THE EDUCATIONAL USE OF SMARTPHONES AT UNIVERSITY

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Abstract

This paper presents an analysis of smartphones’ academic uses of Spanish university students. The purpose is to establish which factors and uses are perceived by students as more functional and productive in order to integrate these practices and uses in the European Higher Education Area. In this study we have implemented a quantitative methodology through factor analysis techniques, in order to discover the main smartphones' academic and general uses for improving learning processes in university subjects. To this end, a scale has been developed and validated to identify academic uses based on the participation of 419 Spanish college students from six Universities. According to the results obtained, we found in factor 1 that University students consider smartphones as a useful tool for developing academic tasks, mainly: "To study", "To look for academic information", "To interchange academic stuff", and "To look for subjects’ information". Furthermore, smartphones can help students to pose and answer questions, complete collaborative projects, and, more generally, engage in the social interactions foundational to learning. Therefore, it is recommended that universities continue developing new didactic strategies to connect both formal-informal and face-to-face ubiquitous learning settings.

Keywords: Smartphones, mLearning, Generic Competencies, Higher Education.

1 INTRODUCTION

Smartphones are increasingly becoming ever-present, penetrating and transforming everyday social practices and space. These practices can be complemented with text documents in different formats, audiovisual contents with mini-videos, microblogging applications, and social networks (Twitter, Facebook, Linkedin, etc.). Smartphones are no longer only a tool for communication, but in many cases have become an instrument of people’s social and work life, and possibly, a powerful instrument in academic life. Therefore, middle and higher education in developed and developing countries are now trying to adopt the use of smartphones in the learning process from different perspectives and teaching methods ([1], [2])

Looking at the wider context of mobile learning, mobile devices are responsible for new forms of art, employment, language, commerce, and learning. Nowadays, there is no separation between real and digital life: staying in online contact with friends and colleagues, working virtually on international projects, writing an online text, or researching recommendations for interesting locations nearby; digital communication enriches the real world ([3], [4]). Although mobile learning support is rare in classroom settings, research on faculty support regarding how mobile technologies can be used for teaching in Higher Education is even scarcer. Therefore, more research is needed to investigate mobile teaching and learning strategies and how these strategies are being implemented to engage students in the learning process ([5]).

For some years now, there has been intense scientific activity focusing on the impact of Information and Communications Technology on Education and the factors that facilitate or impede said impact ([6], [7], [8]). These studies all agree that ICT tools and resources may have a significant influence on teaching-learning processes. This context, mediated by ICT, promotes that knowledge stops to be associated to specific physical spaces and persons and goes through concepts of "mobility" and "ubiquity" ([9], [10]). This enables new scenarios that relax the pace of work, training facilities, and learning interests. On the other hand, it also enables the student to become a digital content-creator, to develop his/her conception of knowledge within an area of personal learning, and spread it

Mobile learning (mLearning) refers to the capabilities that mobile technology devices have brought to a physical classroom context as well as to the activities of students as they participate in learning institutions ([11], [12], [13]). There is an ever increasing amount of mobile learning research focusing on feasibility combined with data on user experience ([14], [15], [16]). The existence of nearly 7 billion active mobile phone subscriptions worldwide dramatically illustrates the huge potential for the mLearning market and its use in education ([17]). Mobile technologies are playing an increasingly
important role in college students' academic lives. Devices such as smartphones, tablets, and e-book readers connect users to the world instantly, increasing accessibility to information and enabling users to interact with each other. With the reality being thus, using mobile technology for teaching and learning has become a rapidly evolving area of educational research ([18], [19]). For this reason, mLearning may be considered as an avenue for content distribution ([20]), as a facilitator of reflective processes ([21]), and as a basis for developing and deploying mobile games based on learning ([22]).

Recent research has explored the patterns of use of a number of mobile services used by students ([23], [24], [25]). Results of these studies illustrate that smartphone-optimized content is widely used and that there is a clear desire by students for more resources to be made available in this format, including administrative information from universities. It is also important to recognize the need to address the technical requirements of producing and sharing content across multiple types of devices and networks. Results also confirm the importance of designing applications and services for learners that are both easy to use “on the road” and by whose use tasks maybe completed in short periods of time. A challenge in higher education is in designing social technologies that allow for the convergence of different pedagogic goals (control of learning) and ways of communication between different actors in the learning environment.

In such a technological context, possessing university generic competencies within EHEA has emerged as one of the fundamental references denoting educational success. By transforming teaching and learning, Information and Communication Technology (ICT) is considered to contribute to the acquisition of many of these key competencies. Students need to achieve an effective level of digital competence to assure their future in academic, personal, and professional fields (Dublin Descriptors, 2005). It is not sufficient simply to teach the handling of digital devices; learners must also be trained in how to learn with the help of ICT ([26]). Today these tools can be directly used as part of classroom activities to promote new methods of teaching and learning. Using portable devices in university degree programs will act to develop new practices, tools, applications, resources, and designing strategies to understand the situations of ubiquitous, pervasive, personal, and connected learning ([27]). This connection could manifest itself through formal education experiences (attending a workshop, participating in a training session, attending classes, etc.), or through informal education experiences for situated learning (receiving performance support while on the job).

The most important feature of new mobile phone technologies in the area of Education occurs when, due to their portable natures and their abilities to promote additional learning methods, learning continues beyond the classroom ([28]). Smartphones provide learning and training support for students through their capabilities, which include the enabling of quick content delivery, enhanced support time in project-based group work, a higher level of student engagement in learning-related activities within a multitude of diverse physical locations, and the enhanced availability and accessibility of information ([29]). The latest smartphone models area veritable mini-computer providing a myriad of capabilities such as a video camera, telephone, GPS, film player, games, e-books, e-mail, and the facilitation of internet access, music MP3, short messages, and the ability to download a plethora of apps designed for different purposes ([30]). Collaborative social networks, such as Facebook and Twitter, accessed via students' smartphones allow students to form groups in order to distribute and share their knowledge with ease, resulting in more successful collaborative learning ([31]). Not only are smartphones an integral part of how knowledge and its discourse transform, they also create new ways of accessing and sharing knowledge ([32]).

From the students' perspective, the key factors for innovation in Education will be the need for competition and implementing the mobility needs for a global higher education without frontiers as it is being promoted today with the trend of MOOCs and PLEs. Mobile computing environments appear to be more student-centered. Research shows that constructivist teaching practices are more prevalent in these contexts. Attendance rates improve and disciplinary referrals decline ([33]). Student attitudes toward learning also improve and the use of project-based and inquiry-based lessons increase with the use of ubiquitous devices. Ubiquitous learning ([34]) represents a new educational paradigm that, to a large extent, is made possible by new media and digital instruments. Ubiquity and mobility become recurrent principles for educational performance in this century. There is a direct relation between the idea of ubiquitous learning and the ability of mobile devices to provide highly interconnected educational environments ([35], [36] [37], [38], [39]).

In this educational and digital scenario, the European Union emphasizes that each citizen will need a wide range of competencies to adapt with flexibility to a world that is rapidly changing and is highly interconnected. A student who performs a practice in a ubiquitous digital ecosystem is subjected to a
series of stimuli flowing between nodes located in different media that filter information through a variety of channels, each one with individual narratives and symbolic codes.

In this paper, we present an analysis of academic uses from Spanish university students when using smartphones for academic purposes. The purpose is to establish which factors and uses are perceived by students as more functional and productive in order to integrate these practices and uses in the European Higher Education Area.

2 METHODOLOGY

A questionnaire was distributed in five Spanish universities (UNED is a Distance University and the other four develop a face to face teaching model: Complutense, Vigo, Oviedo and Granada). This questionnaire was sent through e-mail and by professors face to face intervention. 419 valid questionnaires were received. An Exploratory Factor Analysis with a Varimax (orthogonal) rotation of the five Likert scale questions from the survey was conducted. A correlation matrix is simply a rectangular array of numbers which gives the correlation coefficients between a single variable and every other variables in the investigation. The determinant of the correlation matrix is shown at the foot of the table below (Table 1).

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
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<th>5</th>
<th>6</th>
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<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To perform academic tasks</td>
<td>1,000</td>
<td>.571</td>
<td>.231</td>
<td>.234</td>
<td>.186</td>
<td>.481</td>
<td>.351</td>
<td>.096</td>
<td>.324</td>
<td>.588</td>
<td>.254</td>
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<tr>
<td>2. To study</td>
<td>.571</td>
<td>1,000</td>
<td>.368</td>
<td>.218</td>
<td>.207</td>
<td>.601</td>
<td>.408</td>
<td>.097</td>
<td>.306</td>
<td>.400</td>
<td>.246</td>
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<td>3. To look for academic information</td>
<td>.231</td>
<td>.368</td>
<td>1,000</td>
<td>.539</td>
<td>.662</td>
<td>.317</td>
<td>.667</td>
<td>.083</td>
<td>.507</td>
<td>.264</td>
<td>.646</td>
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<td>4. To chat with other students</td>
<td>.234</td>
<td>.218</td>
<td>.539</td>
<td>1,000</td>
<td>.655</td>
<td>.328</td>
<td>.536</td>
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<tr>
<td>5. To interact in social networks</td>
<td>.186</td>
<td>.207</td>
<td>.662</td>
<td>.655</td>
<td>1,000</td>
<td>.287</td>
<td>.559</td>
<td>.069</td>
<td>.295</td>
<td>.171</td>
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<tr>
<td>6. To interchange academic stuff</td>
<td>.481</td>
<td>.601</td>
<td>.317</td>
<td>.328</td>
<td>.287</td>
<td>1,000</td>
<td>.358</td>
<td>.227</td>
<td>.409</td>
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<td>.238</td>
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<td>7. To manage my email</td>
<td>.351</td>
<td>.408</td>
<td>.667</td>
<td>.536</td>
<td>.559</td>
<td>.358</td>
<td>1,000</td>
<td>.011</td>
<td>.398</td>
<td>.303</td>
<td>.482</td>
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<td>8. I do not use it</td>
<td>.096</td>
<td>.097</td>
<td>.083</td>
<td>.095</td>
<td>.069</td>
<td>.227</td>
<td>.011</td>
<td>1,000</td>
<td>.179</td>
<td>.025</td>
<td>.071</td>
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<td>9. To look for subjects information</td>
<td>.324</td>
<td>.306</td>
<td>.507</td>
<td>.434</td>
<td>.295</td>
<td>.409</td>
<td>.398</td>
<td>.179</td>
<td>1,000</td>
<td>.412</td>
<td>.384</td>
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<tr>
<td>10. To work collaboratively with other students</td>
<td>.588</td>
<td>.400</td>
<td>.264</td>
<td>.202</td>
<td>.171</td>
<td>.527</td>
<td>.303</td>
<td>.025</td>
<td>.412</td>
<td>1,000</td>
<td>.142</td>
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<tr>
<td>11. Leisure time</td>
<td>.254</td>
<td>.246</td>
<td>.646</td>
<td>.426</td>
<td>.511</td>
<td>.238</td>
<td>.482</td>
<td>.071</td>
<td>.384</td>
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<td>1,000</td>
</tr>
</tbody>
</table>

The KMO measures the sampling adequacy which should be greater than 0.5 for a satisfactory factor analysis to proceed. If any pair of variables has a value less than this, consider dropping one of them from the analysis. The off-diagonal elements should all be very small (close to zero) in a good model. Looking at the table below, the KMO measure is 0.807 (Table 4). Bartlett's test is another indication of the strength of the relationship among variables. This tests the null hypothesis that the correlation matrix is an identity matrix. An identity matrix is matrix in which all of the diagonal elements are 1 and all off diagonal elements are 0. From the same table, we can see that the Bartlett's test of sphericity is significant. That is, its associated probability is less than 0.05. In fact, it is actually 0.000. This means that correlation matrix is not an identity matrix.

3 RESULTS

The total variance of the 11 items was reduced by factor analysis. The first three factors explain 66.9% of the total variance. The first factor explains 31.4%, 25.4% the second and the third 10%. The scree plot is a graph of the eigenvalues against all the factors. The graph is useful for determining how many factors to retain. The point of interest is where the curve starts to flatten. It can be seen that the curve begins to flatten between factors 3 and 4. Note also that factor 4 has an eigenvalue of less than 1, so only three factors have been retained (Figure 1).
We have highlighted the values that are large in magnitude and from this we can make the following interpretation. Factor 1: uses of smartphones for academic purposes [1. To perform academic tasks (.925); 2. To study (.878); 3. To look for academic information (.865); 6. To interchange academic stuff (.834); 9. To look for subjects information (.761)]. Factor 2: uses in networking and communication [5. To interact in social networks (.898); 7. To manage my email (.838); 4. To chat with other students (.804); 10. To work collaboratively with other students (.781)]. Factor 3: uses related to leisure time [11. Leisure time (.794); 8. I do not use it (.775)]. (Table 2).

<table>
<thead>
<tr>
<th>Rotated Factor Matrix</th>
<th>Factors</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
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<tr>
<td>1. To perform academic tasks</td>
<td>.925</td>
</tr>
<tr>
<td>2. To study</td>
<td>.878</td>
</tr>
<tr>
<td>3. To look for academic info.</td>
<td>.865</td>
</tr>
<tr>
<td>6. To interchange academic stuff</td>
<td>.834</td>
</tr>
<tr>
<td>9. To look for subjects info.</td>
<td>.761</td>
</tr>
<tr>
<td>5. To interact in social net.</td>
<td>.035</td>
</tr>
<tr>
<td>7. To manage my email</td>
<td>.244</td>
</tr>
<tr>
<td>4. To chat with other students</td>
<td>.047</td>
</tr>
<tr>
<td>10. To work collaboratively</td>
<td>.380</td>
</tr>
<tr>
<td>11. Leisure time</td>
<td>.162</td>
</tr>
<tr>
<td>8. I do not use it</td>
<td>.099</td>
</tr>
</tbody>
</table>

4 CONCLUSIONS

According to the results obtained, we found in factor 1 that University students consider smartphones as a useful tool for developing academic tasks, mainly: "To study", "To look for academic information", "To interchange academic stuff", and "To look for subjects information". This supports findings in previous research, which shows that the main advantage of mobile and ubiquitous learning is that it increases flexibility for students studying at face-to-face and distance studies. Our findings are consistent with the findings of the ECAR study in which tablets and smartphones emerge as a potentially powerful mobile device in academia. Although to capitalize on the advantages of mobile technologies, professors and students need to be trained to successfully incorporate them into pedagogical practice and the development of platforms or software that allow professors and students to create or tailor mobile content should be encouraged.

New mobile approaches have to ensure that educational resources and content, including existing online repositories, are easily accessible from mobile devices. This can be accomplished by creating new formats for supporting the use of open educational resources in smartphones. Therefore, to capitalize on the advantages of mobile technologies, professors and students need to be trained to
successfully incorporate them into pedagogical practice. Similar trends were observed with the academic use of other emerging technologies ([40], [41]).

Professors should adapt resources to the students’ context to improve didactic activities and reinforce traditional learning process in higher education from the principles of mobile learning and ubiquitous digital environments, and students should be able to learn on the move wherever they are. Their smartphones are always with them, so they could be easily reminded of their educational activities and access to curricular content or participate with other students any time and any where through university implementation of mobile learning practice on any subject. This could be supported by the university staff by designing simple apps for developing collaborative work and curricular contents of their subjects and, in that way, to offer more opportunities to access information and interaction with other students.

The current study findings on smartphone capabilities indicate that students consider that these applications and tools to support didactic mobile activities are really useful for their learning and enhance the development of the subject, fostering collaborative work. Smartphones can help students to pose and answer questions, complete collaborative projects, and, more generally, engage in the social interactions foundational to learning. Research has shown that having a clearer understanding of students’ mobile practices encourages the university to implement more student-centered support and services. But technical training and skill development emerge as important factors, and students perceive both as more important than the technology itself. Therefore, to capitalize on the advantages of mobile technologies, professors and students need to be trained to successfully incorporate them into pedagogical practice. In many instances, a government’s investment in teacher training is more important than its investment in technology itself. Without guidance and instruction professors will often use technology to “do old things in new ways” rather than transform and improve approaches to teaching and learning ([42]).

In line with UNESCO Mobile Learning Policy ([1]), educational resources and information about a learner’s progress are stored on remote servers rather than on the hard drive of a single device, students can access similar material from a wide variety of devices (including desktop computers, laptops, tablets and smartphones). Each one suitable for different academic purposes, i.e. computer with a large screen and full-sized keyboard might be better for composing essays and conducting extensive internet research, whereas a mobile device might be superior for inputting bits of information collected in the field and noting exploratory ideas. Software is able to synchronize work across devices, so students can pick up on a mobile device where they left off on a desktop computer and vice versa, thereby ensuring continuity of the learning experience. Also, because computing is increasingly moving to the cloud, devices do not necessarily need expensive processors to utilize sophisticated software; they simply need to provide a learner a connection to the internet. Smartphones and apps in this digital context in higher education should be more than an emerging technology, a useful daily resource.

REFERENCES


