that period of time. This also raises the challenge for disabled people attending university who may not be able to access and use a laptop. Students were also concerned about the incompatibility of different operating systems, protocols and platforms, and safety and security of the network. Their software may be incompatible with the systems that the university supports or the university software may be available only on an expensive license.

##### E. The Extracted Themes

After listing the main responses within the four categories of questions in the survey, Table I will present the themes extracted from the data in detail. In Table I, all the themes are subjected to SWOT analysis and listed under the headings of "Internal Strengths", "Internal Weaknesses", "External Opportunities" and "External Threats".

#### V. TOWS ANALYSIS

TOWS/SWOT analyses uses a cross-functional matrix comparing the data to develop appropriate strategies [16], [17]. SWOT analysis lists the content of the four dimensions Strengths, Weaknesses, Opportunities, and Threats. Then, TOWS analysis was conducted to perform across-matrix match considering the following combinations, Strengths/Opportunities (SO), Strengths and Threats (ST), Weaknesses and Opportunities (WO) and Weaknesses and Threats (WT). TOWS analysis is an effective way of combining a) internal strengths with external opportunities and threats, and b) internal weaknesses with external opportunities and threats to develop a strategy. Table I discusses potential options based on TOWS analysis as follows.

A. *Strengths and Opportunities (SO)*

This combination seeks to determine how internal strengths of mobile learning can help capitalize on the external opportunities. Respondents noted that there were benefits in undertaking group work and sharing information as collaborative learning it helped students to gain greater understanding of the material under review. Furthermore, all the benefits relating to learning enhancement such as

easier access, follow-up of media presentations and the ability to search for information with the use of opportunities such as wireless and affordability assist in transforming the traditional lecture to an active learning environment. Moreover, accessing learning material and writing lecture notes on these portable devices is more environment-friendly as it helped save papers.

TABLE I: TOWS ANALYSIS OF THE USE OF LAPTOPS IN LECTURES

		External Opportunities	External Threats
		1. affordability	1. insufficient power points
		2. simplifies course materials	2. network speed and number of access points
		3. eliminates wastage and PC availability	3. lecture tables inadequate for typing
		4. environmental friendly	4. incompatibility
		5. desktop familiarity	5. security of the network
		6. wireless	6. free software licenses
		7. social	7. all students have to have one
			8. training students and teachers
			9. handicapped students
Internal Strengths	SO-Options	ST - Options	
1. access non university's programs	A. transforming traditional lecture to active learning environment (S2S5S6S8S10O1O2O6)	A.	provide online training sessions for users (S9T8).
2. searching course information	B. providing collaboration environment (SS6O7)	B.	publicise software available for downloading (S1S9S10T4)
3. following up lecture presentations	C. saving environment (S7O4O6).		
4. use breaks time			
5. assists in group work			
6. sharing information			
7. portability/mobility			
8. instant feedback on queries and results			
9. access internet			
10. run codes on remote servers for programming students			
11. note taking			
Internal Weaknesses	WO-Options	WT - Options	
1. distractions: entertainment (e.g. playing games, watching movie)	A. reduce the time that students may waste by getting the advantage of their familiarity with their laptops (W3W6O5)	A.	issues of distraction and damage to laptops to be addressed through security and training measures (W1W5W6T8)
2. distractions: other	B. laptop's affordability may minimise distracting other students in which all students have one and avoid heavy cases(W2W4O1)	B.	power outlets and wireless connectivity can be provided throughout logistic arrangement (W7T1T2)
3. time consuming (math)	C. organize interesting learning materials to minimise the distraction (W1O2)		
4. large heavy case			
5. theft, lose and breakage			
6. lose time fixing problems			
7. cables are a nuisance			

B. *Strengths and Threats (ST)*

The internal strengths identified in mobile learning can help avoid external threats. Incompatibility of software or hardware was cited as one of the main threats in using laptops in lectures. In this case, internet access can help provide training sessions for student and faculty members to further improve their laptop use. Universities may also list all possible programs or applications that work with different operating systems and students can download the appropriate programs.

C. *Weaknesses and Opportunities (WO)*

This theme determines how the internal weakness in mobile learning can be eliminated by using external opportunities. Opportunities can frequently overcome weaknesses. For example, desktop familiarity can be exploited to minimize the time students may take to fix some problems. Also, since laptops are affordable, all students could easily purchase laptops. Therefore, if all students have laptops, this may decrease the possibility of being distracted by other students. Moreover, affordability may also enable students to buy an appropriate case to carry their laptops as this was mentioned as being cumbersome

and problematic by a few students. Furthermore, simplifying and organizing the course material in an interesting way may reduce the distraction problem.

D. *Weaknesses and Threats (WT)*

Reducing weaknesses and avoiding threats can be achieved through the options outlined in this section. Training can be conducted to improve communication and computer skills and provide resources for appropriate pedagogic use of laptops in lectures. Moreover, availability of wireless connectivity and power supply outlets should also be addressed.

VI. DISCUSSION

The purpose of this study was to conduct a comprehensive analysis of student responses to the use of laptops during lectures and explore their perceptions with regard to the four dimensions of advantages, disadvantages, opportunities and threats. Then, the study sought to further extrapolate the responses to derive recommendations for higher education institutions to help better integrate laptops in the learning environment. Respondents indicated many

strengths and opportunities of the use of laptops in higher education. Strengths included searching course information, following up lecture presentations, assistance in group-work, sharing information, portability, instant feedback on queries and results, note taking and internet access. These results are consistent with findings reported in previous studies [5], [6]. Furthermore, as this study focuses on Computer Science students, the significant benefit of this form of learning reported by them was the option of running program codes on remote servers and accessing non-university programs. Simplifying course materials, which was identified as an important opportunity, has also been reported by Barak[7]. Other interesting aspects of opportunities recognized by this study are laptop affordability, environmentally friendly and keyboard familiarity, which could overcome some of the weakness.

A significant weakness identified in this study was distraction, for both students who use laptops and others, therefore, hindering the improvement of learning process for a method which is otherwise proved to have many advantages [11], [8], [12]. Moreover, our findings also show significant challenges that may impede integrating laptops into the lecture format. Examples of challenges were network speed, few access points, software incompatibility, security of the network, lack of free software licenses, lack of universal access to the technology, insufficient power points, lecture tables inadequate for typing, and training for users.

The combinations of the four dimensions in the TOWS analysis generated suggestions for approaches that could be adopted to best use laptops as a learning tool in lectures, by taking advantage of the strengths and opportunities to overcome and/or avoid weaknesses and/or threats. These recommendations could be divided into main two types, technological and pedagogical.

Firstly, Software licenses corresponding to the needs of the course curriculum should be provided and covered in the course fee. Measures must be taken to help students acquire laptops through assisted purchase from the university. Other technological aspects include issues such as access to wireless internet, security, suitable network speed, and power outlets. An important logistical issue relating to technology relates to designing the lecture theatre seating and layout to enable the use of technology in a comfortable and convenient environment by students. All these issues resulting from the threats that may impede the physical use of the laptops in lectures can be resolved with a strong policy on technology compliance.

On the other hand, the pedagogical aspects relate to the issue of transforming the traditional lecture format to an active and collaboration learning environment and apply mobile learning as an effective pedagogical method. Here, distraction was the most significant concern; this means that the learning material should be organized more effectively, teaching strategy and software applications must be tailored to best fit the mobile learning environment in order to decrease distraction and increase engagement among students. Training, orientation and information sessions

must be provided for university staff to enable them to use media as a learning system. Computer skill training should be made available online for all users, students and staff.

## VII. CONCLUSION

University students of this generation are thoroughly immersed in digital culture. They are avid users of mobile devices such as laptops and tablets. In this scenario, it is time to seriously consider transferring the capabilities of these devices to learning environments as logistical or cost barriers to technology are no longer an issue in this day and age. This paper supports the notion of employing mobile learning as an intervention to improve learning experience in higher education lectures. A considerable number of isolated studies have focused on either the benefits or challenges of using mobile devices in higher education classrooms and a select few have also looked at both these issues together. This research, however, not only investigated the advantages and disadvantages, but also the factors that may help develop the use of laptops in lectures by studying the opportunities and threats. Investigating all these four quadrants not only provided rich and varied information but also enabled a strong cross-matrix analysis for SWOT. The results show that the quantity of response relating to strengths was the highest for all the other quadrants in the SWOT analysis. This not only holds importance as a research finding for the literature but indicates that the practical application of mobile devices in higher education has a vast array of strengths to draw on. Further the opportunities identified in this survey also showed great prospects for better utilization of mobile devices. In turn, the strengths and opportunities identified here also guided this research to develop some recommendations to overcome the weaknesses and threats. The recommendations focused on some improving structural issues in the technological and pedagogical aspects in order to better exploit the use of the technology by both lecturers and students. Further research may need to look at the impact of this intervention on learning improvement and performance for different subject areas. The authors also recommend further research on the technological and pedagogical factors of using mobile devices as a pedagogical tool in a different learning context for other subjects using a different research methodology with a larger sample.

### APPENDIX: SAMPLE COMMENTS BY THE SURVEY RESPONDENTS

Strengths	<p>“We can try out code given to us and see the results during the lecture.”</p> <p>“Be able to go through lecture’ slide on laptop.”</p> <p>“Using laptops would be easier to type rather than write note.”</p> <p>“It is portable.”</p> <p>“Students can search for the new materials.”</p>
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Weaknesses	<p>“Laptops can distract students from listening to the lecturer.”</p> <p>“Bulky laptops are hard to carry.”</p> <p>“It may distract both owner and other students.”</p> <p>“I’ve seen people watching movies and playing games during lecture.”</p> <p>“It is not safe, I heard some students lost their laptops in class.”</p>
Opportunities	<p>“It may assist students to understand what the lecturer is talking about.”</p> <p>“All of your files are in one easy spot/ better organization of materials.”</p> <p>“Carrying recourses such as book and lecture notes in electronic way is better, better for the environment.”</p>
Threats	<p>“The power points are not enough.”</p> <p>“Sometimes the signal of the wireless connection is weak.”</p> <p>“Battery life is an issue.”</p> <p>“Can’t assure that all students will have laptops.”</p> <p>“Compatibility between different operating systems.”</p> <p>“The tables are not strong enough to hold my laptops.”</p>

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