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User requirements analysis for use of mobile phones in learning and teaching

Johnnes Arreymbi and Chrisina Draganova

Abstract

In this study we investigate the requirements of students and lecturers from the School of Computing and Technology at University of East London for a system that uses mobile phones to support learning and teaching. We consider in particular those requirements that are related to supporting classroom interaction, student group work and module administration. We offer an analysis model of these requirements that can be further used for the design and implementation of the system.

Keywords: mobile education, mobile learning, mobile technologies in learning and teaching, interactive learning, students' collaboration and administration support.

1. Introduction

In recent years there has been considerable interest among educators in finding ways of integrating mobile and wireless technologies in learning and teaching. This study focuses on the requirements of students and lecturers from the School of Computing and Technology (SCOT) at the University of East London for a system that uses mobile phones to support learning and teaching. Some of these requirements would be applicable to any other mobile wireless devices such as notebooks or PDAs. However, modern mobile phone devices have similar capabilities, and they are less costly and more ubiquitous. According to UK government statistics nearly 75% of the general population in the UK, and nearly 90% of the people between the ages of 15 and 34, own or use a mobile phone.[1]

An activity-based categorisation of mobile technology uses and their mapping to existing learning theories is offered by Laura Naismith et al. in the form of a comprehensive review.[2] According to this classification there are six categories of learning that can benefit from the use of mobile technologies: behaviourist, constructivist, situated, collaborative, informal and lifelong learning, learning and teaching support. In our study we concentrate particularly on investigating the user requirements related to activities that support classroom interaction (behaviourist), student group work (collaborative learning) and module administration (learning and teaching support). Although the use of mobile technologies could be extended to other areas of learning and teaching, our initial investigation

shows that students are primarily interested in these chosen areas. There have been a number of systems developed and tried using mobile phones in support of classroom interaction, student group work and module administration. These have received positive feedback from students and lecturers. However, the adoption of mobile technologies in learning and teaching is still in its infancy and further studies are needed to address issues such as seamless embedding of the technology in the learning environment, interface design, issues of usability and accessibility, privacy, security and cost.

We have collated a comprehensive set of requirements using questionnaires and other related studies that have explored the use of mobile phone technologies for the activities that are of interest for the students and lecturers in SCOT. On the basis of the collated comprehensive set of requirements, we offer an analysis model of the requirements that can be further used in design and implementation of the proposed system.

The paper is organised as follows: Section 2 addresses the motivation for the research to apply mobile technologies in learning and teaching and explores related systems, Section 3 discusses the findings from the questionnaires survey, Section 4 presents, initial use case model of the captured requirements, and the last Section draws from the research and derives our conclusions.

2. Background

A. Classroom interaction

Classroom interaction in the form of asking questions, gathering answers and giving feedback, and/or role play during a seminar/lecture session enhances the students learning by improving their attention and by giving them an opportunity for reflection on the presented content.[3, 4] It also promotes an active learning environment, provides feedback for the lecturer to constructively align the learning and teaching approaches with the expected learning outcomes, and also increases students' motivation. [5, 6] Classroom interaction falls in the behaviourist learning paradigm, which states that learning is achieved through an association between a specific stimulus (e.g. question asked by a lecturer) and a response (e.g. answer given by a student).[7] However, implementing effective interaction in a large lecture session is not an easy task. Typically (or in a typical classroom situation), only a small number from the whole group and usually the same students would participate in such interaction. And from our findings and experience, we realise that, many students find it difficult to ask or answer questions during large lecture sessions for fear that they might sound "obvious" or "stupid".[8] Some students may not be able to think 'fast enough' and they easily give up trying, especially when some of their peers answer the question asked by the lecturer. Therefore, using a system that can give an

opportunity to every student to actively participate or contribute anonymously in the class sessions and without peer pressure or fear of being exposed, can greatly improve the interaction in the classroom and enhance the student's understanding of the material, and in general, the learning experience. Interactive classroom technologies can be used as an additional vehicle for accomplishing personalised learning goals.

The "TV remote" system offers a solution for supporting interaction in class through mobile phones using Bluetooth connections, with no transmission costs incurred by students. [9, 10] The main functionalities that the students can use in the "TVremote" system include: submission of text messages as free text, submission of feedback or lecture evaluation as a rating on the Likert scale, submission of answers to decision polls or multiple choice questions and retrieving information. The functionalities offered by the "TVremote" system to the lecturer include: publishing text that can be retrieved by the student's mobile client, browsing through a current set of messages, graphical overviews of correct and incorrect answers to multiple choice quizzes. An informal evaluation of this system shows that the "TVRemote" system is technically feasible even in a very large lecture scenario, but a formal evaluation of the application of this system on a large scale has not been performed. In our view the "TVremote" system has quite complicated implementation and suffers from the limitations of the Bluetooth technology, including much lower data transfer rates compared to other wireless communication technologies, and the small number of devices that can be connected simultaneously to the laptop of the lecturer.

There are a number of studies that report positive results on the use of SMS/MMS in classroom interaction systems [11, 12, 13.] However, a major issue with these systems is the cost of SMS/MMS that prevents their wide adoption, especially from the students' point of view.

"TXT-2-LRN" describes a SMS-based classroom interaction system and evaluates its use and impact on students' learning experience.[14.] The system consists of a mobile phone connected to the lecturer's laptop with installed SMS management tool. The students using this system can submit questions or comments to the lecture's laptop via SMS and submit answers to multiple choice quizzes. The lecturer can read the incoming questions on the laptop screen and the results from the multiple choice quizzes can be graphically displayed on the projector. This system has been tested in large lectures of 300 students.[7] One of the most useful features of this system reported in the findings is the ability to send the lecturer SMS during class, which enables the possibility for instantaneous feedback and adaptive learning and teaching. Overall, increase of the student participation and better quality feedback have been observed. However there two issues with this system: one noted above is the incurred cost of SMS for students, and another

issue is the need to interpret large amounts of text by the lecturer during the class session.

"Mobile Phone Extension to Ubiquitous Presenter" offers a solution to support active learning in the classroom though SMS/MMS to an email address on a server which is then relayed to the instructor.[15] This system offers two main functionalities to students using mobile phones: text message submission via SMS to short-answer problems and photo submission of hand written answers and/or graphics via MMS to mathematical, code writing and diagrammatic problems. The system offers the same functionalities via laptops and Tablets.

"Pls Turn Ur Mobile On" describes a system that uses SMS to support interaction in the classroom as well as the possibility to store the classroom SMS messages on a server for after class use.[16] The students' SMS submissions are stored on a laptop in an Excel file for viewing on the lecturer's laptop. The lecturer can comment on the submitted text messages. The stored SMS can be used to continue the discussion after class via online threaded comments. The study reports a positive attitude of the students towards the system.

There are other types of interactive systems, such as 'Turning Point Interactive Response Systems' (TPIRS) typically used for interaction with a TV audience during a quiz show, which could be utilized in classroom situations for interaction. For example, in TV shows such as "Who wants to be a millionaire, (ITV.com)" an electronic interactive system is used to assist the contestant with instant feedback from the audience, with results displayed graphically on screen. The TPIRS system can engage an audience of up to 1200 simultaneous users at a range of about 30 meters (www.misco.co.uk), effectively offering a classroom or meeting forum voting system. This type of assessment tool is easy to use and operates using infrared technology that sends information to a central receiver with software that allows quizzing, survey and/or assessing students. It can easily be integrated with Microsoft PowerPoint presentations and can analyse responses in real time. The students can respond to questions using special handsets or computers and the results are graphically presented on screen instantly. The system integrates well into almost any environment and gives instant user feedback for any electronic presentation.

The systems described above show that it is possible to adopt and integrate mobile devices during class room sessions to enhance students' learning experience. However, there is still a need of finding a solution which offers a free-of-cost connection, makes use of the modern capabilities of mobile phone devices, automatically collates students' messages, makes intelligent interpretation of the students' answers and, sends appropriate automatic individual feedback to the students' mobile devices.

B. Student Group Work

Group work activities are often part of seminar/tutorial, workshop or assignment tasks at university level. Naismith et al., suggest that mobile devices can support these activities by providing coordination without replacing human-human interactions.[17] This is achieved by storing all the necessary information for an activity onto the mobile devices of the participants. An application running on each of the devices synchronises the actions of all participants by forcing them to follow a specific sequence of steps and agree on an answer before they move to the next stage of the activity. The mobility of the devises allows participants to collaborate anywhere. This model has been successfully applied to encourage collaboration in primary and secondary school education.[18, 19]

Identifying more examples of the use of mobile devices for students group work and developing appropriate solutions can contribute to improving communication, feedback and discussions and extend our experience in this area.

C. Module Administration

Mobile devices can be used for a number of module administration activities including: attendance registration, sending news about timetable or room changes, module results and evaluations, reminders for appointments and due dates for assignments. In addition to module administration, mobile devices can be used for other administration services such as help desk enquiries, university event announcements, and library reminders for reserved or borrowed items. Making services and information accessible through mobile devices is increasingly demanded by the new generation of students, and universities are expected to meet this demand. For example, a recent news report announced that Abilene Christian University (ACU) in the USA offers new students iPod touch or iPhones to be used to receive homework alerts, answer in-class surveys and quizzes, get directions to their professors' offices, and check their meal and account balances[20.] Several studies have investigated the use of SMS, WAP and Bluetooth technologies for such activities[21, 22, 23.]

Riordan and Traxler suggest using SMS text messages to send information to students whose attendance and performance were considered to be at-risk[24.] This information includes: room changes, appointments, feedback following marking of assessments and exam tips. The study reports that students provided positive feedback about these features and the final exam results were better for the group of students that were sent SMS. This supports the notion of using technology to align teaching & learning strategies or outcomes with students' needs and/or assessments.

SMS text messaging extension to Virtual Learning Environment (VLE) and Bluetooth based communications service have been used to provide personalized unified and cost effective mechanism for communicating with students on a large scale.[25] Although the Bluetooth technology offers free-of-cost connection, the line of communication between devices must be direct and such limitation may impose restrictions on the functionalities of the system.

Chen and Kinshuk describe and evaluate a prototype system for providing mobile educational services via WAP and mobile phones.[26] Some of the functionalities of this system are applicable to module administration, including news, enrolment status, timetable information, exam results and discussion forums. Similar to the systems described earlier, the cost of using WAP can be a problem for students.

In many university campuses nowadays, WiFi networks are available and students can use free broadband connection on their mobile devices. This makes it possible to have web applications that implement the mobile services related to the three areas: classroom interaction, student group work and module administration, which are accessible anywhere and at anytime. Making relevant information and services available to students through different communication channels can improve the quality of their learning experience and provide more opportunities for engagement in the learning process and support the university life in general. Moreover, having the response and feedback from students on time can support us in aligning our teaching and learning strategies and methods to the students' needs and expected learning outcomes.[27, 28]

3. Questionnaires - Results and Discussion

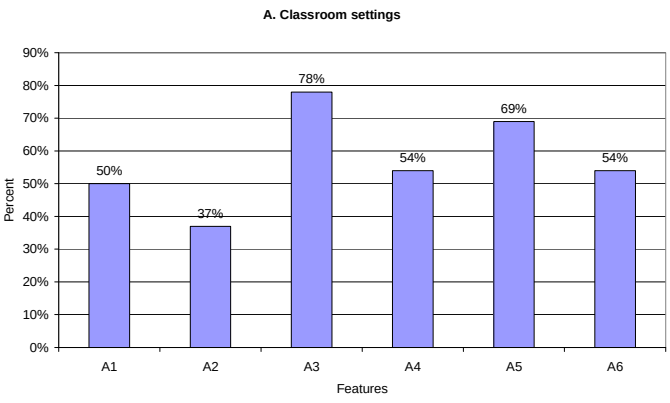
We have used one preliminary questionnaire for students in order to assess the usefulness of different types of services offered as learning support via mobile phones. During the investigation, we have used closed and Likert-type questions on a scale of 1 to 5. The questionnaires have been completed by 120 undergraduate students from SCOT.

The results of the preliminary questionnaire show that 89% of the students would find it very useful or useful to be alerted on their mobile phones about news related to their modules (e.g. deadlines for assignments, relevant links, new information etc.), 80% of the students would find it very useful or useful to use mobile phones to collaborate (communicate) on group assignments and 61% would find it very useful or useful to use mobile phones during lecture session with the purpose of sending feedback to the teacher or answer questions. The students were also asked whether they own a mobile phone and whether they use it for SMS, MMS, Email, Web, Music, Images and Video. 98% indicated that they own a mobile phone. However, less than 10% of the respondents indicated that their set has WiFi

connectivity. The use of the different functionalities within their sets is: 95% - SMS; 42% - MMS; 23% - Email; 31% - Web; 80% - Music; 78% Images and 66% - Video. This use pattern reflects the associated costs of using the different services to the students/users and indicates the typical use of the current capabilities of mobile phones. Our findings confirm that the majority of the students own a mobile phone and are interested in services provided on their mobile phones to support learning. The usage of the different functionalities shows that students are adopting those that are most affordable to them. This confirms that cost is an important issue and it needs to be taken into consideration when developing a system for support of learning and teaching based on mobile phone technologies.

Next we have used two types of questionnaire: one to capture the requirements from the point of view of the students, and another, from the point of view of the lecturers. These questionnaires are focused more precisely in the features that students and lecturers would be most interested to have for support of learning and teaching via mobile phones. The questions have been split in three categories: A. Classroom settings, B. Group work, and C. Module administration and Support.

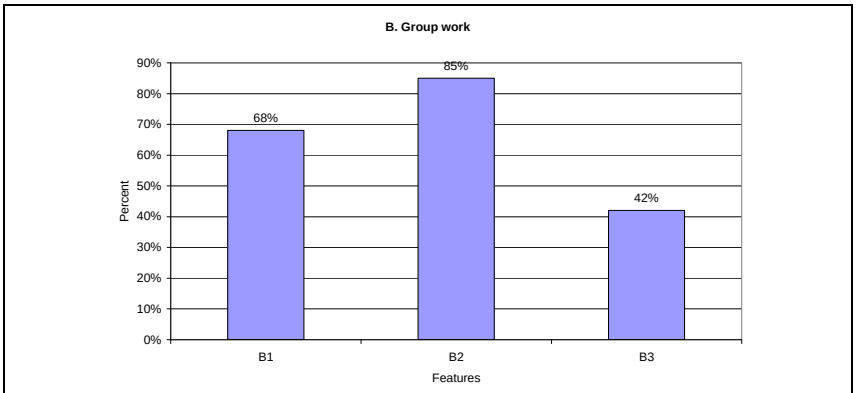
The students' questionnaire has been completed by 119 undergraduate students from SCOT. The students have been asked to tick all appropriate features that they want to have in a system supporting learning via mobile phones. Figures 1, 2 and 3 illustrate the results showing the percentage of students that have selected the specific features related to Classroom settings, Group work and Module administration and Support, respectively.



A1	send anonymously a question during a classroom session to the lecturer.
A2	send anonymously evaluation or feedback about a classroom

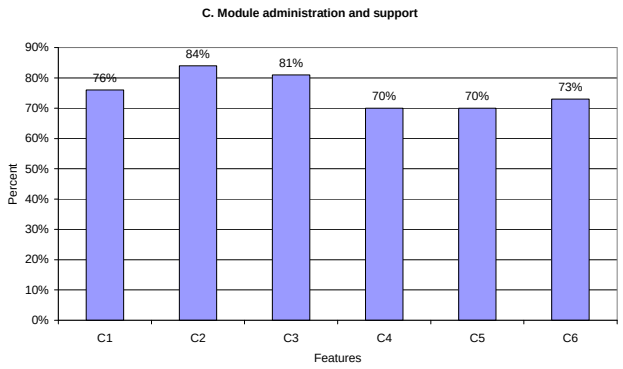
	session to the lecturer.
A3	receive a short summary of the lecture session.
A4	receive animation, audio or video podcast related to a lecture session.
A5	register your attendance.
A6	receive individual automatic feedback after answering questions during a lecture/tutorial session.

Figure 1: Proportions of students that selected the features A1-A6 related to Classroom settings as useful



B1	share information with your peers such as solutions, diagrams, links, summaries etc**.**
B2	contact your peers to coordinate meetings.
B3	participate in collaboration activities such as games or role playing.

Figure 2: Proportions of students that selected the features B1-B3 related to Group work as useful



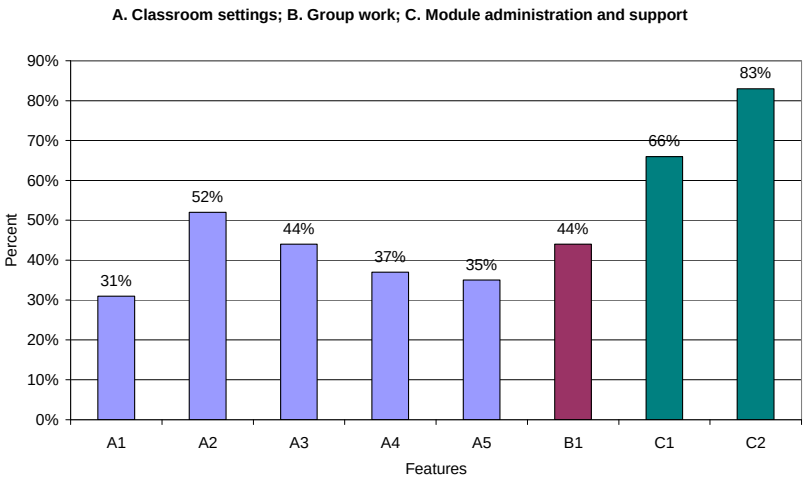
C1	send a message or book an appointment with your tutor**.**
C2	receive reminders and alerts such as assignment deadlines, change of rooms, exam dates, etc.
C3	receive coursework grades and feedback.
C4	receive specific module information in the form of text, audio or video podcasts, links, glossary.
C5	receive tips or hints related to an assessment.
C6	receive warnings in case of unsatisfactory attendance.

Figure 3: Proportions of students that selected the features C1-C6 related to Module administration and support as useful

In addition to the questions asked related to the features above we have asked students to provide other suggestions. Their answers include the following suggestions:

- *"Setting time for tasks at the beginning of each semester; changing tutorial groups"*
- *"Receive mock exam questions to practice"*
- *"To be able to send questions to your tutor outside school hours"*
- *"Send the lecture slides"*
- *"Lecturer is running late it would be nice if you could use the text message scheme to let students know"*
- *"Send text message to the lecturer when students are running late"*
- *"Automated calendar settings sent to phone class/module/programme/tutorial/practical dates and times according to group membership"*
- *"To be able to notify the lecturer of absence from class"*

The lecturers' questionnaire has been divided into the same categories: Classroom settings, Group work and Module administration and Support. The results from 29 completed questionnaires by lecturers are illustrated in Figure 4.



A. Classroom settings	
A1	get answers sent via mobile phones to questions during a lecture session and assess via aggregated response the level of the student understanding.
A2	post automatically messages to all students with short texts, graphics, animations or podcasts..
A3	task students to send SMS about one thing they learned during the lecture.
A4	register student attendance.
A5	receive immediate feedback on your teaching during a lecture/tutorial session.
B. Group work	
B1	run activities/games where students can collaborate
C. Module administration and support	
C1	communicate with students via mobile phones (send group messages, alerts, reminders, grades, feedback, tips, podcasts, etc.).
C2	contact students via SMS in case of unsatisfactory attendance.

Figure 4: Proportions of lecturers that selected the features A1-A5, B1, C1 and C2 related to Classroom settings, Group work and Module administration and support as useful

Comments and suggestions given by lectures include the following:

- *"I don't think the use of mobile phones is appropriate in any of the above. Email & UEL plus will suffice!"*
- *"I think that it will be problematic"*
- *"Send e-mail alerts (official emails only) on their mobile"*
- *Conducting live test i.e. placing a call to the student at agreed time followed by sending an email containing assessment during the live call and sitting in front of PC terminal"*
- *"Most can be done by email"*
- *"The great problem is requiring/expecting all students to own a particular class/capability of phone"*
- *"Turn off in lectures/classes so as not to disturb!"*
- *"Make sure they are turned off during class"*
- *"I wouldn't like to introduce the use of mobile phones into lecture …in case the students use it for inappropriate texting."*
- *"I would like a mobile system where students can easily scan or swipe their ID cards to automatically register class attendance, rather than the current paper based systems"*

In relation to the first category A. "Classroom settings" our findings show that the majority of the students who completed the questionnaire are interested in the feature "receive short summary of the lecture session" (see Figure 1). Figure 4 shows that the highest percentage in category A – 52% of the surveyed lecturers think that the feature "post automatically messages to all students with short texts, graphics, animations or podcasts" would be useful. These two features have common functionality that includes, sending and receiving short text related to a lecture session, which indicates some similarity in the view of students and lecturers regarding the features of the proposed system. While most of the features in category A illustrated in Figure 1 have been found useful by more than 50% of the students, this is not the case with the surveyed lecturers. Less than 50% of those lectures believe that such features would be useful. This gives an indication that the students are more open and positive about introducing mobile phones technologies in classroom settings. This observation is also confirmed in the comments given by students and lecturers. While students offer constructive suggestions in all instances, lecturers are more concerned with issues such as disturbance in the classroom, inappropriate texting, and possession of the right capabilities phones by students. Some lecturers do not see at all the relevance of such a system. These concerns could be shared, due to the fact that mobile technologies are still not widely adopted in Higher Education.

The results displayed in Figure 2 related to Category B. "Group Work" show that, the majority of the surveyed students value the possibility of having a framework that supports communication among peers, coordination of group activity and sharing information. The feature "participation in collaboration activities such as games or role playing" is found useful by less than 50% of the students. A similar result is observed in Figure 4 in the lecturers' survey where the feature "run activities/games where students can collaborate" is found useful by less than 50% of the surveyed lecturers. A possible reason for these results is that students and lecturers might find it difficult to imagine an appropriate scenario for group collaboration via mobile phones.

The results illustrated in Figures 3 and 4 related to Category C "Module administration and support" show that the majority of the surveyed students and lecturers found the suggested features useful. This confirms the observation that in situations where it is relatively easy to see the application of mobile phone technology students and lecturers are positive about using such a system.

The results from the closed questions and the comments overall indicate similar patterns in the views of the surveyed students and lecturers. In general the students are more open and constructive compared to the lectures. This confirms that there is a need to explore different system models that can demonstrate the potential of the new mobile phone technologies in improving engagement and learning processes in order to gain wider acceptance and adoption.

4. Use Case Analysis Model

In this study we employ use case modelling technique which enables capturing functional requirements of a system. The main elements of use case modelling include: stakeholders – people that have interest in the system, use cases describing how the system responds to requests from actors to fulfil their goals and use case scenarios describing the sequence of steps that are executed in order to deliver these goals.[29] Use case modelling is well suited for defining user requirements and is widely used in Information systems development. Table 1 illustrates the initial list of actors, use cases and brief use case descriptions.

Table 1 – Actors, use case, descriptions and prioritisation

Classroom Setting		
Actor	**Use Case**	**Brief Description**

Student	Send a question/ comment	A student sends a question or a comment during a classroom session to the lecturer. The question or comment is received by system. An alert is sent to the GUI to notify the lecturer that there is a question or a comment pending.
Student	Send evaluation/ Feedback	A student anonymously sends evaluation or feedback in a specific format about a classroom session to the lecturer. The formatted text is received by the system and processed to provide an aggregated response.
Student	Register attendance	A student sends his/her student ID number to register attendance. The system records the ID, date and time and sends acknowledgement to the student.
Lecturer	Send summary/ definition/ hyperlink	A lecturer sends short summaries, definitions or hyperlinks at once to students' mobiles using the system.
Lecturer	Send a question	A lecturer sends a question in a specific format at once to students' mobiles using the system.
Lecturer	Send graphics/ animations/ podcasts/ individual feedback	A lecturer sends graphics, animations or podcasts at once to students' mobiles using the system. The system capability includes intelligent techniques for analysing the student responses to questions and generating relevant feedback thus enabling the lecturer to provide individual feedback.
Group Assignment		
Student	Collaborate on a project	Students send SMS or MMS to share information with peers such as solutions, diagrams, links, summaries etc**.**

Student	Contact peers	Students contact peers to coordinate meetings.
Student	Play a game	Students participate in collaboration activities such as games or role playing.
Module administration and support		
Student	Contact a tutor	A student sends SMS through the system to the lecturer. The system automatically sends email to the lecturer.
Lecturer/ Administrator	Send reminder/alert/ Feedback/grade	A lecturer/administrator sends reminders and alerts such as assignment deadlines, change of rooms, exam dates, coursework grades, and feedback using the system to the student's mobiles.
Lecturer	Send module information	A lecturer sends text, audio or video podcasts, links, glossary using the system to the student's mobiles.

Table 4 illustrates the stakeholders and their interest in the system under consideration, and the level of importance of their interest.

Table 2 – Stakeholders Analysis

Stakeholder	**Interest**	**Importance**
Students	To have additional ways of communication with lecturers and peers; To be able to send timely feedback regarding face-to-face sessions; To collaborate on group work; To receive important information on time; To send and receive responses anonymously.	High
Lecturers	To engage larger number of students during lecture sessions; To adapt and align learning and teaching according to the understanding of the students; To improve students motivation; To align learning and teaching strategies to learning outcomes; To align assessment methods to learning outcomes; To	High

	improve students' support;	
Admin staff	To provide additional effective ways of contacting students and improve services to students and pastoral support to students.	High
SCOT	To enhance the students' learning experience, and support lecturers' teaching.	High
University	To explore and evaluate the practice of using mobile technologies in learning and teaching, and in students' support.	Medium

5. Conclusions

This paper has investigated the issues concerning the use of mobile phone technologies in classroom interaction, students' collaboration and students' support. A questionnaire survey was carried out to capture and establish the system's functional requirements. A use-case model was developed and utilised to analyse the requirements. Other studies have been evaluated where similar technologies have been used to improve students learning experience and exam results.

Our findings show that there is similar pattern, in the views expressed by both students and lecturers towards the functional requirements of the proposed system for using mobile phone technologies in learning and teaching. However, we also observe that while the majority of students were very positive, lecturers were somehow concerned about the perceived use and benefits derived from using mobile phone technologies to enhance learning and teaching within SCOT at UEL. Developing a system that implements the use-case model suggested in Section 4 would demonstrate the benefits and illustrate specific examples of how these technologies can be used in learning and teaching.

To create a complete service, the critical issues of usability, authentication, authorization and privacy, should be incorporated in the proposed system.[30] Accessibility of the resources on the mobile system should also be thoroughly investigated. Future work will address these issues and will include design, implementation and evaluation of the proposed system model.

Notes

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