BENTHAM OPEN

CrossMark

Open Medicine Journal

Content list available at: www.benthamopen.com/MEDJ/

RESEARCH ARTICLE

The Use of Smartphone Applications in Medical Education

E. Snashall and S. Hindocha[*]

Department of Plastic Surgery, Whiston Hospital, Merseyside, L35 5DR, UK

Abstract:

Introduction:

With the rise of computer technology, there has seen a shift in the delivery of medical education towards e-learning. Specifically, there has been increased use smartphone technology and applications (app) use.

Aim:

The aim of this article is to assess the use of medical apps amongst medical students.

Results:

89% of respondents owned a smart device. Of these, 98% used Apps. Medical applications were used in 82% of the "App user" population. Apps were used for medical learning purposes in 85% of this population, of which 93% found them useful. If a more comprehensive medical learning application were to be available, 97% of responders would consider using it.

Conclusion:

The use of smart devices and medical apps is prevalent amongst medical students and will continue to rise in the future. Medical apps may be a very important adjunct in medical education however the evidence remains limited. To keep up with technological advances and meet the learning needs of medical students both now and in the future, more research is required to assess and address these needs.

INTRODUCTION

Undergraduate medical education has historically been lecture based. With the rise in accessibility of computer technology, this has seen a shift in the delivery of medical education and has resulted in the development of electronic learning (e-learning). Some medical schools have recognised this growing trend and initiated the introduction of e-learning in the undergraduate curricula [1]. As e-learning developed, some universities began offering distance learning degrees. The number of these distance learning degrees is increasing year on year [2].

As technology and the internet has advanced, social media has become a powerful teaching tool. The use of social media is increasing, especially amongst students. Websites such as Facebook and other social media are being frequently used as an adjunct in the learning process of medical students and doctors [3]. This has increased further with advances in technology that have seen a shift in use from personal computers towards portable electronic hardware devices.

Smart phones and tablet devices [4], or "smart devices" are mobile hardware that have been developed to be used whilst on the move. The devices have a simple design making them easy to use and are becoming increasingly popular. In 2012, nearly 500 million smart phones were bought, which totaled more than the number of personal computers sold [4]. Their popularity is seemingly attributed to the applications ("Apps") that they contain. Apps are independent

* Address correspondence to this author at the Department of Plastic Surgery, Whiston Hospital, Liverpool, L35 5DR UK; Tel: + 44(0)1244366265; Fax: +44(0)1244366265; E-mail: hindocha2001@yahoo.com

software applications. They can be downloaded onto smart devices and can serve multiple functions. Apps are used for advertising and marketing, recreational purposes, by news corporations, for social media and for communication purposes in addition to education.

Apps encompass a multimedia approach including videos, texts, illustrations and podcasts, and their popularity is increasing. Apple's App Store alone has over one billion downloads a month [5]. In 2011, $718 million was spent on healthcare Apps, a seven fold increase on 2010 [6]. The increase in popularity of medical apps is in part due to the immediate access to electronic medical text and portability of the device to enable use anywhere. There is also evidence to show that medical apps have demonstrated an improvement in patient care [7]. Apps facilitate lifelong learning, an essential component not only of undergraduate education but required to continue in a medical career[8]. Handheld computers in medical education are already recognised by professional bodies such as the General Medical Council [8] and some medical schools are already supplying medical students with smart devices [9]. There is a substantial variety of medical apps available for download onto smart devices. As evidence to the increasing availability and diversity of medical apps, websites have emerged that are dedicated to their review [10].

With the continued rise of smart devices and e-learning, medical Apps are likely to become an increasingly important aspect of future medical education.

TEACHING AND LEARNING MODELS

Honey [11] categorize four broad learning styles; activists, pragmatists, theorists and reflectors. This emphasises the importance of understanding different learning needs in order to provide effective teaching. Medical apps can be tailored to target these individual needs and therefore appreciate different learning styles.

Nonaka [12] proposed a theory for the creation of knowledge. This follows that "explicit" knowledge i.e. core knowledge base is obtained prior to becoming "tacit" knowledge. Tacit knowledge is created through experience and practice. Smartphone apps provide a portal to obtain explicit knowledge quickly for example in a clinical situation. This can then be converted into tacit knowledge through application to the clinical scenario. This is important for medical education as effective learning necessitates a balance between the two.

Sfard [13] described two models of learning, the acquisition model and the participation model. The acquisition model puts emphasis upon the individual and their learning needs in contrast to the participation model which focuses upon becoming part of a social community and participating in the learning process. For effective learning, a balance needs to be achieved between these models. Learning requires obtaining knowledge in addition to social participation. Apps provide a channel for the acquisition of knowledge in a clinical setting, which allows practical participation to enhance the learning process. This can be seen in apps which simulate for instance heart sounds or bowel noises.

Another model of learning is illustrated by Lave [14] who describes the concept of situated learning. This puts emphasis on the need for contextualisation of knowledge. The portability of the smartphone device allows information to be readily accessed and applied in a clinical context.

Davies [15] formulated a model of learning facilitated by smartphone devices. A trigger leads to the recognition of an educational need. This may be insufficient knowledge of a disease process during a patient encounter. Following this, the smartphone is used to gain knowledge in this area. The knowledge can then be contextualised into the relevant clinical scenario. Repeated application of the acquired knowledge allows consolidation. Through this, and through reflection, smartphones facilitate learning.

Despite the prevalence of smartphone app use in medical education, there is a distinct lack of objective evidence assessing this.

AIM

The aim of this article is to assess the use of medical applications amongst medical students. In addition to this we aim to ask how these are currently being utilized, and to what benefit, by medical students. We also review current literature on this increasing technology use.

METHODS

A survey was sent to all undergraduates of the University of Liverpool (approximately 1800 student). This was completed anonymously either by hand or by email. The survey was distributed by email to all current medical students

through the University medical school email database. The questionnaire asked questions in relation to the use of smartphones, apps and specifically medical apps. We also asked in regard to their feelings towards the future use of apps in both their training and future careers. The survey can be found as **Appendix 1**.

RESULTS

123 students returned the survey (approximately 7% return rate).

Table 1. Results of medical app survey.

	Number of respondents	Own a smart device	Use apps	Use apps in a medical context	Use medical apps for learning	Found medical apps for learning useful	Believe in need for further medical apps
Medical students	123	109 (89%)	107 (98%)	88 (82%)	91 (85%)	100 (93%)	104 (97%)

Eighty nine percent of respondents owned a smart device. Of these, 98% used Apps. Medical applications were used in 82% of the "App user" population (Fig. **1**). Apps were used for medical learning purposes in 85% of this population, of which 93% found them useful. However, if a more comprehensive medical learning application were to be available, 97% of responders would consider using it (Table **1**). Applications that were most popular amongst these students included "Almost a Doctor", "Oxford Handbook" series and "Pastest".
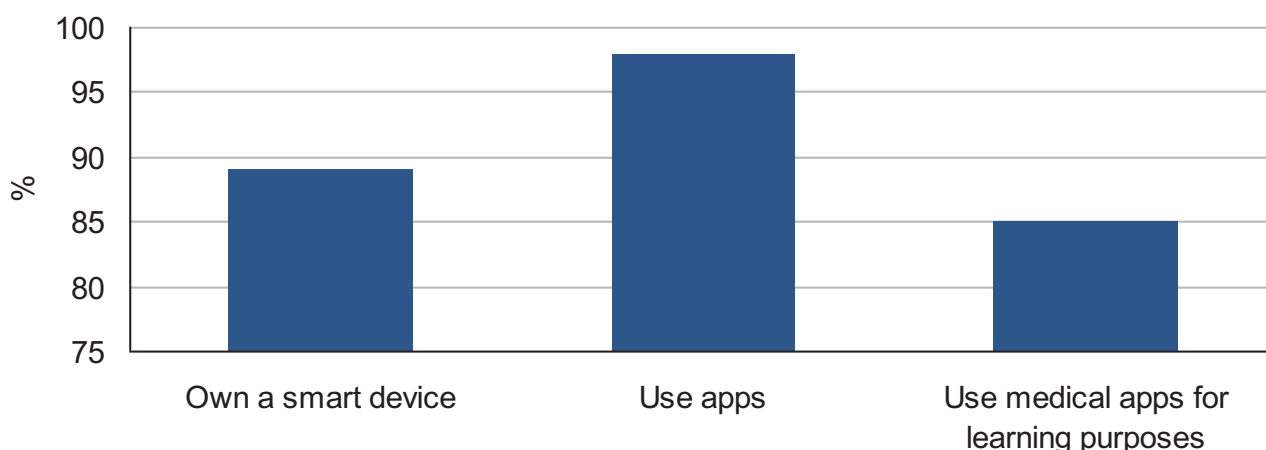

Fig. (1). Use of smart devices, apps and medical apps.

These results, in regard to application use, are comparable to the results of other studies in the literature [17]. The usage of medical applications however, appears to be slightly higher in this cohort than that found in the literature. This may be due to selection bias in that questionnaires were more likely to be filled in by those with an interest in smart devices. Another contributing factor will be the major technological advances and increasing popularity in smart devices in the past year.

DISCUSSION

It is clear that medical apps are widely used by medical students. Medical apps can provide instant, readily available information that can be accessed in a clinical setting such as a ward or clinic. This acquired knowledge can then be put into context and incorporated into clinical practice in order to improve learning. Hardyman [18] demonstrated that the quick and timely acquisition of knowledge from a smart device can provide better patient care and more efficiency in the work place. Another advantage of some medical apps is that they can be used in an "offline" mode, hence they do not require internet connectivity and will therefore not interfere with medical equipment.

There is strong evidence that medical apps facilitate the concept of situational learning. It is documented by both

Sfard [13] and Lave [14] that learning is more effective when in context and when knowledge is combined with practical application. This model of learning is evidenced by Hardyman [14] in a case report series. One report states that a smartphone facilitated anatomy teaching before a theatre session through the use of visual aids and allowed the information being delivered to be put into context and enhance the learning experience [15]. This has a role in impromptu teaching scenarios where learning material has not been pre-prepared. The accessibility and portability of medical apps means that they can be used at times when learning would otherwise be impractical. Examples include whilst stood at a bus stop or between patients in clinic. This reduction in [16] "time wasting" is also evidenced in the literature by Davies [17].

Although the usefulness of medical apps has been well documented, this approach to learning should be supplementary and not be used alone. Apps should be used as an adjunct to traditional teaching methods. This fits in with current learning strategies in that a learning environment should encompass a variety of learning media to maximise the learning process [18].

The above survey reports that 97% of the population would use a comprehensive medical app for learning purposes if available. Franko [19] found that the continued inclination for the development of further apps demonstrates that currently available apps do not meet the current educational needs of medical students and doctors. Greater involvement from universities, postgraduate education programmes and the Royal Colleges, could result in the development of appropriate apps that address the educational needs of this population.

Multiple respondents from the study survey reported concerns regarding the reliability and lack of regulation of medical apps. Franko [19] reported that there is no formal regulation regarding the content of medical apps. This could indicate another potential role for governing bodies to undertake in the future.

Some studies have reported on the affordability of smart devices and apps. Payne [20] reported that some medical students found that smart devices were too expensive for a student budget and therefore the use of medical applications is limited to a certain cohort. Surprisingly, this same study found that more students owned a smart device and used apps than doctors. This was despite the cost of these devices and demonstrates the rise in popularity of smart devices amongst the student population. This might also be explained by the fact that medical students are on average of a higher socioeconomic class compared to the general population and are more likely to have financial help from their parents. Franko [19] found an inverse correlation between seniority of doctor and app use. This is likely to be a result of greater use and understanding of smart devices and technology among the younger population, and could contribute to the higher prevalence of smart devices amongst students. This suggests that the future use of smartphones and apps will increase as the younger and more technologically-familiar students and doctors become older.

The acceptability of smart devices in the hospital setting is another hurdle that needs to be overcome. A case report by Payne stated that some observers found it rude when a smart device was used in a clinical environment. Looking at a phone on the ward could be misinterpreted and risk the health professional looking disinterested. This could adversely affect the patient-doctor relationship. With increasing use and awareness of smart devices, this obstacle may gradually be overcome.

With continued technological advances and increasing popularity of smart devices, app use will increase in the future. In order to meet educational needs, and keep up with the technological advances, medical apps need to be made available to all medical students and doctors. To meet educational needs and demand, more money needs to be invested by Universities, hospital trusts and Royal Colleges into the development of medical apps for learning purposes. This also requires regulation of medical apps by professional bodies. There is a lack of objective data on the use of smartphones and apps in the literature. Further research is required to assess educational needs in relation to medical apps.

CONCLUSION

Smart devices and the use of medical apps is prevalent amongst medical students. This will continue to rise in the future amongst both medical students and doctors. Educational needs can be supplemented by the use of medical apps and are particularly important in contextual learning. Evidence for the use of apps in medical education however, remains limited. To keep up with technological advances and meet the learning needs of medical students both now and in the future, more research is required to assess and address these needs.

Appendix 1: App Survey

PLEASE DELETE ANSWERS AS APPROPRIATE

What is your grade?

Medical student _____ which year? _____ F1/SHO _____ SpR/Consultant _____ Other _____

Do you use a smart phone/tablet device?

Yes _____ No _____

Do you use Apps?

Yes _____ No _____

Have you used Apps in a medical context?

Yes _____ No _____

Do you know of colleagues using Apps to in a medical context?

Yes _____ No _____

Have you used medical Apps for referencing medical information/pathways?

Yes _____ No _____

If so, have you found them useful?

Yes _____ No _____

If available, would you use a medical Apps to reference medical information/pathways?

Yes _____ No _____

Have you used medical Apps for learning purposes?

Yes _____ No _____

If so, have you found them useful?

Yes _____ No _____

If a comprehensive medical app for learning purposes were available, would you consider using it?

Yes _____ No _____

If you have any specific comments/experience please elaborate below

_____

_____

_____

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

REFERENCES

[1]   Choules AP. The use of elearning in medical education: a review of the current situation. Postgrad Med J 2007; 83(978): 212-6.
        [http://dx.doi.org/10.1136/pgmj.2006.054189] [PMID: 17403945]

[2]   Davidson M. Degrees go the distance. The Telegraph Available from: http://www.telegraph.co.uk/education/expateducation/
        8487609/Degrees-go-the-distance.html [25 Jan, 2014];2014

[3]   Hurt NE, Moss GS, Bradley CL, *et al.* The 'facebook' effect: college students' perceptions of online discussions in the age of social
        networking. Int J Scholarship Teach Learn 2012; 6(2): 1-24.

[4]   Weintraub S. Industry first: Smartphones pass PCs in sales. CNN Money Available from: http://tech.fortune.cnn.com/ 2011/02/07/idc-smartphone-shipment-numbers-passed-pc-in-q4-2010/ [25 Jan, 2014];2014

[5]   Thornhill T. Apple's App Store boasts 585,000 apps with 1bn downloads a month. Daily Mail Available from: http://www.dailymail.co.uk/sciencetech/article-2119332/Apps-overtaken-Web-popularity-according-latest-statistics-actually-theres-probably-app-tell-that.html#ixzz2J1RXB1BD [25 Jan, 2014];2014

[6]   Jahns RG. The market for mHealth application reached $US 718 million in 2011. Research2guidance Available from: http://www.research2guidance.com/the-market-for-mhealth-application-reached-us-718-million-in-2011/ [25 Jan, 2014];2014

[7]   Weightman AL, Williamson J. The value and impact of information provided through library services for patient care: a systematic review. Health Info Libr J 2005; 22(1): 4-25.
[http://dx.doi.org/10.1111/j.1471-1842.2005.00549.x] [PMID: 15810928]

[8]   Recommendations on undergraduate medical education Tomorrow's Doctors. UK: General Medical Council 2009.

[9]   Manchester Medical School. Innovative teaching. Available from: http://www.mms.manchester.ac.uk/about-us/whymanchester/education/innovativeteaching/ [25 Jan, 2014];2014

[10]   IPhone Medical Apps. Available from: http://iphonemedicalapps.com/ [25 Jan, 2014];2014

[11]   Peter Honey Publications. The Learning Styles Helper's Guide Available from: http://peterhoney.com/documents/Learning-Styles- Helpers-Guide_QuickPeek.pdf [25 Jan, 2014];2006

[12]   Nonaka I. A dynamic theory of organizational knowledge creation. Organ Sci 1994; 5(1): 14-37.
[http://dx.doi.org/10.1287/orsc.5.1.14]

[13]   Sfard A. On two metaphors for learning and the dangers of choosing just one. Educ Res 1998; 27(2): 4-13.
[http://dx.doi.org/10.3102/0013189X027002004]

[14]   Lave J, Wenger E. Situated Learning. Cambridge University Press 1991.
[http://dx.doi.org/10.1017/CBO9780511815355]

[15]   Davies BS, Rafique J, Vincent TR, *et al.* Mobile Meducation (MoMEd) - how mobile information resources contribute to learning for undergraduate clincial students - a mixed methods study. BMC Med Educ 2012; 12: 1.

[16]   Ozdalga E, Ozdalga A, Ahuja N. The smartphone in medicine: A review of current and potential use among physicians and students. J Med Internet Res 2012; 27, 14(5): 128.
[http://dx.doi.org/10.2196/jmir.1994]

[17]   Hardyman W, Bullock A, Brown A, Carter-Ingram S, Stacey M. Mobile technology supporting trainee doctors' workplace learning and patient care: An evaluation. BMC Med Educ 2013; 13(1): 6.

[18]   Richardson W. Educational Studies in the United Kingdom. Br J Educ Stud 2002; 50(1): 3-56.
[http://dx.doi.org/10.1111/1467-8527.t01-1-00190]

[19]   Franko OI, Tirrell TF. Smartphone app use among medical providers in ACGME training programs. J Med Syst 2012; 36(5): 3135-9.
[http://dx.doi.org/10.1007/s10916-011-9798-7] [PMID: 22052129]

[20]   Payne KB, Wharrad H, Watts K. Smartphone and medical related App use among medical students and junior doctors in the United Kingdom (UK): a regional survey. BMC Med Inform Decis Mak 2012; 12(12): 121.
[http://dx.doi.org/10.1186/1472-6947-12-121] [PMID: 23110712]