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The use of mobile learning by 6th-year medical students in a minimally-supported environment

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Abstract

Objectives: The study aims to identify the impact of minimal support on medical students' mobile learning activities.

Methods: The study was performed at the Sultan Qaboos University, Oman, on 129 medical students in their 7th year. The study consisted of a quantitative survey of the students, focussing on their mobile learning activities during their 6th year, while using their own mobile devices (such as smart phones) for mobile learning activities. In addition, their perceptions of barriers to, and advantages of, using mobile devices were investigated. Data were analysed using Microsoft Excel and EpiInfo.

Results: All students used their mobile device as telephones and used most of the sophisticated applications. There was significantly less usage made of medical applications, such as clinical guidelines and medical reference tools. Barriers were screen size, cost, limited memory and battery. Advantages were time-saving, ease of access and use. Few students (14%) highlighted lack of institutional support as a problem.

Conclusions: Lack of support does not mean lack of usage. It does, however, mean predominantly simple usage. Given the importance of mobile devices in modern medical practice, this has strong negative implications for the professional preparedness of students studying in such environments.

Keywords: Mobile learning, m-learning, medical education, survey, support

Introduction

The use of mobile telecommunication devices by medical professionals in the practice of medicine has been widely documented.[1-10] In these studies, a frequent thread of argument is that mobile devices are crucial to modern medical practice.

The use of handheld mobile devices in education falls under the definition of mobile learning (m-learning). (Sometimes, laptop computers are considered mobile devices, but this not usual when discussing m-learning.) An international survey by one of the researchers (KM) amongst 477 educationalists using educational technology indicated that 27% used m-learning in their teaching.[11] The most common educational activities were feedback to students, direct instruction downloading, course administration, students gathering data to post to the course or to other students, question and answer sessions, and assessment. These activities (with perhaps the exception of "students gathering data to post to the course or to other students") appear to be mobile equivalents of typical activities in any course, especially at undergraduate level. In medical education, however, the later years, or 'clinical years' (from 3rd -year onwards) typically involve less course-based instruction, and rely more heavily on self-directed learning. During this period, students are in close contact with medical professionals using professional tools. Not entirely surprising, then, studies of clinical students' use of mobile devices have shown their increasing use and perception of value of the devices.[5,12-14] For example, Strayer et al. found as many as 59% of the medical students used their Personal Digital Assistants (PDAs) on a weekly basis, and 71% had loaded medical applications onto their PDAs, and accessed their web-based courses from their PDA significantly more than from other computing devices.[14] Crucial to the success of m-learning in the studies is the technical, financial and other support offered to the students.[13-17] For example, Strayer et al. report that PDAs were issued directly

to the students, their online material was adapted so that it could be accessible via PDA, and particular PDA software was recommended for each of the cases that their students were expected to examine.[14] In addition, Grasso et al. found that "lack of institutional support was identified as the most common area of dissatisfaction" amongst students.[12]

Context

The College of Medicine and Health Sciences at the Sultan Qaboos University (SQU), Sultanate of Oman, teaches a seven-year medical degree (MD). In the sixth-year, students go through clinical rotations in the various disciplines in close contact with the health professionals and patients. The teaching occurs at the SQU Hospital and other affiliated hospitals and clinics in the Muscat area. Much of the teaching is case-based, usually supplemented by a weekly lecture series.

Important to this study, however, is that very little support is offered to students for their use of mobile devices. Students have to purchase their own devices and their own software (although they can do so through a loan scheme and pay off the loan over an extended period of time). There is no institutional recommendation of devices, no staff or student training, and no technical support. SQU does not require or even request students to use these devices, and staff are not encouraged to tailor their electronic materials to mobile devices.

In spite of these conditions, general observations indicate that the students at SQU are using mobile devices during their medical training. We wished to know if their usage was comparable to usage patterns detailed in other research. In addition, we wished to know if the lack of institutional support was perceived as a barrier. We needed to know this to determine if lack of institutional support was impacting upon our students' education and, ultimately, their preparedness as doctors.

This study attempted to determine the nature of the students' use of their mobile devices for m-learning activities, and the factors affecting use and non-use of these devices in such a minimally-supported environment. From the results, we wished to draw conclusions regarding these students' preparedness for the demands made on the 21st century health professional.

Methods

The project was aimed at the 129 medical students at SQU who had completed their 6th year of study, and were in their 7th year of study. A survey form and consent form were created. The survey form was based primarily on other surveys evaluating m-learning and the use of mobile devices in the medical fields.[5,6,10-12,16,17] Students were asked to indicate the activities for which they used their devices, and the frequency of usage. The question asked was "Did you use your mobile device for any of the following during the year?" and students were asked to indicate the frequency from a selection (see Table 1). Students were also asked to select items from lists of advantages and barriers, indicating which of these they perceived as advantages and barriers when using their mobile devices. A single question at the end of the form invited further comments from the participants.

The consent form was based on a standard consent form used in other research by one of the authors (KM). The consent form contained the title of the project, the names and contact details of the researchers, the purpose of the research, a description of the research project, a description of the risks and discomforts for participants in the research, an assurance of confidentiality (including the encryption details), a statement informing the participants that their participation was entirely voluntary, a description of the documentation storage and the participants' right to make or request personal copies of the documentation, a final statement of consent, and a place for the participants to write their name, the date and sign the form.

Although many of the students do not have English as their mother tongue, the language of instruction at SQU is English. Common (albeit not absolutely perfect) scales of measuring English language levels are the Flesch Reading Ease and the Flesch-Kincaid Grade Level.[18] The Flesch Reading Ease score of the consent form was determined to be 57.3, and the Flesch-Kincaid Grade Level was determined to be 8.9, indicating that the students would have little trouble in understanding the consent form.

Ethics approval for the study was granted by the SQU College of Medicine & Health Sciences Medical Research Committee and Ethics Committee (MREC#365).

After a brief meeting with two student representatives to explain the concerns of the research, the consent form and survey forms were distributed together in paper format to the 7th year students during October 2010. The distribution was performed by the researchers, and the participants were given the opportunity to ask any clarifying questions. When the documentation was returned to the researchers, the consent forms were separated from the data sheets and stored separately so that no identifying information could be assigned to any data sheet.

All data were collected and stored anonymously and electronically, and were secured by means of passwords, and 256-bit encryption. The data were placed into a Microsoft Excel spreadsheet, and descriptive statistical analyses were performed. Statistical tests were performed using EpiInfo Version 6.

Results

General

A total of 84 students returned completed survey forms, giving a response rate of 65.1%, a figure comparable to other similar surveys.[12] Of the 84 students, 74 indicated their gender, of which 35(47.3%) were male. Compared to

the demographic information supplied by the University's administration, there is no statistical difference between this gender composition and the gender composition of the class as a whole.

Of the 84 students, 55 (65.5%) used Nokia devices, 12 (14.3%) used Sony/Ericsson, and 11(13.1%) used iPhones. Other manufacturers made up the other numbers. From the 82 students who indicated their date of device purchase, we calculated they had had their current devices for a mean of 2.5 years. Of the 61 students who indicated their model number, it was determined that 58(95%) could be classified as "smartphones." (There is no industry-accepted definition of a "smartphone," so the device was classified as "smart" if it had a web browser or if the manufacturer classified it as a smartphone). No participants added any further information or comments.

Activities

The students indicated the number of times during their 6th year that they used their devices for various activities. A summary of the results is given in Table 1 below.

Ranked in this way, the items give an indication that the standard functions of a mobile phone (Short Messaging Services (SMS) and calls) are the most common activities performed on the devices by students. The moment we enter the realm of more sophisticated usage, however, there is a sharp drop in activity. Looking at the last columns (Daily usage), we see that there a statistically significant ($p<0.001$) drop in usage to the next group of activities which includes Scheduling/Calendar services, Dictionaries, and electronic books. From there, usage tapers off, until there is negligible usage of patient tracking, course surveys and evaluations, and accessing of non-medical web sites.

We wished to determine whether or not male students performed any activities to a greater or lesser extent than females, as this has been reported in the literature.[5] There were no statistical differences in whether or not an activity had been performed at all during the year. There was, however, a statistically significant difference in the use of Electronic books, with 34.3% of the males and only 7.7% of the females accessing them on a daily basis, and 42.9% of the males and only 10.3% of the females accessing them at least once a week ($p < 0.05$). These were the only differences found.

Advantages

The students indicated the greatest advantages to them of using mobile devices. A summary of the results is given in Table 2.

Time saving, ease of access and ease of use are the most important advantages associated with using the mobile devices. Interestingly, even without institutional support and training, 59% of the students rated "Ease of use" as an advantage.

Although there appear to be differences between males and females, the only statistical difference ($p<0.05$) was found in "Ease of access to resources."

Table 1. The number of times that the students used their devices during their 6th year

Activity	Never		Once		2-5 times		6-10 times		10 + times		Monthly		Weekly		Daily		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Send/receive SMSs	0	0.0	1	1.2	1	1.2	0	0.0	4	4.8	0	0.0	1	1.2	77	91.7	84
Make/receive calls	0	0.0	1	1.2	1	1.2	0	0.0	4	4.8	0	0.0	3	3.6	74	88.1	83
Sched./calendar	15	17.9	1	1.2	5	6.0	1	1.2	7	8.3	14	16.7	18	21.4	22	26.2	83
Dictionary	25	29.8	1	1.2	3	3.6	3	3.6	12	14.3	3	3.6	15	17.9	22	26.2	84
Electronic books	44	52.4	4	4.8	5	6.0	1	1.2	5	6.0	3	3.6	4	4.8	17	20.2	83
Med. calculators	41	48.8	2	2.4	12	14.3	2	2.4	7	8.3	4	4.8	3	3.6	9	10.7	80
Taking notes	36	42.9	2	2.4	15	17.9	6	7.1	5	6.0	8	9.5	7	8.3	5	6.0	84
Clinical guideline	52	61.9	1	1.2	4	4.8	1	1.2	9	10.7	2	2.4	6	7.1	5	6.0	80
Medical web sites	53	63.1	1	1.2	9	10.7	4	4.8	1	1.2	4	4.8	5	6.0	5	6.0	82
Send/receive email	56	66.7	3	3.6	5	6.0	1	1.2	4	4.8	5	6.0	4	4.8	5	6.0	83
Medical ref. tools	62	73.8	1	1.2	4	4.8	0	0.0	3	3.6	3	3.6	2	2.4	4	4.8	79
Access lec. notes	49	58.3	9	10.7	9	10.7	2	2.4	2	2.4	5	6.0	4	4.8	3	3.6	83
Medical research	69	82.1	0	0.0	3	3.6	2	2.4	2	2.4	2	2.4	1	1.2	3	3.6	82
Access web Vids	53	63.1	4	4.8	8	9.5	3	3.6	4	4.8	2	2.4	4	4.8	2	2.4	80
EMRs	74	88.1	0	0.0	2	2.4	0	0.0	1	1.2	2	2.4	0	0.0	2	2.4	81
Journal articles	64	76.2	1	1.2	7	8.3	1	1.2	2	2.4	1	1.2	4	4.8	1	1.2	81
Course exams	48	57.1	6	7.1	9	10.7	1	1.2	6	7.1	7	8.3	3	3.6	1	1.2	81
Recording Pt. Inf.	70	83.3	2	2.4	3	3.6	2	2.4	3	3.6	0	0.0	0	0.0	1	1.2	81
Lab reports	79	94.0	1	1.2	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0	1	1.2	82
Log books	80	95.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.2	81
Access SQU Vids	73	86.9	2	2.4	4	4.8	0	0.0	0	0.0	2	2.4	2	2.4	0	0.0	83
Patient tracking	76	90.5	0	0.0	0	0.0	2	2.4	1	1.2	0	0.0	1	1.2	0	0.0	80
Course surv/evals.	77	91.7	1	1.2	2	2.4	0	0.0	1	1.2	1	1.2	0	0.0	0	0.0	82
Other sites	64	76.2	5	6.0	4	4.8	3	3.6	1	1.2	4	4.8	0	0.0	0	0.0	81

Barriers

The students indicated the most important barriers to the use of the mobile devices. A summary of the results is given in Table 3.

Screen size and cost appear to be the main barriers to using mobile devices. Again, in the light of lack of institutional support, although "Technical difficulties" was relatively highly ranked, it was not as high as we had expected. Similarly, lack of support was regarded as a barrier by only 14% of the students.

Although there appear to be differences between males and females, the only statistical difference ($p<0.05$) was found in "Limited memory."

Table 2. Summary of the advantages perceived by students (N=76)

Group	Male (30)		Female (38)		N/A (8)		Total (76)	
	n	%	n	%	n	%	n	%
Saves time	20	67	29	76	5	63	54	71
Anywhere/any time access	18	60	28	74	3	38	49	65
Ease of use	20	67	18	47	7	88	45	59
Ease access to resources	7	23	23	61	5	63	35	46
Small Size	14	47	13	34	5	63	32	42
Accessing Current Info	9	30	13	34	4	50	26	34
Reduce risk of errors	8	27	8	21	0	0	16	21
Cheap	6	20	6	16	2	25	14	18
Enhance health care delivery	2	7	8	21	0	0	10	13
Improved patient care	2	7	3	8	0	0	5	7
Easy to complete doc.	2	7	1	3	1	13	4	5

Discussion

Usage patterns

Expectedly, the standard functions of the mobile phones (SMS and telephone calls) are most common uses, and is a result found in most other surveys - after all, a "mobile phone is still a phone."[19] Apart from this, the overall frequency of usage of the mobile device matches the frequency of usage found in some studies.[5, 14,16] The very high popularity of calendar services and dictionaries has been found elsewhere[12,16] as has the relatively low usage of the devices to access electronic medical records (EMRs).[12] Student access to EMRs is a contentious issue.[20] In our setting, one of the main reasons for low usage of the devices for patient tracking and accessing EMRs would be that these activities are tightly controlled, and would be performed only under close supervision.

On specific activities, it is difficult to draw comparisons with other studies, because of differences in student groups, technological devices, and frequency of usage classifications. While many of the individual activities are similar between the SQU students and students in other studies, the SQU students perform those activities to a far lesser degree. For example, Heath et al.[16] found that the calendar was the most used tool, and was not used at all by only 10% of the respondents. In our study, in was ranked as number 2, and was not used by 15% of the students. The difference is, however, that 80% of Health et al.'s participants used it more than once a week, whereas only 26% of SQU students used it as frequently. Nevertheless, the impact of mobility of the students through their rotations and different teaching locations appeared somewhat eased by their being able to manage their schedules electronically, and to carry electronic copies of their books with them. This view was expressed by students in Health's et al.'s study.[16] Of significance, however, is that our students generally used the medical applications far less than students in other studies.[14,16] We will return to this issue later.

Advantages

The patterns of the advantages listed by the students reflects patterns that have been reported by other surveys of both students and teachers.[6,10,11] It is obvious that, having the device in one's hand and so easily portable means a saving of time, and allows access at any time and from any place, as needed. The students recognise, however, that this comes at a cost, and less than 20% of the students saw this as an advantage.

Troubling, however, is the fact that the value of the devices to enhancing health care and improving patient care are not immediately apparent to the students. One of the reasons may be that the students are not yet directly responsible for patient healthcare; a second may be the point raised in the previous sub-section: that these students do not use the medical applications as much as has been found in other studies.

Table 3. Summary of the impact of barriers perceived by students (N=79)

Barrier	Male (31)		Female (39)		N/A (9)		Total (79)	
	n	%	n	%	n	%	n	%
Screen Size	17	55	21	54	3	33	41	52
Cost	20	65	17	44	3	33	40	51
Limited Memory	8	26	21	54	5	56	34	43
Battery	16	52	12	31	3	33	31	39
Technical Difficulties	11	36	15	39	4	44	30	38
Speed	9	29	15	39	2	22	26	33
Keyboard size	10	32	7	18	1	11	18	23
Software Quality	7	23	9	23	2	22	18	23
Prefer pen & paper	4	13	12	31	0	0	16	20
Lack of knowledge	4	13	10	26	1	11	15	19
Interface	7	23	2	5	5	56	14	18
Slow data Entry	6	19	6	15	2	22	14	18
Lack of support	6	19	3	8	2	22	11	14
Privacy	2	7	6	15	0	0	8	10
Bandwidth	4	13	3	8	0	0	7	9
Device too delicate	2	7	3	8	2	22	7	9
Interf. w. other devices	4	13	2	5	0	0	6	8
Poor Vision	0	0	2	5	0	0	2	3
Loss of data	0	0	1	3	0	0	1	1

Disadvantages

The small size of the device has been found to be a barrier in other studies.[10] Corresponding to the small numbers who had found the devices cheap, 50% of our students registered the cost as a barrier, as has been found in other studies where users of mobile devices have had to supply their own devices without financial assistance.[21] Similarly, limited memory and battery life are problems that have been found elsewhere.[10, 22]

Level of support

For the purposes of this paper, the most crucial issue is that of support. As Sandars and Dearnley note succinctly, "Training is essential for all users."[23] Studies performed on medical students have highlighted the value of a wide range of support approaches, including building specialised networks for mobile devices,[15] provision of the devices (or subsidising students' costs),[5,15,16,21] recommending specific software, devices or technical specifications[16,17] adapting materials specifically for the handheld devices[14,15,17] ensuring that academic tasks were tailored to the functionality of the devices[15-17] providing technical support and training to students and staff,[5, 14-17,21] and performing feedback surveys as follow-up and quality control.[14-17] Jackson et al.[17] reported that the majority (60%) of their students required hands-on technical assistance with their devices, even after training.

At a first glance, the results from our study appear to contradict these previous studies. As indicated, SQU does not offer any support to its staff or students. While technical difficulties were experienced by a relatively large percentage of the students, the very high number that rated "ease of use" as an advantage, and the very low number that registered lack of institutional support as a barrier was unexpected.

The most plausible explanation, however, lies in the discussion of the activities for which the students are using their devices: our students are not using their devices to their full potential. For the most part, their devices are being used as cell phones with a little bit of extra functionality, there is very little usage of the sophisticated medical applications that occurs with students in other studies.

Implications for our students as doctors

At the University of California, Los Angeles, it is mandatory for 3rd and 4th year students to have PDAs or equivalent devices. This is "for two primary reasons: to enable 'point of contact' access to information resources; and to prepare students for practicing medicine in the 21st century."[24] This statement echoes the findings of the researchers of medical professionals' usage of mobile devices[1-6,8-10] who argue for the importance of mobile devices in modern medical practice.

From this argument, it is clear that, if medical training institutions do not provide proper support for students in their use of hand-held devices, they will run the risk of not equipping those students to deal with the problems facing the 21st century health professional. This appears to be the case at SQU.

Study limitations

The study has relied on a self-reporting survey at one institution, and there may be other variables affecting the low usage of the sophisticated medical applications available on the mobile devices. As with all surveys, the sample may be more interested in the topic than their entire class, and therefore usage may be higher than the entire class. Repeated studies at other institutions that do not offer support will be able to confirm or refute the generalisability of these findings. In addition, in order to cover usage across the entire 6th year, this survey had to be conducted during the students' 7th year. Although the survey was conducted early in their 7th year, it would still require them to remember their usage over the previous year.

Conclusion

It is apparent that, without support, medical students will use their handheld devices as telephones as much as supported students may. It is also apparent that unsupported students will use similar tools that supported students may use. Crucial, however, is the fact that unsupported students appear to use the medical functionality far less than supported students, and this has a direct bearing on their preparedness as doctors in the 21st century.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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