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MOBILE LEARNING TECHNOLOGY: USING PERSUASIVE MOBILE UX DESIGN TO CHANGE LEARNING BEHAVIOR

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Abstract: *In an era of Information we are constantly battling for the attention of our learners. Learners are also having difficulties to cope with distractions, they are striving for motivation and effective time organization. This paper identifies possible role of smart-phone devices in online learning solutions: how to combine information design with persuasion design to help learners organize better, to keep track of their progress, recover from breaks, and to change their learning behavior in the long term. This research then concludes with possible directions to accomplish the construction of the user interface model of the smart-phone application*

Keywords: *Design, Education, Communication, Incentives, Web based learning, Mobile technology, Mobile HCI, Smart-phone, Persuasion, User interface, User experience*

1. INTRODUCTION

Persuasive technology is all about ”computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without using coercion or deception” [1]. “Persuasive learning” could be easily mistaken for manipulation or coercion, but it is actually meant to motivate and persuade learners to interact with the subject matter and become active participants, not to coerce them into completing the module [2].

This study is based on the working hypothesis that by combining the principles of human cognition, human-centered design principles, and persuasive design elements we could identify effective practices, meet the new requirements and help students to change their learning behavior. Targeted behavior of online students would include engagement in activities beyond their regularly assigned course work. The goal is not only to avoid cramming, but also to enable online students to overcome communication barriers that frequently exist within the viral community. This would in turn decrease feelings of isolation and potentially generate involvement in research projects, stimulate interest in competitions and conferences, thus increasing online student retention.

The focus of this paper is on the design of mobile e-learning components (MELC) for higher education that can be distributed to the smartphone devices. The objective of these components would be to support e-learning systems in facilitating better time management, enabling progress tracking, and providing better support in terms of technology, communication and motivation in order to change students' learning behavior.

Theory framework for mobile and persuasive learning has been created through literature analysis, and the design model is based on research conducted through the use of Belgrade Metropolitan University’s (BMU) learning management system (LMS), collecting requirements and involving students in the information architecture and design process. Some of the survey findings and design sketches will also be presented in this paper. The future goal would be to design the online learning environment with adaptable components that are contextually distributed to users’ devices.

2. MOBILE LEARNING

Internet and Web technologies have made online learning possible. Now, mobile technologies, especially smartphone devices that are perpetually within reach of users (both students and instructional designers), are generating opportunity to implement “persuasive design elements” [3] into mobile e-learning components. Centers supporting web-based learning are common part of university infrastructure, as are specialized learning management systems such as Moodle, Canvas, and Blackboard [4], but the potential relationship between cell phone use and academic performance is not clear [5]. Recent researches by Lepp et al. [5; 6] suggest that many college students perceive the cell phone primarily as a leisure device, and students most commonly use cell phones (smartphones) for social networking, surfing the Internet, watching videos, and playing games. Conversely, these devices could be very useful in education as they provide immediate, portable access to many of the education-enhancing capabilities such as online information retrieval, file sharing, and interaction between professors and fellow students alike [7].

According to Sharples et al. [8] the essential difference between mobile learning and other types of learning is that mobile learners are continually on the move. We learn across space (applying learning resources gained in one location to another) and across time (by revisiting knowledge that was gained earlier in a different context).

We move from topic to topic managing a range of personal learning projects rather than following a single curriculum, and we also move in and out of engagement with technology. In *Minds Online,* Miller [4] explores the cognitive principles that enable us to create better learning experiences with technology and presents key ways in which technology can help optimizing the way we teach:

- Technology enables frequent, low-stakes testing
- Technology encourages better spacing of study over the time course of the class and helps prevent cramming
- Technology offers new methods for capturing and holding students' attention, which is a necessary precursor for memory.
- Technology offers new avenues to connect students socially and fire them up emotionally
- Technology allows us to borrow from the techniques of gaming to promote practice, engagement and motivation.

These aspects of technology have been used as a foundation for designing the persuasive user experience of MELC.

Paulins et al. [9] state that technology itself does not contribute much to education and it is necessary to develop a specific methodology for visualization and production of electronic materials in mobile environments. Most learning management systems (LMS) are developed for desktop environments and not for mobile devices. In [9], Paulins et al. proposed a specific approach for development of learning content for mobile platforms, and the reuse and redesign of existing LO (learning objects). This methodology is not quite aligned with learning habits of online students and the mobile context that is already mentioned in the research [5; 6] that demonstrates how students perceive the cell phone primarily as a leisure device.

In the Mobile report marketing 2014 Study [10], results showed that consumers associate the term "mobile" with their smartphones, and only 14% of consumers associate tablets and e-readers with the word "mobile". Furthermore, tablets are generally seen as companions of smartphones and are mostly owned by those who are 35+ and can afford the extra technology.

The importance of tablet computers in mobile learning is evidenced in Pew Research Center's study [11], which concerns e-book reading trends in the US (see *Figure 1*). The data demonstrates that people read less on desktop computers and smartphones. The new generation of smartphones with bigger screens, so-called "phablets" (the word is a portmanteau of the words phone and tablet [12]), could increase percentages of book reading on smartphones. The presented research results lead us to the conclusion that smartphones are not perceived as platforms for reading and learning, but rather as devices used primarily for leisure

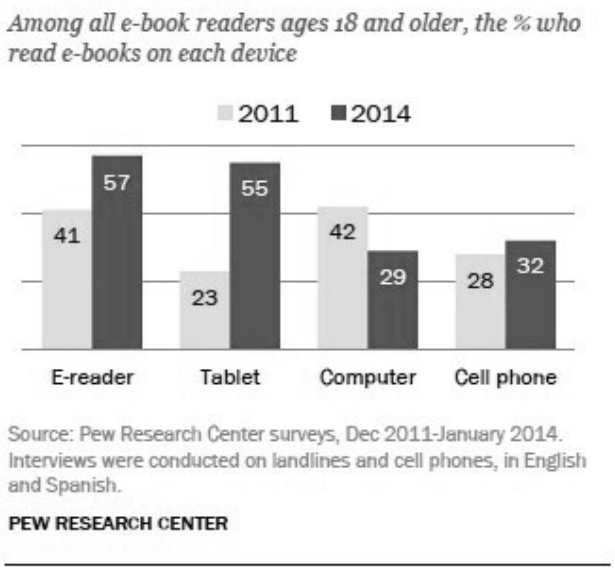

Figure 1. Trend accessing e-books on each device (Pew Research Center, 2014)

Contrary to this conclusion, some web statistics show that Education is one of the most popular categories on the Google Play mobile app store [13]. Statistics for the iOS (Apple) mobile apps [14] also show that Education is a popular category – right behind Games and Business apps. Books and Readers are in 8th place (*see Figure 2*).

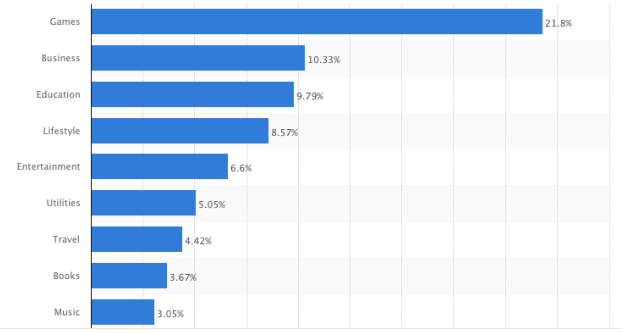

Figure 2. Most popular Apple App Store categories in June 2015, by share of available apps (statista.com)

The Education category presented applications for learning languages (Duolingo), memory training (Luminosity), various interactive educational games for young children, popular science (NASA Visualization Explorer), web based learning applications (like Khan Academy) and more. There are also some interesting applications that use geolocation and augmented reality techniques (Star Chart). Most of these applications are distributed for free, and many use gaming techniques that could be applied in the design and development of specific mobile learning applications for higher education.

3. A BEHAVIOR MODEL FOR PERSUASIVE SYSTEM DESIGN

To encourage change in one's behavior, we can use various models. These models are more or less applicable to e-learning technologies [3]. In the Fogg Behavior Model (FBM) [15] behavior is a product of three factors: motivation, ability, and triggers. The FBM asserts that for a target behavior to happen, a person must have sufficient motivation, sufficient ability, and an effective trigger to perform the behavior at the right moment (timing). All three factors must be present during the same instant for the behavior to occur. The ability dimension of MELC would depend on its content and graphical user interface (GUI) design.

In order to perform a certain behavior, for example to apply for a design contest by using the smartphone, online students should have **the ability** to fill out the application form within the existing mobile application. If the mobile form were to be well designed (i.e. filling out the form doesn't require a lot of input elements from users, but generates data from their existing profile – name, address, faculty...) the ability to perform would be high. If the application form were to be complicated (demanding a lot of input data and uploading additional examples of previous work, images, presentations or media that are not usually available on smartphones), the ability to perform would be low, and many students wouldn't apply. Motivation to apply would vary from student to student, but some kind of reward for the winner of the competition could be considered as a solid motivational factor. Motivation alone, may not get people to perform a behavior if they don't have the ability [15]. The third factor is the trigger, which can take many forms: a ringing alarm, a text message, an announcement that the deadline is approaching etc. The trigger occurs when one is both motivated and able to perform the behavior. The FBM implies to designers that increasing the ability (making behavior simple) is the path for increasing behavioral performance.

In order to influence and change the behavior of online students via mobile applications, it would be useful to know how students perceive m-learning (ability dimension) and how to motivate them to perform target behavior. Rosemary L. in [16] literature review identifies 9 reasons why students who took online courses dropped out:

- Feelings of isolation
- Frustration and disconnection
- Technology disruption
- Student failure to make contact with faculty
- Inadequate contact with students by faculty
- Lack of student and technology support
- Lack of instructor participation during class discussion
- Lack of clarity in instruction direction or expectation
- Lack of social interaction.

In the survey conducted at BMU, students pointed out that they were mostly discontent while using LMS due to sense of isolation, lack of instructor participation in forums, and inadequate contact between students and the faculty. If we would like students to perform a targeted behavior, such as engagement in activities beyond their regularly assigned course work, we would have to create the ability for students to communicate within LMS.

Nor Aziah Daud et al. [3] presented a very useful summary of persuasive system design (PSD) and evaluation of the system in different contexts. Based on this research, they created the Initial Persuasive Model of Web Based Learning (WBL), and identified the design factors in WBL, *Table 1*.

Table 1: Example of Design Factors in Web Based Learning (WBL)

1. Content for adult learners (andragogy)
2. Guide learning process {theory, video, question & answer}
3. Simplifying in sequence topic
4. Measure own performance {graph, time period}
5. Assessment before and after
6. Easy to understand, easy to use, easy to find information, download the short, easy to navigate and other usability features.
7. Useful, sufficient, timely
8. Correct, equitable, unbiased
9. Clear layout, consistent graphics/images/typography, avoid misspelling, grammatical errors, excessive marketing element,
10. Contact information {name, position, email, telephone, address, web address, photo, biography}, appropriate background
11. Provide background information, video from experts and communication spaces with experts.
12. Links to external resources, references to scientific publications, clear expert's references, accurate resources
13. Related logos {High Education Ministry}
14. Learning style {Visual, auditory & kinaesthetic}
15. Syllabus, learning schedule, learning approach
16. Automatic prompts
17. Words/sound/symbols/visual
18. List of top learners, chart of website's success
19. Relevant visual
20. Online competitions
21. Interaction method {list of email, chat room, discussion forum and share journals/articles}
22. Comparison method {frequency of learners visit, the most active learners, the highest evaluation/mark}
23. Observation method {shows learners who referring the same topic, doing quiz, discussing certain topic}

4. DESIGN METHODOLOGY

In order to design MELC for BMU, we included users (students and instructional designers) in the design

process. We used a human centred design approach to evaluate existing e-learning infrastructure and to implement new requirements based upon users' feedback. Human centered design is a process of developing products that is grounded in information about the people who will be using them [17].

In the design of all successful products, the essential factor is usability. This refers to whether an application is easy to learn, easy to use, and enjoyable to use for the intended users [18].

Participants of the BMU survey were students of the Faculty of Information Technologies (FIT) and Faculty of Digital Arts. Requirements of instructional designers were gathered using interviews. BMU's educational resources are based on learning objects which are stored in several repositories and deployed in LMS, which is designed exclusively for the desktop. Additionally, there is the "Info-eStudent" mobile application, developed for the Android mobile platform, which enables BMU students to get information (via Web) about their marks, exam scheduling, teachers, finances, and to view news feeds from the BMU's website [19].

The usability objective of the MELC application is to combine data that could be retrieved from LMS (tracking progress within lessons, forum participation, test results etc.) with information that is part of the e-student platform.

5. DESIGN PROCESS

Maguire [20] identified five essential processes that should be carried out in an iterative fashion as depicted in *Figure 3*, with the cycle being repeated until the particular usability objectives have been attained:

1. Plan the human-centered design process.
2. Understand and specify the context of use.
3. Specify the user and organizational requirements.
4. Produce designs and prototypes.
5. Carry out user-based assessment.

The first three processes are as follows:

5.1 Mobile context

According to Steve Love [18], when designing any kind of interactive system it is necessary to consider the context in which the service or application will be used. Mobile devices are very specific because we use them in dynamic environments. Smartphone screens are rather small, so the amount of displayed information is very limited, thus directly impacting content management. Tablets have good performance in terms of reading, but smartphones are generally not perceived as readable. Mobile screens are typically not clear in the strong sunlight (outdoors), and touchscreens can make interaction difficult if the interactive targets are not well designed, that is, if they are smaller than the ideal size of 22mm [21].

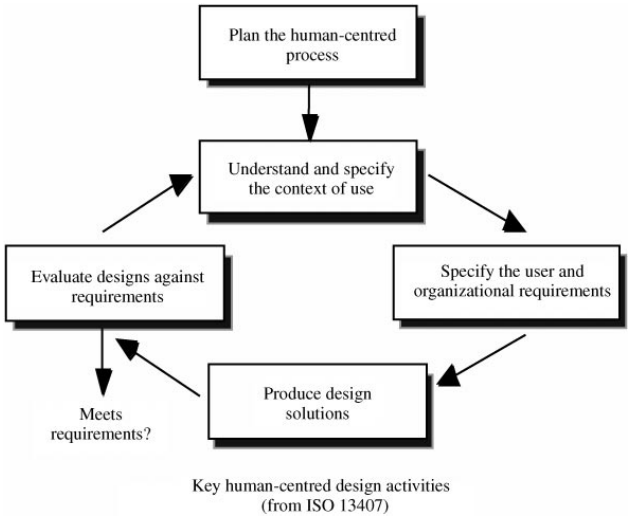

Figure 3. The human-centered design cycle.

These specific issues have a strong influence not only on the design elements of the GUI, but also on information design and overall usability. Some usability problems arise from the way mobile apps are developed – using desktop computers and rich development tools coupled with mobile phone emulators [22]. Therefore, it is necessary to consider mobile user interface (UI), specific users and their requirements, and context of use.

5.2 User and organisational requirements

In order to make a functional system, we must concentrate on all users: students, professors, faculty members and system administrators. *Figure 4* illustrates the relationship between the system and its users. In this case, the Web Based Learning System not only refers to software but also to administrators, system designers, developers, and technical support, since those people must often personally respond to user requirements.

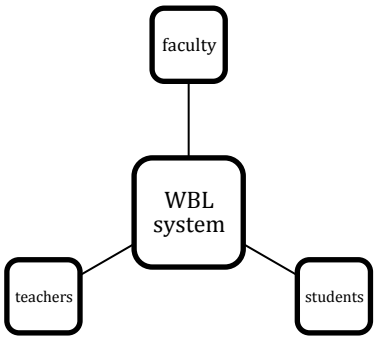

Figure 4. Relationship between Web-based learning system and key users

In the BMU survey, 100% of students replied negatively when they were asked if they had ever opened LMS on their mobile phones. Some reasons that students provided were that mobile screens were too small for reading or they simply assumed that the system wasn't optimized for mobile devices. When asked if they had tried to open

other online courses they also replied negatively: 100% of the time. Thus, we must conclude that implementation of learning objects into mobile device applications would be redundant, because students simply wouldn't use the application. However, we could try to implement a persuasive model into mobile e-learning systems in order to change students' learning behavior.

According to Christopher Pappas [2], it is important to build emotional connections with learners, as to make them aware how they will feel once the course is complete. Such emotional connections can be created through persuasive narrative, use of design elements like characters in a story, visual representations that are associated with a feeling of progress, and visible goals such as climbing mountains etc.

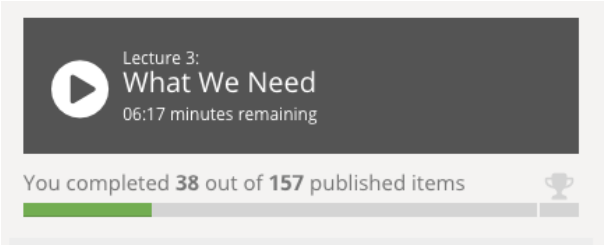

Figure 5. Udemy.com - Example of visual tracking, Prize visually presented in form of a Cup

BMU students didn't like the idea of an assistant in the form of an illustrated or animated character (*see Figure 6*), because it appeared childish to most of them; however, they reacted positively to the idea of info-graphics (data visualization, graphs, progress bars etc.). Although they didn't read lessons on their smartphones, students liked the idea of tracking their performance and getting notifications about paper deadlines, forum participation and summary of their grades (points) on their mobile phones.

Based on interviews and surveys at BMU, these are the key requirements potential MELC users noted:

- Students: better communication with instructors and faculty, ability to meet/ message other online students and work in groups.
- Instructors: less administration (reports), less emails, easier content update.
- Administrators: easier system updates and backups, less training, less emails.
- Students and Instructors: unique application that gathers LMS, eStudent (eProfessor) and E-mail in one place.

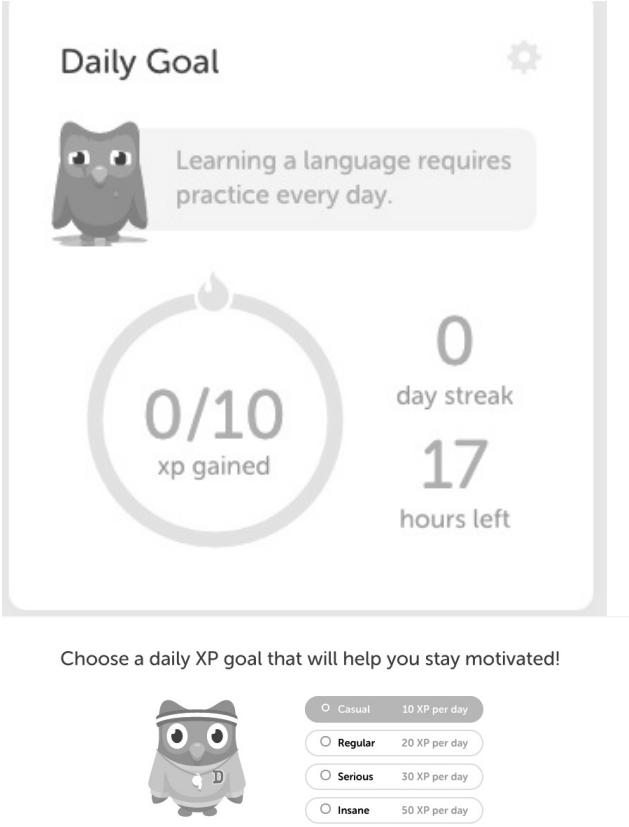

Figure 6. Persuasive design elements from Duolingo.com: illustrated assistant, motivational instructions, and visual progress tracking

5.3 Persuasive design solutions

Target behavior for MELC users (both students and instructors) would be engagement in activities beyond regularly assigned work. In order to be engaged in additional activities, users require more free time. This means that we must design systems that would remove some of the task load from our users. Thus, the basic assumption is that effective time management and task automation would help users to perform the targeted behavior – to be more engaged. In *Figure 7* we can see the behavior model–FBM that illustrates the premise: if users have more time (ability) for additional work, and motivation (personal goals), we must trigger them (for example: with notifications in MELC) to perform the behavior (for example: to enter a design competition).

Key users and their tasks within the LMS system at BMU are presented in *Figure 8.* Blue and orange sections (administration and computer mediated communication - CMC) are identified as critical, since they have been demanding too much time from both students and lecturers. Students desire more effective communication with instructional designers, as well as a more transparent online community.

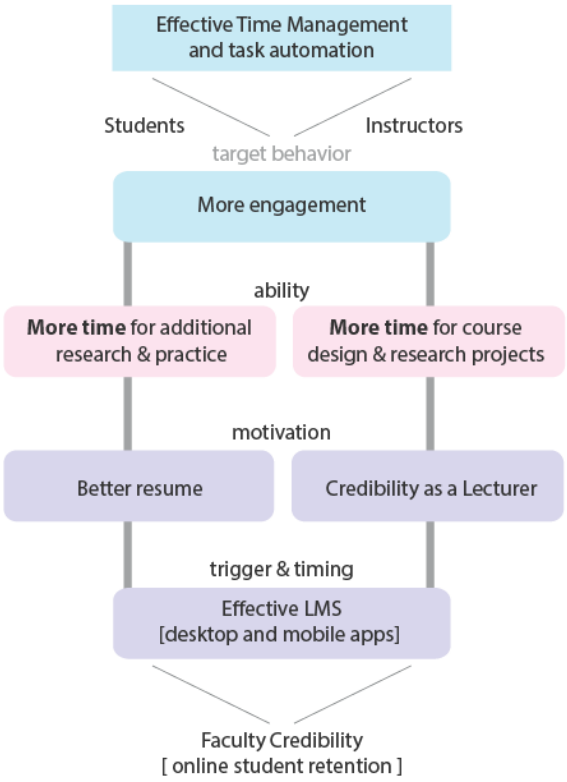

Figure 7. Fogg Behavior Model in persuasive LMS design

As of now, online students at BMU don't know each other; they don't know how many students are attending class or their backgrounds, and they are unfamiliar with others' works. Additionally, lecturers don't have time to reply to all students' questions, so it would be useful to group questions under certain topics, and encourage online students to assist one another.

We could create a more transparent virtual community if we would simply implement the UI of mobile social networks into the e-learning system. The advantage of this methodology is that users are already familiar with the interface, so training wouldn't be necessary. Students could create personal online profiles that include pictures, resumes and lists of assigned courses (*Figure 9*). Some data could be part of the public profile, while other data would be visible only to the owner of the profile. Students would be able to see and communicate with colleagues who attend the same course. They could bookmark certain profiles by adding them as friends (*mark 1 in Figure 9*). This would eventually reduce instructors' communication load, because students could support each other and discuss certain topics within more accessible forums. Instructional designers would have their own separate profiles.

In *Figure 9*, we can see an active "slide-out" mobile menu that is accessed by clicking on the "hamburger icon", a typical navigation element of smartphone GUI. The menu items are: My Courses (see also *Figure 10*), To-Do List, Friends (*mark 1, Figure 9*), BMU Info (news feeds from the university's web site), Forum (all forum topics) and Profile Settings (personal details, filters, personalization options).

Figure 10 presents one possible layout of the "My Courses" page. Icons which are frequently interacted with are positioned on the right side of the top navigation bar; an email icon (*mark 1*) which provides access to chat and

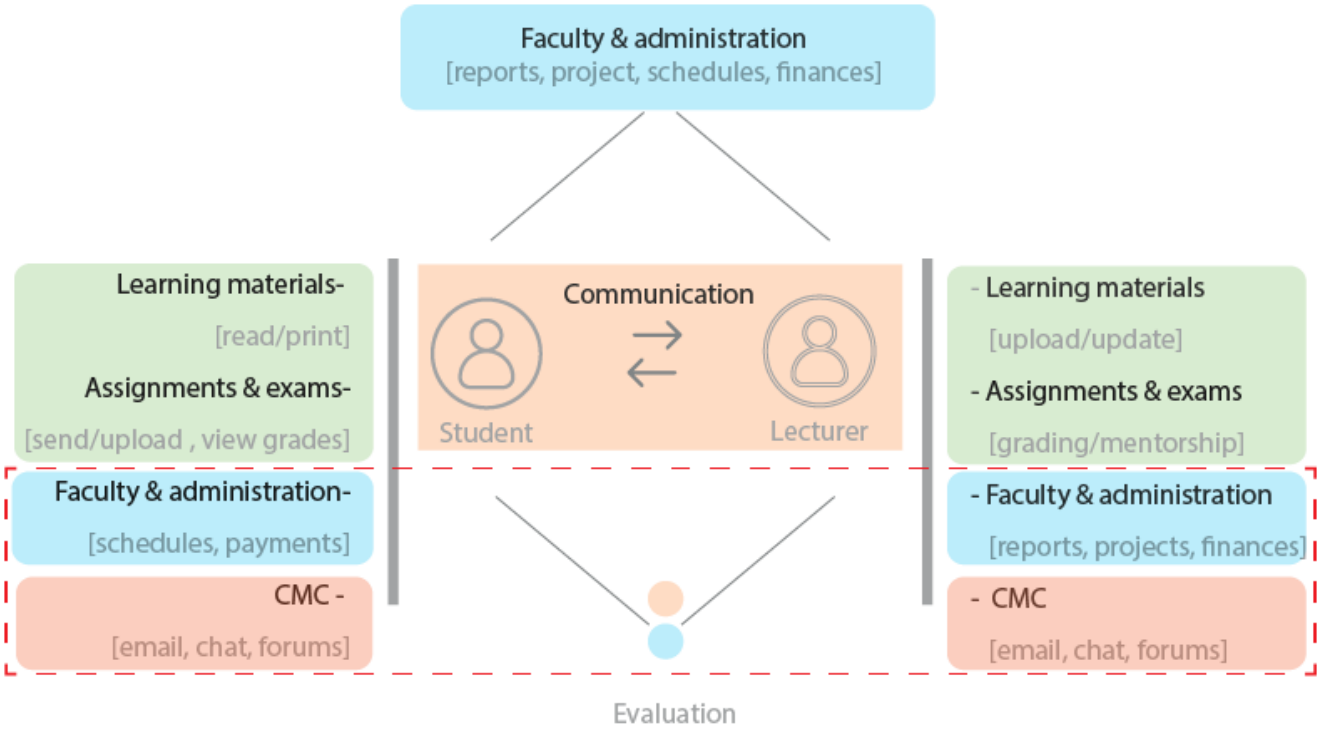

Figure 8. LMS users at BMU and their tasks

email; a calendar icon (*mark 2*) that is synchronized with the BMU calendar; and a notification icon (*mark 3*) that displays important events.

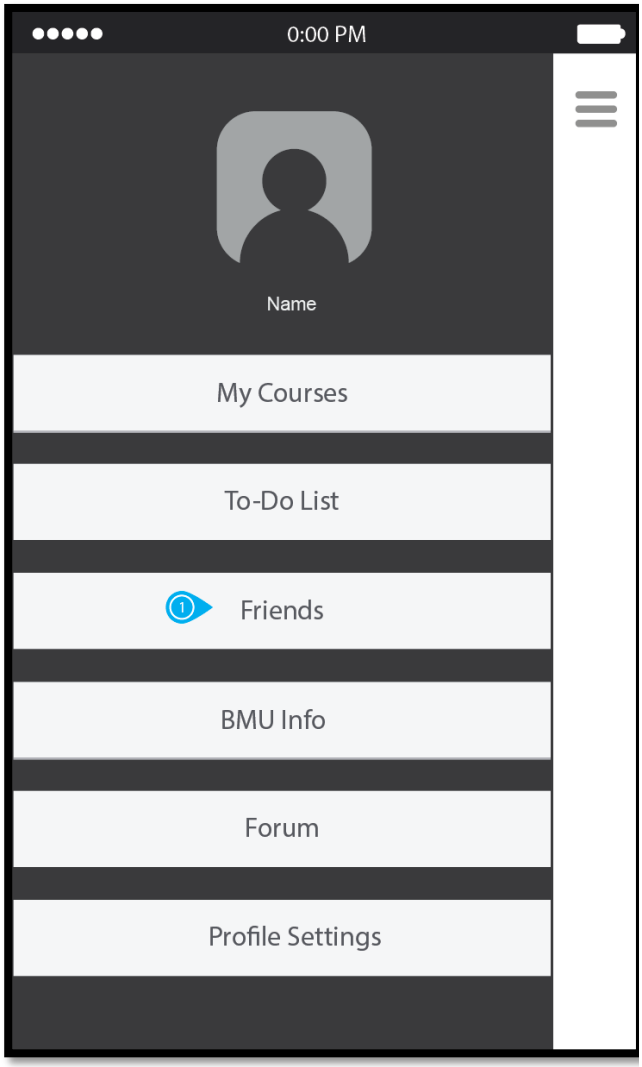

Figure 9. Personal profile / Menu item in MELC

Below the navigation bar is a list of courses with one open item, "Course D", that illustrates students' progress with assignments (*mark 4*). Below this is a submenu that includes a list of fellow students (*mark 5*), a link to the lecturer's public profile, a list of literature, schedules, and forum topics related to the course. The usability goal of this page is to provide simpler communication tools, which should in turn enable students to effectively build online communities.

Figure 11 shows a list of students who also took "Course D", with an option to bookmark or remove profiles from the Friends list (already presented in the *Figure 9*) by using the "Add friend" or "Unfollow" button (*mark 1, 2*).

Figure 12 illustrates a student's public profile, with an option to send a quick message to him/her (mark 3). This page displays the latest activity feeds and the student's forum posts (*mark 4*).

5.4 Design evaluation

These page-design examples demonstrate how design elements and information architecture can direct and encourage communication. Testing the application and measuring achievements without the implementation of MELC into the actual BMU system wasn't possible. Our target behavior requires building a community and implementing new communication infrastructure, and this is not easily simulated. Design prototypes were relevant only to GUI design testing.

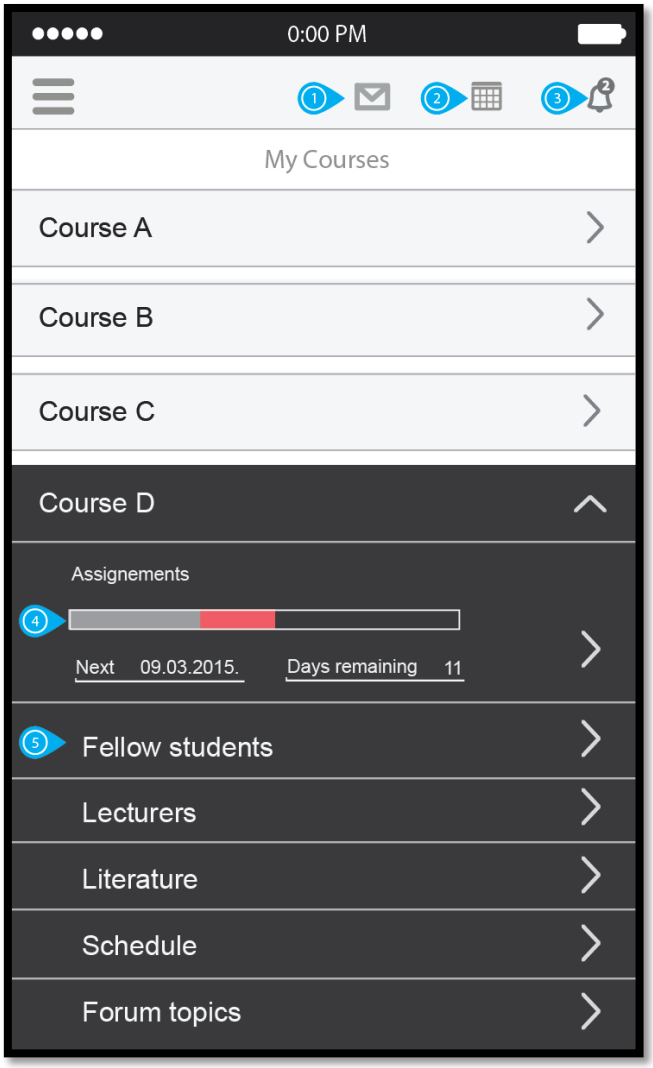

Figure 10. "My Courses" listing in MELC, with detail view of the item "Course D"

7. CONCLUSION

This paper focused on how to combine human (user) centred design principles and persuasive design methodology in an e-learning environment in order to influence and change users' behavior. The goal is to make an effective WBL system that is contextually distributed to desktop and mobile devices, thus increasing online student retention. In order to make an effective e-learning system, we must consider all users - not only students and their demands, but also the requirements of instructors and faculty staff. It is also important to align content management with the context of usage, and to design

separate user experiences for desktop and mobile applications.

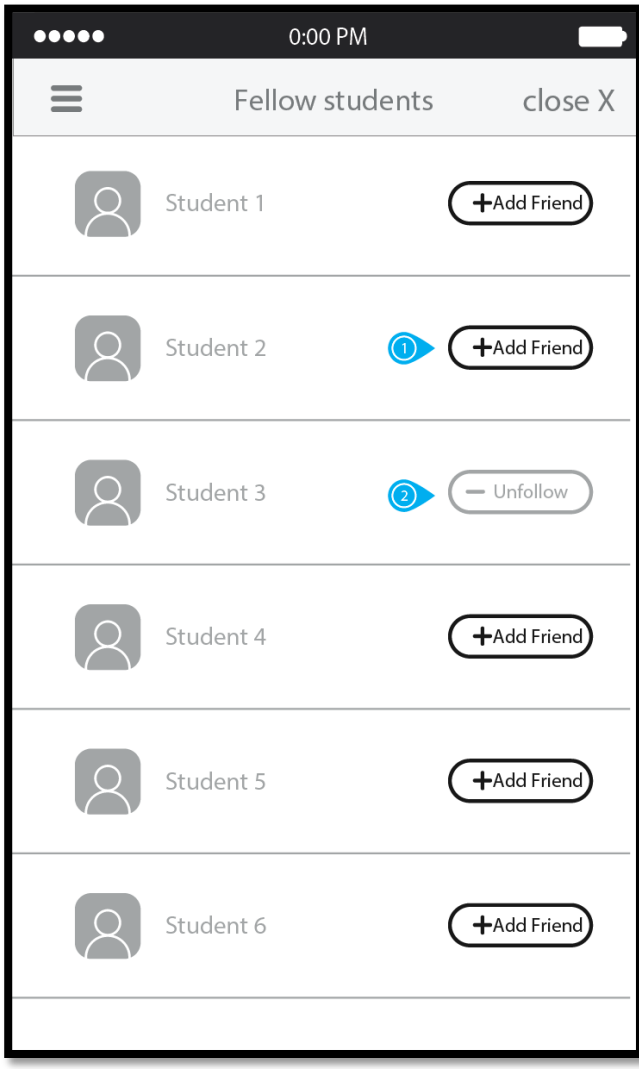

Figure 11. "Fellow students", list of all students who attend certain course

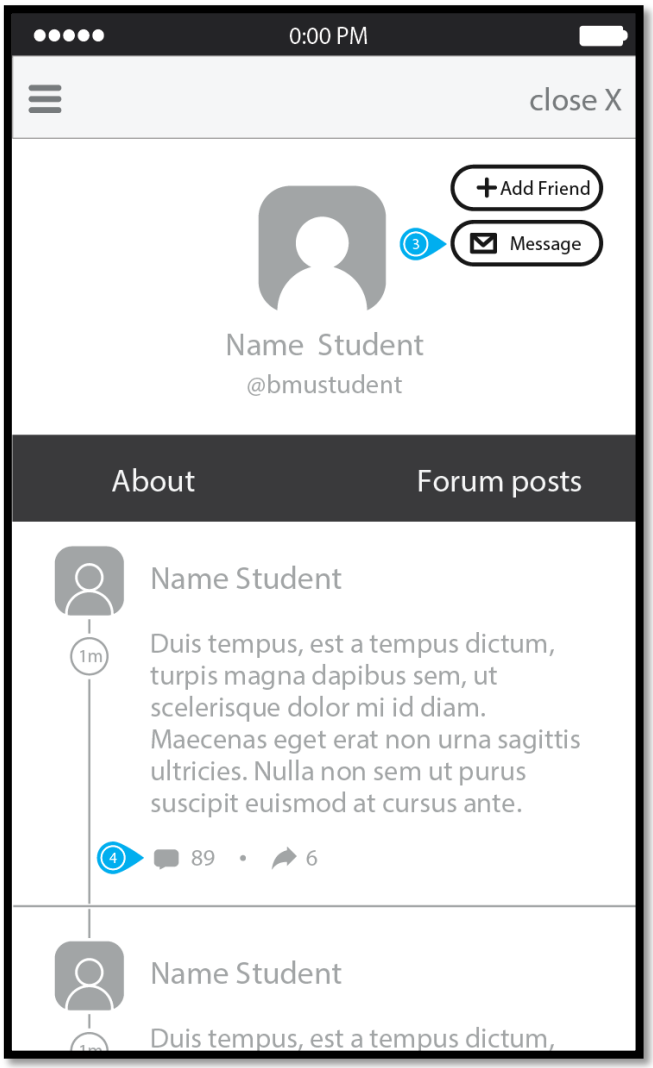

Figure 12. Public profile of a student

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