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Online learning: an effective option for teaching ENT to medical students?

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Abstract

Objective. ENT is underrepresented in the curriculum, and this has been compounded by coronavirus disease 2019. Recent restructures have removed ENT placements from the curriculum. This lack of exposure needs to be addressed, and increased use of online learning represents an opportunity to facilitate this. This study aimed to evaluate whether online learning can effectively deliver undergraduate ENT teaching.

Methods. An online ENT module was created; content was structured on the Sheffield Medical School curriculum. Pre- and post-module tests and 5-point Likert scales were used to assess student knowledge and confidence, respectively.

Results. A total of 115 participants were recruited. Test scores improved by 29 per cent ($p < 0.001$) and confidence by 66 per cent. Anatomy and ENT conditions demonstrated significant improvement in confidence, with a lower confidence score for examination.

Conclusion. This study showed improved knowledge and confidence, whilst highlighting greater efficacy in content over practical skills teaching. Online learning is a validated educational tool; however, it should not be used as a replacement but as an adjunct to supplement learning.

Main Article

Dr A Ijaz takes responsibility for the integrity of the content of the paper

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Introduction

ENT surgery patients represent a significant portion of the population in primary care and the emergency department.[1–2] Despite this, undergraduate teaching of ENT is limited; on average, medical students have only 7–10 days of clinical exposure in their degree.[3] This has contributed to poor student confidence in knowledge and clinical skills within ENT, and low satisfaction in teaching.[4]

The restructure of the University of Sheffield Medical School curriculum has reduced this already limited exposure to solely voluntary participation in student-selected modules. This appears to be a trend, with other UK medical schools no longer providing ENT placements.[3] As a result, clinical exposure in ENT is now limited to opportunistic experiences in paediatrics, emergency medicine and primary care.

This limited contact has been exacerbated by the coronavirus disease 2019 (Covid-19) pandemic, which has significantly affected student opportunity within ENT.[5] Decreased availability and capacity of clinics and operating theatres have further restricted student opportunity. Whilst this may be unavoidable, the wider issue of poor representation of ENT in medical school curricula has predated this compounding factor.

Online learning standardises teaching and allows students to maximise opportunity in related clinical specialty placements. Its flexibility and accessibility are practical solutions to address the issues of curriculum pressure, and these have been recognised in other areas of medical education.[6]

ENT remains an important clinical topic, and students' educational requirements appear unfulfilled. We therefore developed an online learning module for undergraduate medical students at Sheffield University. The content covered the essential anatomy, conditions, and examination knowledge and skills required for summative assessment and clinical use as foundation doctors. The efficacy of this teaching was measured objectively with pre- and post-module tests, and confidence was measured subjectively with a Likert scale questionnaire.

This study aimed to assess the efficacy of an online learning module in delivering ENT teaching to undergraduate medical students.

Materials and methods

An online learning module was created using Xerte Online Toolkits (Apereo Foundation). Xerte Online Toolkits is an open-source web-based content creation tool developed by the University of Nottingham that allows users to produce online learning platforms. It is designed to be simple to use, and content producers do not require any significant

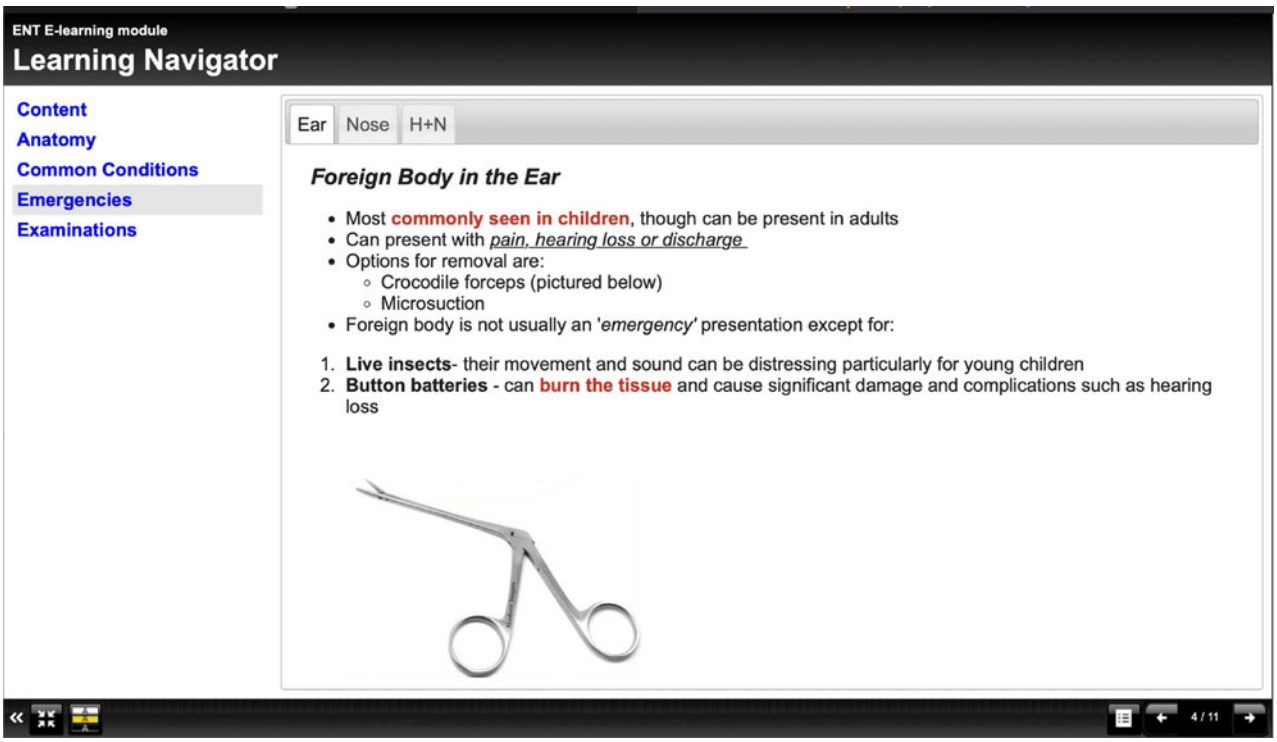

Fig. 1. A sample teaching slide on foreign bodies in the ear.

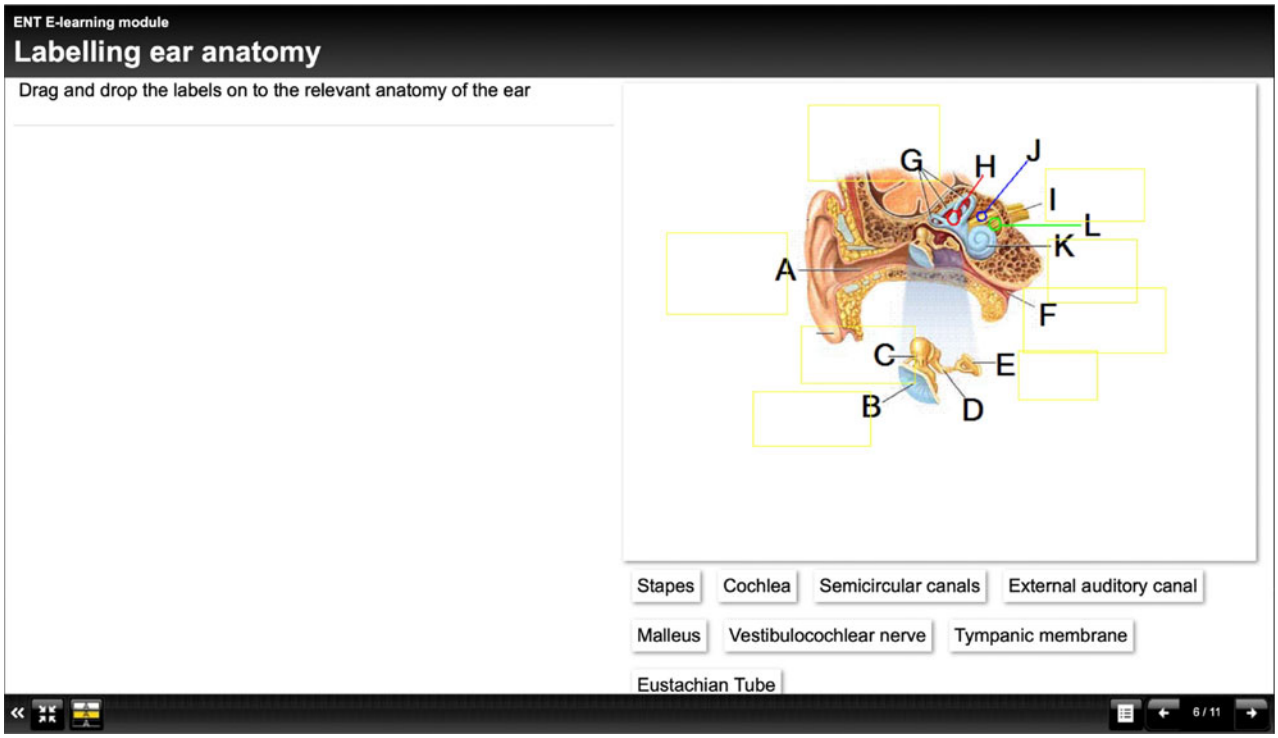

Fig. 2. A sample test slide asking students to correctly label ear anatomy.

information technology (IT) skills or background. Although it is free of charge, IT administrative support is initially required for set up on a server required for university use.

The learning module was created by the corresponding author over a two-week period. The structure of the content was divided into ENT anatomy, common and emergency conditions, and clinical examinations. Content was guided by the University of Sheffield Medical School curriculum. The learning module contained a mixture of text, images, videos and practice questions, as shown in Figures 1 and 2. There was no time limit to complete the learning module, and it could be revisited as many times as required.

All undergraduate medical students at the University of Sheffield were potentially eligible for this study. Students who did not complete both pre- and post-module questionnaires were excluded from analysis. Recruitment was carried out with broadcast emails aimed at senior medical students. The module was initially made accessible to all undergraduate students in

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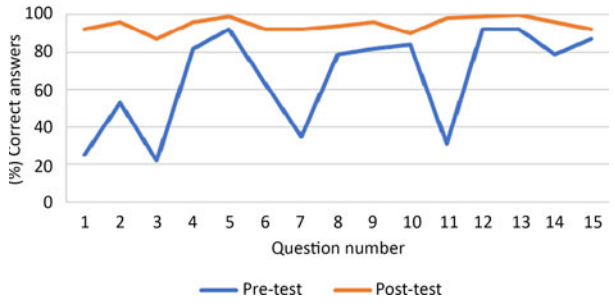

Fig. 3. Comparison of pre- versus post-test results.

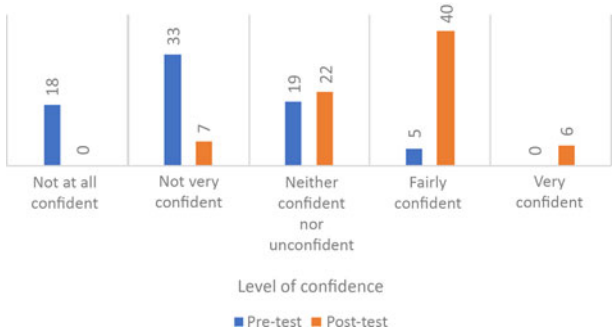

Fig. 4. Likert scale answers regarding students' confidence in ENT anatomy, showing numbers of responses to the question 'How confident are you with ENT anatomy?'.

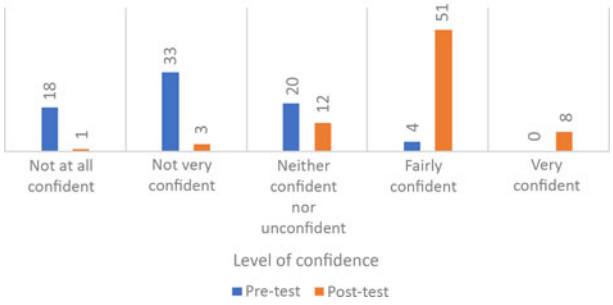

Fig. 5. Likert scale answers regarding students' confidence in ENT conditions, showing numbers of responses to the question 'How confident are you with ENT conditions?'.

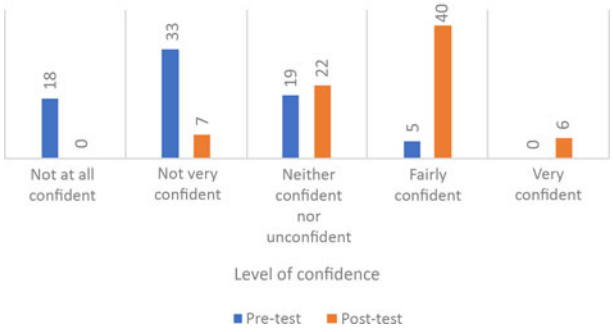

Fig. 6. Likert scale answers regarding students' confidence in ENT examination, showing numbers of responses to the question 'How confident are you with ENT examination?'.

August 2021 on an optional basis and later formed part of mandatory online learning for final-year medical students.

A cross-sectional study design was used to assess efficacy. A multiple choice test was performed at the start and repeated at the end of the module, with a maximum score of 15. A 5-point Likert scale questionnaire to assess confidence in ENT anatomy, common and emergency conditions, and clinical examination, was completed at the start and end of the module. Likert scales allowed quantitative analysis of responses; responses were scored from 1 to 5 (e.g. not at all confident = 1, very confident = 5) Both pre- and post-module test results were required for analysis. Results were collected in December 2021.

Statistical analysis was performed using IBM® SPSS® software, version 26. The Shapiro–Wilk test was used to assess data normality. The Wilcoxon signed rank test was used to compare improvement in module test performance and Likert-assessed confidence score. The Mann–Whitney U test was used to compare module test performance across different year groups. A *p*-value of less than 0.05 was considered statistically significant.

Results

Participants

The pre-module test was completed by 115 medical students, but only 75 students completed both the pre- and post-module tests, and 40 pre-module test results were removed as a result. Of the 75 students, 28 (37 per cent) were 'phase 3' students and 47 (63 per cent) were 'phase 4' students. This is equivalent to students in their penultimate and final years of undergraduate study.

Pre- and post-module test results

There was a significant increase in the mean (± standard deviation (SD)) test score between pre- and post-module tests: 9.8 ± 1.9 versus 14.2 ± 1.5. This was an increase of 4.4, representing a 29 per cent increase ($p < 0.001$) (Figure 3). There was no significant difference in pre-module test results between phase 3 (9.9 ± 2.2) and phase 4 students (9.7 ± 1.7) ($p = 0.350$), or in post-module test results between phase 3 (14.5 ± 0.9) and phase 4 students (13.9 ± 1.7) ($p = 0.111$). The two questions with the lowest correct response rate in the pre-module assessment (22 per cent and 23 per cent) were both testing anatomy.

Likert scale results

Likert scale results are shown in Figures 4–6. In the pre-module assessment, 6 per cent of responses were rated as 'fairly confident' or 'very confident'. This improved to 72 per cent in the post-module assessment. There was a comparable increase in confidence in ENT anatomy (from 5 per cent to 76 per cent) and ENT conditions (from 5 per cent to 79 per cent). Confidence in ENT examination improved from 7 per cent to 61 per cent. The overall mean (± SD) Likert scale score improved significantly from a pre-module score of 2.1 ± 0.85 to a post-module score of 3.7 ± 0.73 ($p < 0.001$).

Discussion

Online learning improves knowledge

This online module in ENT has shown significant improvements in undergraduate medical students' subjective confidence and objective test performance. Both content and examination material were aligned to University of Sheffield Medical School curriculum requirements and additionally

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guided by the Student and Foundation Doctors in Otolaryngology UK handbook.

Confidence in knowledge-based subjects notably improved. Prior to the module in anatomy and ENT conditions, 5 per cent of students rated themselves as 'fairly confident' or 'very confident'; these values improved to 76 per cent and 79 per cent, respectively, after module completion. By comparison, confidence in ENT examinations improved from 7 per cent to only 61 per cent. Other studies utilising online learning for ENT have also shown its efficacy in improving objective knowledge in anatomy and common conditions.[7] However, there are no studies on the role of online learning specifically in teaching ENT examinations.

This lower confidence response was noted, and a follow-up face-to-face lecture was delivered on ENT examinations, with good feedback response. This may highlight a potential shortcoming in isolated online learning, and may be a reason to advocate for face-to-face or supplemental teaching in practical skills and clinical examination.

Need for online learning

Limited clinical exposure in ENT has been a long-standing issue for medical students.[3] A systematic review of ENT teaching in UK medical schools confirmed that low student confidence in ENT was well-documented, and specifically identified limited clinical placement duration as an important factor.[8] Although an increase in clinical placements would address this, because of curriculum constraints this is not a realistic option, and studies advocate for the use of 'integrated learning', including using online learning as an educational tool.[8]

The Covid-19 pandemic has accelerated the use of online learning across all clinical learning within the medical curriculum. Despite the loss of face-to-face teaching, evidence suggests that students have been broadly satisfied with the use of technology, particularly when used in combination with traditional teaching methods.[5–6]

Given the importance of ENT in clinical practice, medical students' lack of confidence and wider curriculum pressures, online learning represents a feasible solution to address this.

Although there is no standardised undergraduate curriculum, given the specialist nature of ENT, it is likely that the required learning objective across UK medical schools will be grossly similar. With the introduction of the UK Medical Licensing Assessment for all medical students from 2022, there is additional pressure to ensure that teaching prepares students for this, and it may homogenise UK medical school curricula.[9] Consequently, there may be a role for a standardised UK-wide ENT online package.

Current ENT online learning in medical schools

Evidence from other studies into the strengths of online learning has been largely positive in a variety of topics, including anatomy, clinical skills and examination.

When directly compared with face-to-face teaching, online learning has been shown to be equally effective, although with slightly lower student satisfaction.[10] A systematic review on the use of technology in teaching ENT shows that it may even be more effective than face-to-face teaching.[11] There are acknowledged weaknesses when teaching more complex, spatial anatomy;[7] however, when online learning is used in addition to traditional methods, it has superior effects in terms of both confidence and objectively measured test performance.[12]

This evidence supports the use of online learning as an effective method of delivering education, which can be used either as a direct replacement for face-to-face teaching or, more successfully, as part of an integrated teaching methodology.

Alternatives to online learning

Near-peer teaching models have also been shown to significantly improve both confidence and assessed knowledge in ENT anatomy.[13] This can be an alternative, resource-friendly approach to address curricular constraints, whilst also offering face-to-face learning.

Despite concerns over Covid-19 transmission, patients seem happy to participate in face-to-face learning with medical students in ENT, reporting a 95 per cent comfortable rate despite Covid-19.[14] Additionally, most patients report being happy to participate in remote learning by being recorded and included as part of a virtual clinic or ward round – a technological solution to reduce contact in light of the pandemic.

A US multi-centre project compiled a mixture of videos, case-based discussions, podcasts and online learning in response to reduced ENT exposure during Covid-19.[15] This aimed to comprehensively cover all major aspects of clinical ENT, surgical procedures, clinic work, and the diagnosis and management of common conditions. This, again, is to be used in collaboration with practical exposure, but is a realistic option for medical schools with no formal ENT placements.

Simulation

Use of physical models within ENT has good evidence of efficacy, particularly for practical examination and procedural skills. This can include mannequins to practise otoscopy, flexible nasendoscopy and micro-suctioning,[16] as well as models for practising surgical techniques.[17] This is relatively resource-friendly and is a common mode of teaching introductory procedural skills such as otoscopy.

- ENT is underrepresented in the undergraduate curriculum and has been further affected by the coronavirus disease 2019 pandemic
- Reduced exposure in ENT needs to be addressed given its clinical importance
- Our online module has been shown to improve student knowledge and confidence in a range of essential areas within ENT
- Online learning is a realistic, future-proof option to address curriculum pressures, whilst helping supplement placements with ENT exposure

Simulation has expanded significantly with the introduction of virtual reality. This concept combines physical anatomical models, often three-dimensionally printed, with augmented reality headsets. This allows students to 'operate' in a virtual environment, emphasising the visual-motor skills required in a low-fidelity environment. This novel tool has been shown to be effective in teaching ENT skills in temporal bone, endoscopic sinus, and open head and neck surgical procedures.[18–20] Wider use of augmented reality at undergraduate level has included bedside teaching and anatomy, with good results.[21–22] Such simulation is currently limited by cost and resource requirements; however, it could represent the future of ENT and generic medical teaching.

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Limitations

This was a single-centre study with a relatively low number of participants. Our objective assessment tool would ideally have been taken from summative examination data rather than our own written test. Furthermore, we were only able to include data from participants who had completed the module; therefore, the more driven students may have skewed our data. Additionally, examination technique would be best assessed via the Objective, Structures, Clinical Examination format rather than multiple choice examination, and would corroborate the findings of our Likert scales.

Conclusion

Online learning represents a realistic, future-proof option to help students attain the required ENT knowledge at undergraduate level. It is easy to design, implement and distribute an online learning module to ensure fair, standardised teaching. However, we would suggest that online learning is to be used as an adjunct to, rather than a replacement for, clinical experience.

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Data availability statement. All data generated or analysed during this study are included in this article.

Competing interests. None declared

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