Eur Arch Otorhinolaryngol (2015) 272:759–763
DOI 10.1007/s00405-014-3326-6

MISCELLANEOUS

Comparison of traditional face-to-face teaching with synchronous e-learning in otolaryngology emergencies teaching to medical undergraduates: a randomised controlled trial

Talal Alnabelsi · Ali Al-Hussaini · David Owens

Received: 6 July 2014 / Accepted: 7 October 2014 / Published online: 12 October 2014

Abstract Undergraduate otolaryngology teaching in the UK is generally limited primarily due to curriculum time constraints with traditional face-to-face (FtF) teaching being restrained by the limitations of time and location. Advances in network technology have opened up new doors for the delivery of teaching in the form of online learning. This study compares a traditional instructor-led lecture with synchronous e-learning (SeL) using otolaryngological emergencies teaching as an educational intervention. A randomised controlled trial was designed involving two groups of medical students attending an otolaryngology emergencies management lecture: one present FtF and the other viewing the streamed lecture online. The primary outcome measure was improvement between pre-and post-lecture test scores. Secondary outcomes comprised the students' ratings of the lecture on a Likert-type scale. Students in both groups had improved test scores following the lecture ($p < 0.001$ for both groups) and there was no difference in magnitude of improvement in test scores between the two groups ($p = 0.168$). There was no difference in student ratings between the two groups for the usefulness of the lecture ($p = 0.484$), interactivity ($p = 0.834$) and meeting educational needs ($p = 0.968$). The FtF group, however, was more satisfied overall ($p = 0.034$). This study demonstrates that SeL may be as effective as FtF teaching in improving students' knowledge on the management of otolaryngological emergencies, and that it is generally positively perceived by medical undergraduates. This highlights the potential utility of e-learning technology in undergraduate otolaryngology training.

Keywords Otolaryngology education · E-learning · Face-to-face teaching · Undergraduate

T. Alnabelsi · A. Al-Hussaini (✉) · D. Owens
Department of Otorhinolaryngology, Head and Neck Surgery, University Hospital of Wales, Cardiff CF14 4XW, UK
e-mail: alialhussaini@doctors.org.uk

Introduction

Undergraduate otolaryngology education in the UK is generally limited primarily due to curriculum time constraints [1, 2], though the importance of teaching basic otolaryngology knowledge and skills so that newly qualified doctors are competent to manage patients they are likely to encounter in their daily training and practice is fundamental. As well as otolaryngological conditions presenting to the hospital junior doctor, otolaryngology forms a considerable proportion of the general practitioner's caseload. In the UK, up to 60 % of medical graduates embark on a career in general practice [3]; with otolaryngology representing up to a quarter of their adult consultations [4] and half of their paediatric caseload [5]. Furthermore, there is evidence to suggest that both hospital junior doctors [6, 7] and general practitioners [8] discern they have inadequate otolaryngology training to deal with common otolaryngology presentations. Thus, the development of satisfactory knowledge and skills acquired through undergraduate otolaryngology training and appropriate exposure to the specialty by utilising new methods of learning delivery is of paramount importance.

Traditional face-to-face (FtF) teaching has always been restrained by the limitations of time and moreover location; the tutor and students have to physically be at the same location. However, recent advances in network technology

have improved the delivery of distance education in the form of online electronic learning (e-learning). The World Wide Web has enabled us to reach remote individuals for educational purposes and create a bridge between teachers and students allowing easier communication and interaction between them [9].

The mid-1990s saw the birth of internet education and the early applications of online distance learning which can be divided into synchronous and asynchronous methods [9]. Asynchronous e-learning represents students and tutors interacting at different times, via email or discussion boards for instance [10]. This has been the more popular form due to limitations in network bandwidth and less complex technology involved. Synchronous e-learning (SeL), on the other hand, utilises videoconferencing and messaging systems to offer real-time interaction between students and instructors regardless of their location [11]. It requires both parties to be present at the same time for teaching to occur.

Synchronous e-learning may seem to impose similar restrictions in the time dimension to FtF teaching, but the ability to provide immediate educational support and feedback gives it a unique advantage over asynchronous learning [12]. Additionally, it provides logistical, instructional and financial advantages over traditional FtF teaching [13]. The logistical advantage of SeL is the ability of participants to take part in the learning process from any geographical location. An instructional advantage is the opportunity for learners to utilise rich multimedia resources. The financial benefit of SeL is that it eliminates the costs of travel and time away from clinical training sites, while still providing interaction between students and instructors in real-time.

Despite its obvious advantages, surprisingly little research has been conducted to evaluate the potential of synchronous online educational events in delivering learning opportunities. This is particularly the case for otolaryngological teaching and surgical teaching in general. Medical placements are generally set up in ways that force students to be on remote clinical training sites away from the centre of learning. The aim of this study was to assess and compare FtF teaching with SeL in the context of otolaryngology undergraduate training using teaching on otolaryngology emergencies as an educational intervention.

Materials and methods

The study design was that of a randomised controlled trial. This involved two groups of participants observing a single educational event consisting of a powerpoint lecture on the basic management of otolaryngological emergencies including epistaxis, peritonsillar abscess, stridor and periorbital cellulitis. The subjects of this study were fourth and fifth year medical students who were recruited after full disclosure of the study design. The rationale for choosing such a cohort was that they had a good foundation of general medical knowledge, yet their knowledge of otolaryngological emergencies was likely to be limited and amenable to improvement. By the time the study was conducted, all participants had undergone at least a week of clinical rotation in the department of otolaryngology.

The study participants were divided into two groups: the face-to-face teaching group (FtF) were present in the lecture theatre and the SeL group viewed the streamed lecture online via webinar. The participants in the SeL group were able to hear and view the slides as well as interact in real-time and ask questions to the instructor via text or audio communication throughout the teaching session. Notably, none of the participants in the SeL group had prior experience of learning via a webinar. We utilized the Cisco Webex (Cisco Systems, Inc, CA, USA) webinar platform as our medium to facilitate synchronous e-learning. This software allows synchronous communication and multi-level interactions between users and instructor. Webinar also enables instructors to archive their contents for learners to access at a later date.

The primary outcome measure for this study was the improvement in each student's performance from the pre-learning intervention test to the post-learning intervention test. Deriving experiences from a pilot study and from reviewing previous similar studies [14], the post-test to pre-test difference of positive answers in the FtF group was anticipated to be 30 % higher (an expected improvement in correct answers from 40 to 70 %). The anticipated range for this difference would be 10–50 %, thereby applying a standard deviation for all groups at 10 %. We expected that the FtF and SeL educational methods would deviate slightly from each other, and a 13 % difference, which is the difference of two correct answers (out of 15 questions) in the pre-test and post-test, was chosen as the minimal important difference between the two groups. The significance level was set at 5 %, and statistical power at 95 %. This calculation yielded a total of 16 subjects in each group. To avoid an impact due to dropouts or missing data, it was decided that each group consisted of 25 subjects.

To recruit participants, emails highlighting this educational event were sent out to fourth and fifth year students at Cardiff University asking them to sign up by responding to the email. The first 50 respondents were chosen as the enrolment group and were allocated individual numbers from 1 to 50 accordingly. The enrolment group was then randomised into Groups FtF and SeL using ResearchRandomiser online software version 4.0 (CT, USA) [15], which

uses a random number generator to produce customised sets of random numbers so that each participant had an equal chance of being allocated to the equally sized FtF or SeL groups.

Students in both groups were assessed on their knowledge of otolaryngological emergencies using 15 single best answer questions displayed on the powerpoint presentation before and after the lecture. The students in the FtF group wrote their answers on answer sheets administered to them in the lecture theatre. The students in the SeL group responded in real-time to each question within the private text platform of the webinar. This enabled each student in the SeL group to answer the questions in private and be identified by the unique webinar login given to them.

Following the post-lecture test, students in each group rated the efficacy of the mode of delivery of the learning intervention using a 1–10 Likert-type rating scale (1 = very poor, 5 = satisfactory, 10 = excellent). The domains scored included usefulness, interactivity, meeting educational needs and overall satisfaction. These student ratings formed the secondary outcome measures. The students in the FtF group wrote their ratings on a separate response sheet administered to them in the lecture theatre. The students in the SeL group responded in real-time by typing their rating score for each of the above-mentioned domains within the private text platform of the webinar. After this, students in both groups were invited to add free text comments and feedback on the lecture.

The null hypothesis was that there was no difference between the efficacy of distance learning by synchronous e-learning delivery and a traditional instructor-led lecture. Ethical approval for this study was granted by the Local Health Board Ethical Approval Committee. Data were analysed in Microsoft Office Excel 2007.

The Shapiro–Wilk test of normality determined that the improvements in test scores were not normally distributed for both groups. Thus, given the relatively small sample size, the Chi-squared (χ^2) test was used to statistically analyse for improvement between pre-test and post-test scores within each group. Furthermore, the non-parametric Mann–Whitney U test was chosen for between-group comparisons of improvement in test scores and subjective ratings of the students. A p value <0.05 was taken as being statistically significant.

Results

All 25 students from the FtF group attended the live lecture. They comprised 9 fifth year and 16 fourth year medical students; there were 11 males and 14 females in this group. All 25 students from the SeL group viewed and listened to the lecture synchronously using webinar. These comprised 10 fifth year and 15 fourth year medical students; there were 13 males and 12 females in this group. There were no statistical differences between both groups in terms of year of study of the students (Fisher's exact test, $p > 0.999$) and students' gender (Fisher's exact test, $p = 0.778$).

Both the FtF group and SeL group demonstrated a significant improvement between their pre- and post- learning intervention test scores. The FtF group exhibited an overall improvement of 32.8 % (χ^2, $p < 0.001$) and the SeL group had an overall improvement of 38.4 % (χ^2, $p < 0.001$). There was no significant difference in the pre-test scores attained by the FtF and SeL groups (Mann–Whitney U test, $p = 0.522$) indicating that both groups had a comparable knowledge base prior to the learning intervention. There was also no significant difference in the overall improvement in test scores between the two groups (Mann–Whitney U test, $p = 0.168$). Table 1 summarises the pre- and post- lecture test scores of the FtF and SeL groups.

There was no statistically significant difference between the FtF and SeL groups, in terms of subjective ratings of the mode of delivery of the lecture on the 1–10 Likert-type rating scale (1 = very poor, 5 = satisfactory, 10 = excellent), with respect to perceived usefulness (Mann–Whitney U test, $p = 0.484$), interactivity (Mann–Whitney U test, $p = 0.834$) and meeting educational needs (Mann–Whitney U test, $p = 0.968$). In these aspects, the median ratings of the two groups were very similar and indicated generally positive feedback. Notably, however, the overall satisfaction of the SeL group was lower than that of the FtF group; this finding was statistically significant (Mann–Whitney U test, $p = 0.034$). Table 2 summarises the students' subjective ratings on the mode of delivery of the otolaryngological emergencies lecture.

Overall, the delivery of the lecture and its contents were well received by both groups. Positive qualitative feedback from students in both groups included: concise lecture with case-based presentations helping to illustrate various

Table 1 Comparison between the pre- and post-lecture percentage test scores of the FtF and SeL groups

Group	Pre-test score[a]	Post-test score[a]	Overall improvement[a]	p value
Ftf ($n = 25$)	53.6 % (48.2–59.0)	86.4 % (82.0–90.8)	32.8 % (25.0–40.6)	<0.001
SeL ($n = 25$)	51.2 % (47.2–55.2)	89.6 % (85.6–93.6)	38.4 % (33.9–42.9)	<0.001

[a] Mean (95 % confidence interval)

Table 2 Comparison between the FtF and SeL groups in terms of educational domains evaluated

Domain evaluated	FtF ($n = 25$)	SeL ($n = 25$)	p value
Usefulness[a]	8 (8–10)	8 (8–9)	0.484
Interactivity[a]	7 (6–8)	8 (6–8)	0.834
Meeting educational needs[a]	8 (8–10)	8 (8–9)	0.968
Overall satisfaction[a]	8 (8–10)	7 (7–8)	0.034

[a] Median (inter-quartile range)

topics, content pitched at the right level, relevance to foundation year training, and use of questions to test their knowledge. There were some considerable setbacks with the webinar indicated by the SeL group, most notably intermittent audio–visual problems. These included the intermittent breaking of sound and excess background noise.

Discussion

This study endeavoured to assess and compare FtF teaching with synchronous e-learning in the context of otolaryngology undergraduate training using teaching on otolaryngological emergencies as an educational intervention. Analysis of the data from the SeL and the FtF groups showed comparable results between the two. Both groups significantly improved their test scores after the learning intervention. The only statistically significant difference was the higher overall satisfaction rating in the FtF group. This was somewhat expected as some technical difficulties interfered with the learning experience of the SeL webinar group; this suggestion was reciprocated by the SeL group's qualitative feedback. However, besides the technical difficulties all the students agreed that the lecture was highly beneficial and relevant to their learning. It may be argued that if those technical problems are minimised in future sessions, results in the overall satisfaction domain would be similar to the FtF group.

Our results showed that students in the SeL group benefited from the lecture, and doing that from the comfort of their own homes or clinical placements may be more convenient. Overall, results were promising and demonstrated that educationally, synchronised distance learning is as effective as FtF teaching. This could potentially be a solution for students being on placement away from the centre of teaching. It may also aid the further incorporation of otolaryngology teaching into undergraduate medial education. A study undertaken by Khan and Saeed [2] investigating undergraduate ENT experience across UK medical schools found that 10 of the 26 UK medical schools did not offer an ENT attachment, and where it was offered the mean mandatory placement was for 8 days. Providing clinically relevant lectures through e-learning may, therefore, serve to bridge the gap created by the lack of ENT attachments.

The findings obtained in the current study were similar to previous studies across the literature, which involved the use of e-learning in comparison to traditional FtF instruction. Previous studies demonstrate that overall there was no difference in these modes of teaching delivery in terms of knowledge attained and students' ratings [16–18]. However, a meta-analysis by Bernard et al. [11] revealed a small but statistically significant effect favouring classroom instruction compared to e-learning in terms of overall achievement outcomes. Notably, the authors of this meta-analysis cautioned on interpreting these results in light of the wide variability in effect size. We believe our study design overcomes many of the methodological flaws noted from the studies included in the aforementioned meta-analysis. Additionally, our study is unique for comparing real-time synchronous e-learning with FtF teaching, whereas the majority of previous studies have been comparing asynchronous e-learning to FtF instruction.

The use of the webinar technology in this study was not without its limitations, however. There were some audio–visual difficulties throughout the webinar lecture, which impaired the teaching of the students. We believe that this was the most likely reason that the overall satisfaction of the SeL group was significantly lower than that of the FtF group. The study was designed to be a live randomised trial; therefore, these technical issues were unavoidable at the time. On reflection, the use of the webinar requires experience with the software and first time users may need time and experience to develop enough skills to run sessions smoothly.

We are aware that the relatively small sample size limits the external validity and generalisability of the current study and future research should aim to compare FtF and e-learning using a larger sample size. Additionally, it would be interesting to re-test the knowledge of participants after a longer time interval to determine retention rates and assess whether students re-visited the lecture archived on the Webex system. Different types of media besides the webinar could also be investigated to determine the most appropriate and convenient software to deliver synchronous e-learning.

Conclusions

This study demonstrates that synchronous e-learning is as effective as FtF teaching in improving students' knowledge on the management of otolaryngological emergencies, and that it is generally positively perceived by medical undergraduates. Furthermore, it highlights the potential of SeL in

overcoming the cumbersome same place same time requirements that traditional teaching imposes. More research is warranted to evaluate SeL using other surgical specialities and media for instance. Nevertheless, with ongoing technological advances its role in medical education is likely to grow in the near future.

The findings of the present study should not be merely restricted to undergraduate medical curricula. On the postgraduate training level, SeL may be of great benefit in offering learning opportunities for clinicians outside of normal working hours. Moreover, e-learning may break down geographical restrictions and allow for far more educational collaboration and networking on an inter-continental and international front. Clearly, the dissemination of expertise in this way across borders is advantageous for clinicians and ultimately optimising patient care.

Conflict of interest The authors have no conflicts of interest to declare.

References

1. Neil JF (1979) Otolaryngology in the curriculum. J R Soc Med 72(8):551–552
2. Khan MM, Saeed SR (2012) Provision of undergraduate otorhinolaryngology teaching within general medical council approved UK medical schools: what is current practice? J Laryngol Otol 126(4):340–344
3. Health & Social Care Information Centre (2013) NHS Staff 2000–2010 Overview. http://www.hscic.gov.uk/searchcatalogue?productid=2186&q=nhs+staff+overview+2000-2010&sort=Relevance&size=10&page=1#top. Accessed 19 April 2014
4. Griffiths E (1979) Incidence of ENT problems in general practice. J R Soc Med 72(10):740–742
5. Donnelly MJ, Quraishi MS, McShane DP (1995) ENT and general practice: a study of paediatric ENT problems seen in general practice and recommendations for general practitioner training in ENT in Ireland. Ir J Med Sci 164(3):209–211
6. Sharpe D, Farboud A, Trinidade A (2009) 'Is that the ENT SHO?': concerns over training and experience of juniors expected to cross-cover ENT at night. Clin Otolaryngol 34(3):275
7. Davis SJ, McDonald S (2006) Covering ENT out of hours: how confident are senior house officers? J Laryngol Otol 120(7):587–590
8. Clamp PJ, Gunasekaran S, Pothier DD, Sunders MW (2007) ENT in general practice: training, experience and referral rates. J Laryngol Otol 121(6):580–583
9. Ruiz JG, Mintzer MJ, Leipzig RM (2006) The impact of e-learning in medical education. Acad Med 81(3):207–212
10. Hrastinski S (2008) Asynchronous and synchronous e-learning. Educ Q 31(4):51–55
11. Bernard RM, Abrami PC, Lou Y, Borokhovski E, Wade A, Wozney L et al (2004) How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. Rev Educ Res 74(3):379–439
12. Chen NS, Ko HC, Kinshuk, Lin T (2005) A model for synchronous learning using the Internet. Innov Educ Teach Int 42(2):181–194
13. Hannum W (2001) Web-based training: advantages and limitations. In: Khan BH (ed) Web-based training. Educational Technology Publications, Englewood Cliffs, pp 13–20
14. Worm BS (2013) Learning from simple e-books, online cases or classroom teaching when acquiring complex knowledge. A randomized controlled trial in respiratory physiology and pulmonology. PLoS ONE 8(9): e73336. http://www.plosone.org/article/fetchObject.action?uri=info%3Adoi%2F10.1371%2Fjournal.pone.0073336&representation=PDF. Accessed 27 Oct 2013
15. Urbaniak GC, Plous S (2013) Research Randomizer (Version 4.0). http://www.randomizer.org. Accessed 14 April 2013
16. Hortos K, Sefcik D, Wilson SG, McDaniel JT, Zemper E (2013) Synchronous videoconferencing: impact on achievement of medical students. Teach Learn Med 25(3):211–215
17. Garland KV (2010) E-learning vs. classroom instruction in infection control in a dental hygiene program. J Dent Educ 74(6):637–643
18. de Jong N, Verstegen DML, Tan FES, O'Connor SJ (2013) A comparison of classroom and online asynchronous problem-based learning for students undertaking statistics training as part of a Public Health Masters degree. Adv Health Sci Educ 18(2):245–264