Mobile Devices and Apps, Characteristics and Current Potential on Learning

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ABSTRACT

Mobile devices and apps are placed in a prominent position in the daily routine of all people. The ubiquity and mobility are their main advantages. They are really becoming tools available for students and professionals in order to be totally connected anywhere and for consulting and accessing information of any field. In fact, the use of these devices has sparked a positive impact on medical sector as they allow implementing and including new technologies to make students more prepared for their future work. The goal of this paper is to describe the main characteristics and the use of mobile technologies in this field. The mobile technology's scope covers tablets and Smartphones. To achieve this goal, a survey was conducted in the University of Salamanca and the participants were undergraduate students of Medical Schools and medical professionals. Results reveal that the usage of mobile devices and apps are spread out among them. However, it is still necessary an in-depth analysis of the potential and the use of specialized apps for medical education.

Keywords *Apps, Higher Education, Medical Education, mHealth, mLearning, Mobile Devices, New Technologies*

INTRODUCTION

Currently, there are 50,76 million of mobile lines in Spain (CMT, 2014). Step by step, people have got used to these devices, which have provided new ways of communication, interacting each other, getting information or even learning.

The number of these lines has been increasing dramatically since the last decade. Not only that, this trend has sparked the appearance of mobile devices more sophisticated as Smartphone and tablets where it is possible to run mobile applications or apps on them. In fact, according to the study conducted by *Fundación Telefónica* (Fundación Telefónica, 2015), there is roughly 4 million of downloads of apps daily in Spain. Smartphones have, on average, 29 apps installed on it per user, whereas tablets have around 33 apps.

Thus, these figures reveal their popularity and success. These apps can be found in the marketplace, available since different mobile devices. In fact, according a report (Statista, 2014), there are currently more than a million of apps in Google Play and more than one million in App Store.

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On the other hand, there is a study conducted by Educause Center for Applied Research (ECAR) (Eden Dahlstrom, 2012) that has published an article about the use of mobile technology in higher education. One of the results claim that around 67% of surveyed students reported that mobile devices are very important in their academic success and their activities in the University. In fact, one of the upward trends of the last years is precisely the application of new technologies within the educational context and specifically of mobile devices and its educational use, which is known as mobile learning (Prieto, Migueláñez & García-Peñalvo, 2014a; Prieto, Migueláñez, & García-Peñalvo, 2014b). Therefore, higher education and consequently and specifically, medical education, are highly impacted by this trend.

There are many reports related with the use of mobile devices (Nielsen, 2014; MillwardBrown, 2014; Interactive Advertising Bureau, 2014, Mobile Marketing Association, 2013; Salesforce Marketing Cloud, 2014) in general and the use of students in particular (Eden Dahlstrom, 2012). One of the reports (Fundación Telefónica, 2014) affirmed that around 90% of medical professionals has accessed Internet during 2013 and 51% of them has used Smartphones to access medical information. However, the studies centred on the use of mobile devices are oriented for a commercial use, specially designed for market analysis to analyse the behaviour of users and identify their demands from a marketing or commercial point of view (Nielsen, 2014; MillwardBrown, 2014; Interactive Advertising Bureau, 2014, Mobile Marketing Association, 2013; Salesforce Marketing Cloud, 2014)

The use of mobile devices and its inclusion as learning tools in the classrooms of Medical Schools is becoming a reality. Some Schools, as the Medical School of University of Stanford have already adopted the new technologies (mainly tablets) for leaning, forcing their use providing one of them to all undergraduate students (Dolan, 2011; Gallegos, 2013)

Students want to be more and more prepared for the work, so University and Medical Schools must adopt the cutting-edge technologies for providing the students the best education and allow them to be part of the new digital era. Because of that, they must solve some pitfalls in order to modify their curriculum. It is important to notice that the Medical Schools that have implanted these devices, they are still using them (Briz-Ponce, Juanes-Méndez, & García-Peñalvo, 2014a).

However, in spite of these advantages, the use of medical apps for medical education is still limited or unknown. This paper wants to analyse these benefits and the behaviour of a specific group such as students and medical professionals. Besides, it wants to provide some insights about the main factors to consider when it is necessary to promote the use of apps in an academic environment. This outreach includes the analysis of different characteristics of the participants and how they could influence on the use of mobile devices for learning. It is important to notice that this paper also tries to analysis the relationships between these characteristics and how they may have an effect on the participants' behaviour.

The study is divided in four sections. The first section describes the methodology used to perform the survey in University of Salamanca and provides a review of the main characteristics of the participants' profile. The second section explains the results obtained focusing on the main uses of mobile devices and the different types of apps utilized and the time employed. The third part is focused on the discussion and finally it describes the main conclusion drawn of this research.

METHODOLOGY

Method

The method used for the current investigation is a cross-sectional survey distributed in two ways: face to face and on line.

The face-to-face survey was conducted in the Medical School of University of Salamanca, distributing it directly to undergraduate students ten minutes before a class. In case of medical professionals, the survey was giving directly to personal contacts.

The online survey was developed using GoogleDocs. The participants received a link to the survey. The first page described in detail the goal of the survey as part of the study of a doctorate programme. The participants answered the survey anonymously.

The conducted survey was formed by 19 questions which covered the main participant's characteristics: gender, age, ownership of mobile devices, daily use of Smartphone and tablets, the most important issues for downloading apps and the type of apps downloaded by the participants.

The data were collected for a month since March 2014 to April of 2014 and the final number of participants was 124. The data were computerized in the program SPSS v21 (Vinacua, 2007) and we use this tool to analyse the different variables obtained from the data (Lee & Wang, 2003)

Participants

The survey was conducted in University of Salamanca and the participants were undergraduate students of Medical School and professionals. It involved medical residents, medical specialists and medical teachers in the group of medical professionals. The Table 1 provides information of the survey participant's characteristics, such as frequency and the percentage of each dimension.

As for the data, the dominant age of the participants falls within the range from 18 to 35 years old with 71% of the participants.

Besides, half of the participants were students (n=61, 49,2%), medical residents were 19,4% (n=24), medical specialists 16,9% (n=21) and finally medical teachers 14,5% (n=18) which it means that medical professionals represent 50,8% of total. More information about the characteristics of participants could be found on the published articles (Briz-Ponce, Juanes-Méndez, & García-Peñalvo, 2014b; Briz-Ponce, Juanes-Méndez, & García-Peñalvo, 2014c).

It is important to emphasize that most part of the survey respondents (94,4%) owned a mobile device.

RESULTS

Use of Mobile Devices

This section analyses the daily use of participants with their smartphones, tablets or both. The obtained results reported that most part of the participants used the mobile devices daily and only 9% of them that owns a smartphone, did not use it to download apps. This data reveals the importance that the user gives to the apps and how the apps are widely spread in the Society, as it was commented before.

Table 1. Descriptive statistics on participant characteristics

Variable	Participants' Characteristics		
	Descriptive	***Frequency***	***%***
Gender	Male	45	36.3%
	Women	79	63.7%
Profile	Student	61	49.2%
	Medical Residents	24	19.4%
	Medical Specialists	21	16.9%
	Medical teachers	18	14.5%
Range of age	From 18 to 25 years	60	48.4%
	From 26 to 35 years	28	22.6%
	From 36 to 45 years	6	4.8%
	From 46 to 55 years old	23	18.5%
	+ 55 years	7	5.6%
Ownership	Only Smartphone	58	46.8%
	Only Tablet	1	0.8%
	Smartphone and Tablet	58	46.8%
	None	7	5.6%

Frequency of Use

In the survey, all the participants had to answer their frequency of use of apps on Smartphone and/or tablets. The results differentiate between the data obtained for students and the one obtained for professionals, overall to analyse if there is any difference between them. The results claimed that medical professionals (medical residents, specialists and teachers) used Smartphones between 1 and 2 hours per day, whereas students used them between 3 and 4 hours per day. In addition, analysing more in depth the tablets, the results obtained are completely different. In this case, students, medical specialists and medical teachers on average do not use tablets. On the contrary, medical residents are very active users using the tablets on average between 3 and 4 hours per day.

It is interesting to know the dependency between two variables: daily use of apps on Smartphone and the profile of participants. The null hypothesis indicates that there is no dependency between them and the alternative hypothesis is there is a dependency between them. As they are nominal variables, it was necessary to use the non-parametric Chi-Square method (Chakravarthy et al., 2011). In this case, the SPSS program was used. The variable selected as row is: daily apps for Smartphone and as column, the variable is: the profile of the participants (students, medical residents, medical specialists and teachers). The values of Phi and Cramer's V (Alan Agresti, 2002) were calculated as well. The results were: Chi-Square=71,012, ρ=0,000, Phi=0,757 ρ=0,000 and Cramer's V =0,437, ρ=0,000.

At the α=0,05 level of significance, there exists enough evidence to reject the null hypothesis that considers both variables independents (p=0,000, p<0,05); besides, the values of Phi and Cramer's V falls within the range from 0,3 to 0,7 so it can be said that there is a moderate relationship between the daily use of the smartphones and the profile of the participants.

Then, the same process was performed again, but in this case, between these two variables: the profile of the participants and the use of tablets. The results obtained were Chi-Square=14,054, ρ=0,120, Phi=0,347 ρ=0,120 and Cramer's V=0,200, ρ=0,120.

At the α=0,05, level of significance reveals that there is no evidence enough to reject the null hypothesis that both variables are independents (ρ=0,120>0,05).

Characteristics

Other aspect to consider in the survey was the most important factors that participants considered to download apps. It was possible to select more than one option, without a limitation on the maximum number of answers. The Figure 1 shows the percentage of each factor considering all participants. It is important to notice that the participants could select more than one option.

On average, each participant had selected 2,89 characteristics of 8 options they could choose.

The Content characteristic is the factor considered the most important one, followed by usability. Half of the participants reported the recommendation of a friend and privacy/security as relevant. Then, Figure 2 shows the same information but categorizing the results by profile of participants.

From here, it is possible to deduct several points. The first point is that the content is the key characteristic for all profiles to download apps. In fact, medical professionals consider it the

Figure 1. More important characteristics to download apps

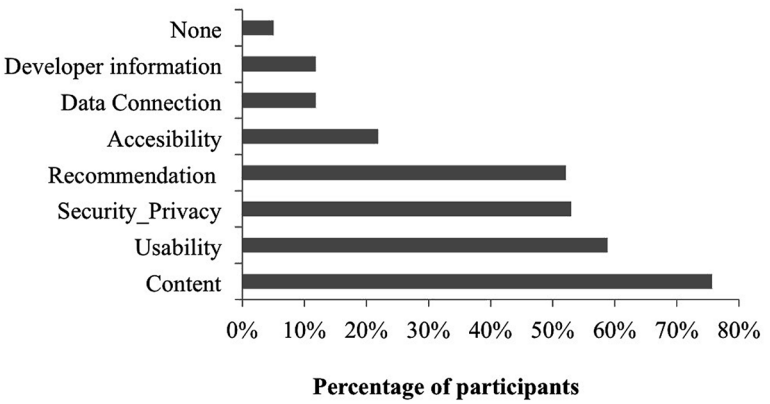
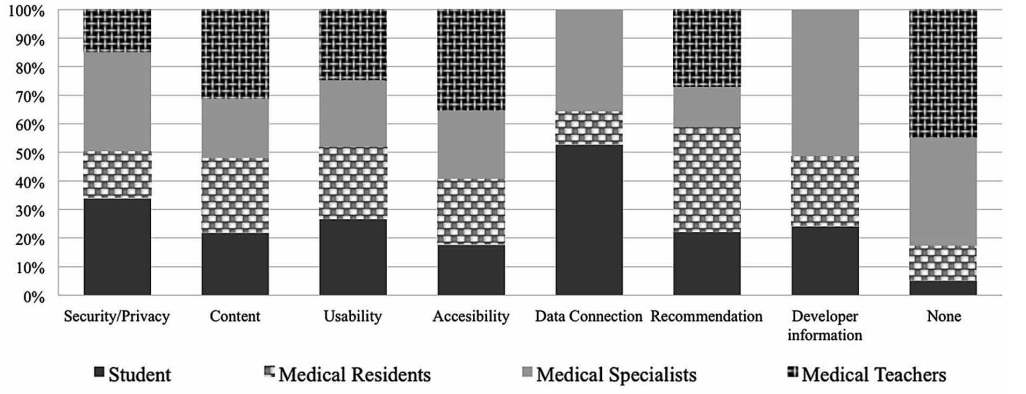


Figure 2. Key factors to download apps according to the profile



most important issue when they had to select only one option. Medical specialists and residents considered that the content and the security/privacy have the same level of importance.

Recommendation of a friend is the factor most used for medical residents and teachers, whereas this characteristic is not so relevant for students.

In addition, the survey included an open question to give the participants the possibility of providing other factors not included already in the list. 83,9% of participants (n=124) considered that there are not any additional characteristics. A minority of them, 4,8% did not even answer. The total number of answers for this question was very scarce. However, 6,5% and 1,6% of participants that answered it, reported that the price and the capacity respectively, were very important to take into account when downloading any app.

Finally, the survey asked for the most important characteristic for downloading apps. In this question, it was only possible to select only one option to download apps. The content factor was scored as first option (34,3%), followed by security/privacy (28,4%). The third position was placed by usability (16,7%), then recommendation (9,8%) and only 7,8% of participants selected none of them. Therefore, the content option was again considered key to download any app (as it appeared in Figure 1).

Type of Apps

This section explains the type of apps that students and medical professionals use more frequently. This analysis applies to the type of apps, not the app itself and the results are shown in Table 2. The most popular type of apps are related with entertainment, followed by social networks and games. The apps related with medicine: medical apps and training medical apps are placed on 5th and 7th position respectively. It is important to highlight the difference between the apps used for medical education (such as atlas, information, etc.) and the apps used for medical diagnosis (drugs dictionary, taking care of patient, medical calculator, etc.).

The last column of the Table 2 indicates the percentage of participants that had selected this option. For example, 70,97% of all them (n=124) had selected entertainment apps, whereas 33,06% had selected medical apps and 25,00% of respondents chose training medical apps. The second column indicates the percentage of the total of answers (N=426) as it is necessary to take into account that one participant could have checked more than one option. On average, each participant selected 3,5 different categories.

Table 2. Type of apps used for participants

	Answers		Percentage of participants
	N	*Percentage*	
Entertainment	88	20.7%	70.97%
News	33	7.7%	26.61%
Social Networks	84	19.7%	67.74%
Email	56	13.1%	45.16%
Games	64	15.0%	51.61%
Medical Apps	41	9.6%	33.06%
Medical Education	31	7.3%	25.00%
Other	20	4.7%	16.13%
None	9	2.1%	7.26%
Total	426	100%	346.55%

This study is mainly focused on apps related with medicine, specifically on two types of apps: medical apps and training medical apps. In this case, medical professionals use these types of apps more frequently than students as it is shown in Figure 3. The percentage of this figure was calculated based on the total of participants. The reasons claimed by students to explain this result is the unawareness of these types of apps or that they did not have to use them.

From the graphic of Figure 3, it is possible to observe that the number of students that had used a training medical app is higher (5%) than the one that had used a medical app (2%). If this number is calculated only considering the percentage based on number of students, the result indicates that 15% of students had used some apps related with medicine.

On the other hand, the profile that had used the most the apps related with medicine are medical residents. In this case, the medical apps are the most popular one and they are oriented for the treatment of patients and for diagnosis.

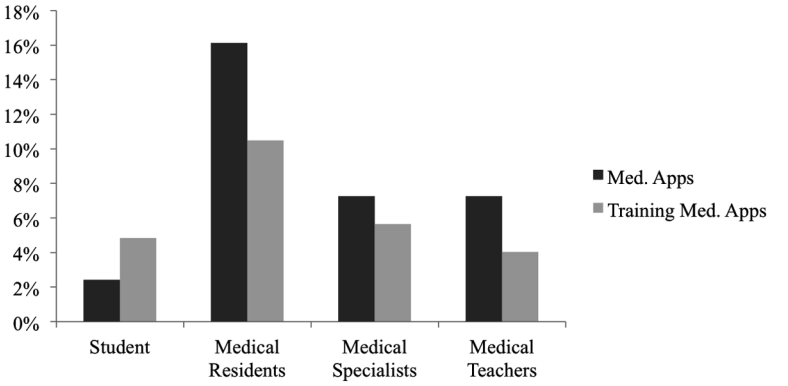
The total percentage of professionals that had used some apps related with medicine is 32%, whereas considering only the number of professionals, the percentage is increased until 63%.

Number of Downloaded Apps

The survey also studied the number of apps that the participants had downloaded during the last month. The measurement of the participants' activity covers only a short specific period of time, as it is more relevant the activity during the last month than one or two years ago.

The mode is calculated in order to know the most frequent value of the data. The results indicate that the number of apps downloaded on Smartphone was between 1 and 10, whereas on tablets, the figures indicated that they do not use them for downloading apps.

Figure 3. Percentage of participants that have selected medical apps or training medical apps according to the profile



In this case, it is calculated the grade and the correlation relationship between these two variables (download of apps for Smartphones and Tablets) and the profile of the participants (students, medical residents, medical specialists and medical teachers). In this case, the same process as it was followed in the last analysis, was performed: the Chi-square method and the Phi and Cramer´s V value were calculated as well. The results were Chi-square=13,176, ρ=0,040, Phi=0,326 ρ=0,040 and Cramer's V =0,310, ρ=0,040.

The null hypothesis indicated that there was no relationship between the number of apps with Smartphone and the profile of participants, whereas the alternative hypothesis indicated that there was a relationship between them.

At α=0,05, level of significance, the output data was ρ-value <0,05 (ρ=0,04) so it is enough evidence to reject the null hypothesis. Thus, there is a relationship between both variables. In this case, the Phi and Cramer's V values were found within the range 0 – 0,3, so there is a weak relationship between them.

The same method was used to analyse the tablets. The null hypothesis was that there is no relationship between the number of apps utilized on tablets and the profile of the participants. The results were Chi-Square=7,968, ρ=0,537, Phi=0,259 ρ=0,537 and Cramer's V=0,251, ρ=0,537.

At α=0,05, level of significance, the results reveal that there is no enough evidence to reject the null hypothesis (ρ=0,537, ρ>0,05), so both variables could be considered independents

DISCUSSION

These results can provide important insights in the use of mobile devices. The use of new technologies is part of our lives and it is a reality that it is not possible to avoid. These gadgets can be used for higher education (Juanes, 2013) but we do not know exactly how medical professionals are using them.

There are several publications that consider the mobile technology with a great potential in the context of higher education. However, it seems that its use it is centred on a didactic goal, more than a constructivism ecosystem (Herrington, Herrington, Mantei, Olney, & Ferry, 2009).

It is important to highlight that the survey conducted by General Medical Council (Visser & Bouman, 2012) reported that 30% of physicians use medical apps with Smartphone. Our results

support this study, as we have obtained that roughly 33,3% of participants downloaded a medical app and 25,2% of respondents has used a training medical app.

In addition, an article (Ozdalga, Ozdalga, & Ahuja, 2012) claims that the apps have existed since several years, however there is not specific data that help us to understand them better.

Different European organisations are interested on mobile learning. UNESCO (UNESCO, 2011) recognizes that the mobile phones are evolving rapidly and they claim that the integration of mobile phones into education carries a great potential that could make important changes on the way of learning. Mobile technologies provide new ways of communications and share information anywhere and anytime and they are the main reasons that make UNESCO be interested on the evolution and the potential on mobile learning.

Besides, in 2009, the International Telecommunication Union, (ITU, 2009) published a brief report about mobile applications. They explained the rapid growth of these devices and they claimed that the lack of interoperability between different Operation Systems (Android, IOS, etc.) could be a constraint for the development of mobile apps market . Even, it could make the process slow and may cause customer confusion about availability and features.

Currently, this prediction could be considered a reality, as there is some confusion about the number of apps in the marketplace. The developers have to follow the process of different marketplaces and sometimes it is not realistic to launch the app in all of them for two main reasons: cost and time to market.

CONCLUSION

The use of apps is gradually growing. According our results, smartphones are the devices most used for downloading apps and for looking information. The survey also suggests that the students are active users for smartphones whereas medical residents are active users for tablets. It is important to take into account that there is a relationship between the use of smartphones and the daily number of apps used and the profile (students and medical professionals).

On the other hand, the medical apps and training medical apps are spread among the medical industry. As it is mentioned above, the great amount of apps in the marketplace makes that the most part of students and physicians have an unawareness of them. This unawareness is precisely one of the causes that they use to justify not using them.

Surprisingly, the results obtained with the present study could suggest that around 63% of medical professionals have used apps related with Medicine, whereas only 15% of students have used them, which is against we could think at the beginning. Thus, we could suggest that medical professionals are very open-minded to the cutting-edge technologies and they consider them a tool that is worthy to use and explore.

The role of these tools is still unknown, and although there is some Medical Schools that incorporate technologies in their curriculum, there is still a gap to cover. The problem is that technology goes faster that Institutions are able to adopt it. In fact, it could be possible that when a University decides to implement it, it is obsolete because new learning methodologies are being studied and analysed.

This article pretends to show a brief overview of the real use of mobile devices by students and medical professionals. Besides, it is important to notice that if this technology can become a new tool for students and help them for learning within the new digital era, it is necessary that the apps fulfils the requirements and the demands of the users. Because of that, three future line of research could be implemented.

For example, it could be interesting to obtain samples from different Universities and even different countries in order to establish a comparative overview of the results of the survey. This information could be useful in order to determine the acceptance of technology from different points of view, which will provide the research with more data and valuable information for the analysis.

On the other hand, it could be complementary to analyse an specific app with an experimental session in order to evaluate directly this tool for students and their interaction with the new technologies.

Finally, due to the great amount of apps available in the marketplace, it is not possible to know which one is the best. For that, a quality protocol should be developed, designed and implemented in order to guarantee an useful app which will provide the requirements of the users.

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