Teaching Medical and Health Sciences students to develop e-posters with Learning Toolbox

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Abstract

Introduction: In the 21st Century, medical personnel require electronic and written communication skills in order to communicate with colleagues and patients. These specific skills are seldom taught, as communication skills’ teaching and assessment currently emphasises face-to-face, verbal communications. This study aims at teaching some skills required for electronic communication, and evaluating the process.

Methodology: We used a specific platform to teach 188 medical and health sciences students, working in groups, to develop e-posters that run as mobile apps, and evaluated the process in terms of resource demands, students’ experience (through an online survey), and e-poster quality.

Results: From 188 students, a total of 144 students submitted 30 accessible e-posters, and 71 students participated in the survey. The resource demand was equivalent to resource demand for teaching paper poster design and creation. Despite technical problems not related to the platform, the students were able to produce acceptable quality e-posters with reasonable effort.

Discussion and Conclusion: This study indicates that it is possible to teach medical and health sciences students the basics of e-poster design, and extend their communication abilities into the realm of electronic communication. This bodes well to prepare them to take their place as e-poster creators in a broad range of spheres, especially for academic conferences and patient communication.

Keywords: communication skills, mHealth, e-posters, mlearning, Learning Toolbox

Introduction

Electronic communication skills
Communication skills are essential for health professionals, and are used in day-to-day interaction with patients and colleagues. (Epner and Baile 2014; Hinkle et al. 2017; Modi et al. 2016; Roze des Ordons et al. 2016; Sanson-Fisher and Cockburn 1997) Current medical student communication skills’ training and assessment focuses on face-to-face, verbal communication. (Boileau, Patenaude, and St-Onge 2018; Goldhamer et al. 2018; Hinkle et al. 2017; Joyce, Steenbergh, and Scher 2010) As we progress through the 21st century, however, more and more communication happens electronically and asynchronously; while health professionals’ communication via email and texting has been explored, other forms of communication will need attention as their potential becomes more obvious.

One such form is the use of mobile applications (apps) for healthcare. The use of mobile apps in health care is known as mHealth, and is a field recognised by the World Health Organisation as having the "potential to transform the face of health service delivery across the globe." (World Health Organization 2011) Within mHealth, the use of mobile apps in medical teaching and learning (mlearning) is also receiving attention, and an important component of mlearning is teaching medical students to develop their own apps. (Masters et al. 2016) At Sultan Qaboos University, investigations into this area have been explored for some time, and these investigations have shown the viability of such apps and the need to teach students the basic tools for developing such apps. (Masters 2014)

Simultaneously, at academic conferences, poster presentations are undergoing a transition, and electronic posters (e-posters) are becoming increasingly popular; e-posters move away from a static sheet of paper to a dynamic and interactive experience that actively engages the audience, and permits the poster designer to present material in multimedia and multilingual environments. (Powell-Tuck, Leach, and Macready 2002; Shin 2012; Masters, Gibbs, and Sandars 2016; Carter 2016)

Large professional organisations, such as the Association for Medical Education in Europe (AMEE), have been using e-posters for several years at their conferences (Masters, Gibbs, and Sandars 2016). Because e-posters are still relatively new, however, a short-coming of many e-posters is that some designers are simply creating electronic versions of the paper equivalent, with very little exploration of the potential of what the new media can offer. As with all skills, there is a need to teach health professionals how to design e-posters properly.

Background

At Sultan Qaboos University, Medical (MD) and Basic Medical Science (BMS) students have been taught paper poster design in their 1st-year undergraduate medical informatics course (Medi2100). The students work in groups over a 5-6-hour period, which includes time to present their posters to the other students and receive peer comments and questions. The emphasis is not so much on content as on the process of working in groups, designing a poster aimed at a specific audience, and giving and receiving peer-review. In Phase II of their degree, as part of their Research Module project, the students design an academic-style poster, and present the work that they have researched. In their poster design, they use the poster design skills learnt in Phase I.

While this is a useful exercise, until 2017, it suffered from a flaw: students were being taught paper poster design, and the current literature (cited above) informs us that this approach is fading. By the time our students graduate, it is likely that e-posters will dominate in academic poster presentations, and our students will have no training and no experience in creating e-posters. As a result, there is a need to develop a systematic and effective approach to teach medical and health science students how to design e-posters.

Aim of the Study

The aims of the study were to:
determine whether e-poster design skills could be taught in the same way as paper poster design skills have been taught;
• evaluate the process and the students’ experience, and
• provide insight for principles that can benefit future SQU classes and students at other universities.

Research Methodology

Development environment testing

As yet, there is no industry-standard e-poster design system. Whichever system is taught, however, the basic principles and skills of what one can expect from one e-poster system should be relatively easily transferable to another (just as spreadsheet skills can be relatively easily transferred from one spreadsheet system to another).

For this research, the development environment used to create the e-posters was Learning Toolbox (LTB). LTB is a web-based platform originally developed as part of the EU’s 7th Framework Programme (Grant Agreement #318209) for workplace learning, allowing people to quickly and easily build their own mobile learning apps through simple drag-and-drop processes, and share them with others. It has since been further developed and extended with e-poster creation and management capability.

LTB was chosen because it offers the opportunity to combine mobile app development with e-poster design, and already has an impressive (albeit short) history of being used in academic conferences, including the AMEE2017 Conference in Helsinki, Finland and the European Conference on Technology Enhanced Learning 2017 in Tallinn, Estonia. While LTB is not quite a mobile app development platform, the e-posters are available within a mobile app, and this gives them the look and feel of an independent mobile app.

For initial testing, the lead researcher experimented with LTB for more than six months, and worked with LTB’s designers and creators in order to more fully understand the environment. During the Summer Semester of 2017 at SQU, two students taking the Medi2100 course tested LTB by creating a simple mobile app e-poster. The results indicated that, using the instructional material supplied by LTB and supported by extra material developed by the course instructor, the students were able to develop a simple and successful mobile app e-poster.

As a result, a decision was taken to expand the use of LTB to the main course to be run in the Fall Semester (September 2017-January 2018), and to monitor and evaluate the results. Before taking this decision, the researcher liaised with the Phase II Research Module Course Coordinator who approved the innovation, and who would observe the results to see if the format would be compatible with expectations required in the later course.

The course had 188 students, divided into three sections. The same instructor taught all students. Technical assistance for LTB was provided online at a distance from The Netherlands. Ethics approval was granted by SQU’s Medical Research Ethics Committee (MREC #1554).

Usage in a full course

The timing of the e-poster classes replaced the time previously allocated for paper poster design, so no extra load was placed on the students’ or instructor’s time.

For preparation, students were given an introduction to the concept of posters, e-posters, and mobile apps. Students were then given a 45-minute didactic instructor-led session, in which they used a simple LTB e-poster template to
develop their first mobile app e-poster. They were then able to test this e-poster on their own mobile devices.

Students then had access to further instructor-developed documentation and LTB's instructional videos and documentation. Although these videos were all available through YouTube, they were made available, with LTB's permission, through the university's Learning Management System (LMS), Moodle.

For their task, students worked in teams of 3-5, and developed e-posters that could be delivered in the form of mobile apps on their devices. Although the e-posters were automatically visible to the students, they were not accessible by non-course participants unless the students elected to make them more widely visible.

During the time of running the research, the university’s computer network had a wide range of technical errors related to student network accounts, and these errors caused connection problems with the LTB site. Although the problems were unrelated to LTB, and most were resolved by the time the research period had ended, about a third of the students were unable to access their work directly from the student computer laboratory. These students relied on access from their rooms, home, or through the student leading their group.

**Evaluation Process**

The success of the project was measured by:

- An anonymous student survey, preceded by an informed consent form, delivered electronically to the students though the university's LMS at the completion of the exercises. The student survey tool was based upon an evaluation instrument used previously by the lead researcher.(Masters 2014) The aim of the evaluation was to gather background experience from the students, to assess their overall experience of the e-poster design process, and to determine the extent to which prior exposure to similar work impacted upon their experience and their ability to produce effective e-posters. Using the same (albeit extended) survey instrument would be able to give some base point from which to work, and also give a point of comparison regarding the previous students’ experience.

- An evaluation of the quality of the e-posters based on a rubric (See Appendix) drawn up by two of the researchers (KM and TT). The focus of the evaluation was not on the quality of the content (as the students had fewer than 6 hours to construct the e-posters), but on the extent to which the students were able to utilise the various features offered by the LTB system. These features include the ability to include multimedia, interactivity, support materials, and layers of detail. A "mark” out 10 was awarded for each poster indicating the level of sophistication. (This mark did not contribute towards the student grade; it was a general quality measure used for this research only, and these marks were not given to the students).

Although anonymous, survey data were analysed using Microsoft Excel®, and encrypted with a password longer than 12 characters.

Students presented their posters to their peers, and were given constructive, formative feedback by the instructor, and could also respond to comments and questions from the class.

The Phase II coordinator and administrative support attended one of the presentation sessions, and approved the quality of the e-posters.

**Results**
From the class of 188 students, a total of 144 students submitted 30 accessible posters, and 71 students participated in the survey (a response rate of 49.3% of those students submitting accessible posters). Given that only 35 students participated in the course evaluation held in the same week, this response rate is encouragingly high.

Of the respondents, 35 (49.3%) were male and 36 (50.7%) were female.

In addition to the instructions given in class, students had access to videos supplied by Learning Toolbox. Students were asked how many of the videos they had watched: 21 (29.6%) said they had watched "all", 9 (12.7%) said "most", 21 (29.6%) said "some", and 20 (28.2%) said "none".

In a qualitative question, the students were asked if anything in the videos was unclear, and 26 (36.6%) of the students answered this question. Three students indicated that they had not watched the videos, 1 student referred to initial confusion about using the Twitter feed, 1 student said "most" were, and 20 indicated that the videos were all clear.

In response to questions on previous experience with related work, the students answered as depicted in Table 1:

| Statement                                      | Yes n (%) | Yes (m) | Yes (f) |
|------------------------------------------------|-----------|---------|---------|
| Before this course, I had developed a mobile app. | 16 (22.5) | 10 (28.6) | 6 (16.7) |
| Before this course, I had created a paper poster. | 49 (69.0) | 20 (57.1) | 29 (80.6) |
| Before this course, I had created an e-poster.    | 6 (8.5)   | 3 (8.6)  | 3 (8.3)  |
| Before this course, I had done some programming.  | 42 (59.2) | 18 (51.4) | 24 (66.7) |

The students were asked to indicate the target audience of their app. The results are shown in Table 2:

| Audience                | N (%)  |
|-------------------------|--------|
| Child Patients          | 11 (15.5) |
| Adult Patients          | 21 (29.6) |
| Non-medical caregivers  | 29 (40.8) |
| Students                | 47 (66.2) |
| Health Professionals    | 20 (28.2) |
| Other                   | 28 (39.4) |

In addition, the students were asked if they felt that their e-poster would be useful for their intended audience. Of
the 71 responses, 66 (93.0%) felt that it would be useful for the intended audience. Thirty two (91.4%) of the males and 34 (84.4%) of the females agreed with this statement.

The students were asked about their experience in developing the e-poster. Table 3 shows their responses on a Likert Scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

Table 3: Experience of the e-poster development (N=71)

| Statement                                                                 | Strongly Disagree | 2 | 3     | 4   | Strongly Agree |
|--------------------------------------------------------------------------|------------------|---|-------|-----|----------------|
| Enough information was given to us by the teacher to complete this e-poster. | 4 (5.6)          | 5 (7.0) | 17 (23.9) | 16 (22.5) | 29 (40.8) |
| Enough time was given to us by the teacher to complete this e-poster.     | 3 (4.2)          | 6 (8.5) | 9 (12.7) | 12 (16.9) | 41 (57.7) |
| Our team planned and developed our e-poster together.                     | 4 (5.6)          | 7 (9.9) | 8 (11.3) | 20 (28.2) | 32 (45.1) |
| Each person in my team did roughly the same amount of work on this e-poster. | 6 (8.5)          | 10 (14.1) | 17 (23.9) | 21 (29.6) | 17 (23.9) |
| I learned new computing skills because of this project.                   | 2 (2.3)          | 5 (7.0) | 9 (12.7) | 26 (36.6) | 29 (40.8) |
| I did my fair share of work on this project.                              | 3 (4.2)          | 4 (5.6) | 12 (16.9) | 17 (23.9) | 35 (49.3) |

The students were asked about problems experienced when developing the e-poster. Table 4 shows their responses on a Likert Scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

Table 4: Problems experienced with the e-poster development (N=69)

| Statement                                                                 | Strongly Disagree | 2 | 3     | 4   | Strongly Agree |
|--------------------------------------------------------------------------|------------------|---|-------|-----|----------------|
| Lack of computer skills.                                                  | 35 (50.7)        | 17 (24.6) | 13 (18.8) | 1 (1.4) | 3 (4.3) |
| Several students all needing to work on one computer.                     | 14 (20.3)        | 15 (21.7) | 16 (23.2) | 12 (17.4) | 12 (17.4) |
| Finding information.                                                      | 28 (40.6)        | 25 (36.2) | 7 (10.1) | 5 (7.2) | 4 (5.8) |
| Learning Toolbox could not do all that we wanted to do.                   | 19 (27.5)        | 12 (17.4) | 25 (36.2) | 8 (11.6) | 5 (7.2) |
| The time it took for small tasks (like getting icons the right size).     | 17 (24.6)        | 24 (34.8) | 14 (20.3) | 10 (14.5) | 4 (5.8) |

In addition, 58 (81.7%) of the students said that they would have preferred using a more sophisticated environment, even if it meant they had to learn some programming. Although this desire was widespread among the students, the
desire was statistically significantly higher ($r (69) = 0.2; p < 0.05$) among those students who had had previous programming experience.

In a qualitative question, students were asked how they would improve their e-posters if they had had more time. Forty six (64.8%) of the students answered the question. From their responses, the following general themes emerged: adding more information, including video and images (25); change the design (8); use the time to learn more about the various tools in LTB (7); change the topic (4). Three students referred to adding 3-d images. The reason for their referral to this this was that one of the e-posters demonstrated to them had 3-d images,(Brenton, Zary, and Yap 2017) and so the students possibly thought that this tool was part of the Learning Toolbox system.

In a qualitative question, students were asked what specific problems they had with the software. Although 31 (43.7%) of the students answered this question, 13 answered that they had had no problems, leaving 18 (25.4%) identifying problems. There was no recurring theme, but the problems appeared to be related to the newness of the software, and initial understanding of the technology.

Of the time spent on the project, 51 (71.8%) of the students spent fewer than 2 hours of class time on the project, possibly a reflection of the network problems experienced in the computer laboratories.

Unlike the previous study,(Masters 2014) this study showed no statistically significant correlation between previous experience (with creating paper posters, e-posters, and programming) and perceptions shown in Table 3 and 4 (information, time, etc.) This is discussed in more detail in the Discussion below.

Finally, the quality of the e-posters was evaluated independently by two of the researchers (KM and TT). This analysis focused on establishing whether students had made use of the functionalities within LTB designed to support the production of richer (structured, interactive, multimedia) e-posters.

The most commonly-used features were the text boxes, online content (including links to YouTube Videos), extra files (mostly in pdf or docx format), and Twitter feeds. Nearly 50% used more than one layer, so utilised the ability to include far more in-depth levels of material. Two poster utilised an RSS news feed, and one poster utilised an online survey form that the students had created in Google forms. Between the two graders, a mean score of 5.8/10 was awarded (based on the use made of possible features).

Given the time permitted and the level of student, the feedback from the students and the quality of the e-posters, the researchers were satisfied with the overall quality of the work.

Based on the visit from the Phase II coordinator, he agreed that the quality of the e-posters was high enough to permit this medium to be used as part of the research module.

**Discussion**

This paper has described a small research project aimed at measuring the ability for medical and health sciences’ students to learn how to produce e-posters in mobile-app format and to evaluate the process. It has determined that, with minimal training (almost identical to training for paper poster design), they are able to produce such e-posters of reasonable quality and without too much exertion.

The discussion below gives some insights into lessons and principles that need to be taken into account when implementing such teaching on a wider scale.
Using the resource material

In spite of the fact that less than 1/3 of the students had watched all of the instructional videos, they were still able to produce reasonable-quality e-posters. Contributing factors would probably have been:

- The short instructor-led introduction;
- The system’s user-interface which is mostly a drag-and-drop environment.
- The fact that 23% had developed apps before;
- The fact that 60% had some programming experience, and

Impact of previous experience

Unlike previous studies of students’ developing computing materials,(Bosch, D'Mello, and Mills 2013; Ivins and Ong 2005; Masters 2014; Wiedenbeck, LaBelle, and Kain 2004) this study showed no statistically significant correlation between previous experience (with creating paper posters, e-posters, and programming) and perceptions shown in Tables 3 and 4 (information, time, etc.)

This lack of correlation is a good sign indeed, as it indicates that students with average computer skills are not disadvantaged compared to students with advanced computer skills when developing e-posters with LTB. This would be encouraging for students working in technologically poor environments, and also for current health professionals who may not have received any advanced computer training. Given LTB's rather straight-forward drag-and-drop user interface, it is likely that that this made a significant contribution to the ease with which users can create e-posters with it. For this reason, one might easily argue that, in the sub-section immediately above, the last two bullets have little substantiation.

Either way, it indicates that the sophistication of the software is well-aligned with medical and health sciences’ students computing skills, irrespective of any previous specialist computing training that individual students may have had.

Further advances

Many students (especially those with prior programming experience) would have been happier if the system could be more sophisticated, even if it needed the user to program a little. This is something that could be taken into account by teachers and the LTB developers; on the other hand, one of the reasons for TLB's success appears to be the drag-and-drop ease of use, so this might not be a direction in which they would wish to go.

Lack of Time

The students’ comments do indicate that they would have been able to improve upon their e-posters if they had had more time. This was to be expected. The six-hour total allocated was an introduction to the concept of e-poster design. In reality, creating a poster takes a lot longer than six hours. The comments reflect a realisation that, with more time, these students could have created posters worthy of an academic conference.

While the narrow focus of this research has been the viability of teaching the specific environment, Learning Toolbox, in undergraduate health sciences courses, this study has broader implications for medical education.

Communication skills

No medical educator doubts the value of teaching communication skills to medical students, but, as noted in the
Introduction to this paper, current teaching and assessment of such skills focuses almost entirely on face-to-face, verbal communication. Written skills are seldom addressed. (Boileau, Patenaude, and St-Onge 2018; Goldhamer et al. 2018; Hinkle et al. 2017; Joyce, Steenbergh, and Scher 2010) This is particularly concerning, as research does indicate that patients’ understanding of written communication from health providers is far from optimum. (Tavakoly Sany et al. 2018)

Unfortunately, not teaching and assessing written communication skills ignores the reality of a shifted ground where health professionals are increasingly communicating with patients through email, social media, and other electronic methods. Further, this approach appears to reflect a lack of awareness that teaching electronic media communication skills, especially in asynchronous communication, is urgently required, and these skills are not going to be learned by osmosis, any more than face-to-face professional communication skills were learned in the past.

The ground has shifted even further. Previously, the idea of clinicians’ communicating through social media was a novel idea; today it is common-place. But there are limitations to what can be handled in emails and social media, and the next frontier to be conquered is information communication through patients’ mobile devices.

Until recently, this was the domain of programmers’ developing mobile apps, but this is rapidly changing on two fronts. Firstly, mobile app development platforms are becoming increasingly easy to use. Secondly, this study has demonstrated that environments like Learning Toolbox give people with minimal training the ability to develop a reasonably sophisticated app-like environment for patients. From the lessons learned from the spread of social media, it is fair to surmise that future health professionals will be expected to communicate with patients in this way. The required skills will need to be taught.

E-Posters in the Academic Environment

While e-posters are only recently becoming popular at conferences, they have been predicted for at least 10 years. (Brownlie 2007) The lack of an industry standard for e-poster development is problematic, but we can assume that lessons learned from one environment would be reasonably easily transferrable to another, especially as the tools improve. As academic conferences move increasingly towards e-posters, it is surely incumbent on medical educators to ensure that their students are prepared for this new presentation method. As a result, some teaching and practice of e-poster creation as part of medical students’ research training should be standard.

Simultaneously, organisers of academic conferences need to be aware that the demand for e-poster presentation is growing rapidly. The presentation of e-posters does have implications for costs, changes to floor and room layout, etc. Given this, it important for conference organisers to be pro-active in moving ahead with e-poster displays; failure to do so will make their conference appear terribly out-dated. Using paper posters only would be the equivalent of insisting that plenary speakers use OHP transparencies in their presentations.

E-Posters for patients

It is also with some pathos that one observes the ignored paper posters on walls in hospitals, clinics and doctors’ waiting rooms. These carefully prepared posters become old and yellowed and faded, cannot be read at a distance (and patients cannot be expected to stand for 15 minutes reading them), are based on out-dated research, and contain out-dated telephone (and even fax!) numbers. All the while, the patients’ heads are down, looking at their mobile devices.

It is at this point that e-posters can utilise the power of mHealth, and allow for far more meaningful communication with patients. How much easier and obvious it would be to have a small descriptive poster with a QR (or similar)
code that the patients can scan in a second and then instantly have access to the most up to date information on their phones. Instead of 1950s-type images with stereotypical patients, the posters can have text supported by current evidence, can be vibrant, containing animations, links to videos, news and Twitter feeds, current information, and can be read easily when the patient is no longer in the hospital. In addition, there is a world of difference between broadcast and communication, which also includes feedback. A dynamic, mobile e-poster will permit immediate feedback facilities for the patient.

The students in this study designed many e-posters aimed at patients, and this is illustrative of the fact that they know patients will find these of value. It is time that we responded to that need and taught these students the needed skills.

**Conclusion**

Electronic communication skills are essential for the 21st-Century Health Professional. These skills will be needed for a variety of tasks, including communicating with patients and colleagues via email, social media, and other electronic systems. Integral to this communication is the communication through e-posters and mobile apps.

This study has demonstrated that medical and health sciences students can be taught the required skills to develop mobile app e-posters, in much the same way that they can be taught any other essential skills. Although there is not yet an e-poster industry standard, whatever the future holds, teaching these skills will have a positive impact on the electronic communication between health professionals, colleagues and patients.

**Take Home Messages**

- Electronic and written communication skills are seldom taught and assessed, yet are needed by 21st Century medical professionals.
- This study evaluated the teaching of such skills to medical and health science students, by studying resource demand, student experience and quality of output.
- The results indicate that these skills can be taught effectively and efficiently.
- The skills should be taught to all medical students so that they can fulfil the requirements of 21st century professional communication.

**Notes On Contributors**

- KM (PhD, ACHEM) is Assistant Professor of Medical Informatics at Sultan Qaboos University, Oman. He has been involved in education for more than 30 years, and medical education for more than 15 years.
- TT (BEng, MSc, Dip(Sys)) is Senior Strategist in Technology Enhanced Learning (TEL) at Leeds Institute of Medical Education in the University of Leeds, UK. She has been involved in TEL research and practice for more than 20 years and has worked within the medical education domain for 10 years.
- RE (MSc) is Director and Co-Founder of stack.services and RayCom B.V. He is a developer and entrepreneur, who specialises in educational and knowledge management software research, development & consultancy. He has over 15 years’ experience of leading and contributing to international technology enhanced learning projects.
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Appendices

Appendix: Marking Rubric for E-Posters

| Use of different tile types                |
|------------------------------------------|
| Text tile                                |
| App tile (or link to app)                |
| File tile (docs/pdf/ppt etc)             |
| Online content (website including YouTube)|
| Stack screen (to create second level)    |
| Collection (to create second level)      |
| User content (to allow users to add content)|
| Other stack                              |
| News feed                                |
| Twitter feed                             |
| Appearance                               |
| Icon changes on tiles                    |
| Use of colour on tile titles             |
| Changes in tile sizes                    |
| Use of inline image within text tile     |
| Content - making use of richness         |
| Authors - more than just names           |
| References - links to actual papers      |
| Uses videos                              |
| Includes interactive options             |
### Declaration of Interest

The author has declared the conflicts of interest below.

- KM advises AMEE on aspects of MedEdPublish, and is an Associate Editor of MedEdPublish. This paper has been submitted through normal channels, and he has played no role in the decision by MedEdPublish to publish this paper.  
- RE is the main developer of LTB and Director and Co-founder of stack.services. He supplied technical support from The Netherlands, and was not present at the class, nor interacted with the students in any way, nor affected the data gathered.  
- TT has been involved, as an advisor, in the development of LTB into an e-poster platform.