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# “Flipped classrooms” in training in maxillofacial surgery: preparation before the traditional didactic lecture?

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## Abstract

While virtual learning environments (VLE) can be used in medical education as stand-alone educational interventions, they can also be used in preparation for traditional “face-to-face” training sessions as part of a “flipped classroom” model. We sought to evaluate the introduction of this model in a single module on maxillofacial radiology from a course on trauma skills. Course delegates were randomised into two groups: one was given access to an e-learning resource (test group) and the other attended a traditional didactic lecture (control group). Knowledge and confidence were assessed before and after the course with a 20-question single-best-answer paper and a 10-situation 100 mm visual analogue scale (VAS) paper, respectively. All participants were then given free access to the VLE for 30 days and were invited to take part in an e-survey. Neither group showed improvements in the single-best-answer scores, but both groups showed comparable improvements in VAS (control: median (range) values improved from 40.8 (17.7–82.5) mm to 62.8 (35.3–88.7) mm,  $p=0.001$ ; test group: from 47.7 (10.9–58.1) mm to 60.5 (32.4–75.6) mm,  $p=0.005$ ). Half of the respondents stated that they preferred the “flipped classroom” approach, and 22/22 stated that they would be “likely” or “very likely” to use an e-learning resource with expanded content. The “flipped classroom” approach was well received and there were comparable improvements in confidence. As maxillofacial radiology lends itself to online instruction with its reliance on the recognition of patterns, and problem-based approach to learning, a piloted e-learning resource could be developed in this area.

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## Introduction

Virtual learning environments (VLE) and e-learning resources are increasingly being integrated into postgraduate medical education. They typically offer advantages over traditional teaching methods because they are easy to access and flexible, and enable participants to learn at their own pace.<sup>1</sup> They have been designed for use in medical specialties and one such resource on maxillofacial emergencies for frontline staff was designed by one of the authors.<sup>2</sup>

In the “flipped classroom” model, learners have access to the educational content (such as a VLE) before a traditional lecture so that time in the classroom can be dedicated to activities that apply it to problem-solving.<sup>3</sup> We sought to examine the comparability and face validity of such an approach in a single module (maxillofacial radiology) of a course on skills in maxillofacial trauma for dental core trainees.

## Methods

Delegates were randomly allocated to two groups by computer two weeks before the course: a test group and a control group. Before the course, those in the test group were given access to an e-learning resource on maxillofacial radiology that they could use as often as they wished, then during the

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face-to-face course, they were given an interactive tutorial based on the problems and learning objectives they had identified (the so-called “flipped classroom” teaching method). Those in the control group attended only a lecture on the same subject during the face-to-face course.

The e-learning course was created using Articulate 360 (Articulate Global Inc) with the content authoring tool Rise, and was distributed using a shareable weblink. This did not allow learners’ progress to be tracked, but avoided the need to use a potentially costly additional learning management system such as Canvas® (Instructure Global Ltd), Blackboard® (Blackboard Inc), or Moodle™ (Moodle).

Knowledge and confidence in both groups were assessed at the beginning and end of the face-to-face course by a 20-question single-best-answer paper and a 10-situation 100 mm visual analogue scale (VAS) paper, respectively. Both groups were given access to the e-learning content for 30 days after the course, and were then asked to complete an online survey (SurveyMonkey®) of their experiences. We used the Wilcoxon signed rank test to compare scores from before and after the course within the groups, and the Mann–Whitney test to compare scores between the groups. Non-parametric tests were used because of the small sample numbers, which precluded the certainty of normal distribution. Summary statistics are therefore given as median (range). All statistics were calculated with the help of IBM SPSS Statistics for Windows, version 22 (IBM Corp). Probabilities of less than 0.05 were accepted as significant.

## Results

Participants were randomised in a 1:1 ratio before the course but as some did not attend, there were 14 in the traditional lecture group (control) and 10 in the e-learning group.

Differences in single-best-answer scores before the course were not significant between groups (median (range) control group: 14 (10–16); e-learning group: 15 (13–17,  $p=0.16$ ). After the course there was no significant improvement in scores in either group (median (range) control: 14 (10–18),  $p=0.47$ ; e-learning group: 15.5 (10–16),  $p=0.73$ ), and the differences in the scores between the groups were also not significant ( $p=0.47$ ).

Before the course, participants in the control group had a median (range) VAS of 40.8 (17.7–82.5) mm, which again did not differ significantly from that of the other group (47.7 (10.9–58.1) mm,  $p=0.95$ ). Both groups, however, showed significant improvements in VAS (control: values improved to 62.8 (35.3–88.7) mm,  $p=0.001$ ; e-learning group: improved to 60.5 (32.4–75.6) mm,  $p=0.005$ ). Differences between groups once again were not significant ( $p=0.71$ ).

There were 22 responses to the SurveyMonkey® online survey after completion of the course and a 30-day trial of the VLE. Half of the respondents stated that they preferred the flipped classroom approach ( $n=11$ ) (Fig. 1), and they

Table 1

Suggested topics for inclusion in e-learning resources for dental core trainees by respondents to the online survey.

Suggested topics	No. of responses
Management of maxillofacial trauma	21
Management of dentoalveolar trauma	21
Perioperative management of orthognathic patients	21
Perioperative management of patients with cancer of the head and neck	20
Fluid balance/shock diagnosis and management	19
Head injuries	17
Management of cervicofacial infections	16
Airway management/tracheostomy	16
Management of penetrating neck trauma	11
Ballistics injuries	7
Abdominal trauma	5
Thoracic trauma	4

cited better retention of knowledge, the potential for learning to be more interactive, and the ability to access the VLE at any time, as key advantages.

Twenty-one respondents rated the content of the Articulate 360 learning environment as “good” or “better” on a 5-point Likert scale, and the same number agreed that the online resource had met their needs with respect to content. All the respondents thought that they would be “likely” or “very likely” to use a similar resource with expanded content, and they identified several electronic devices they would habitually use to do so (Fig. 2). Only 13/22 stated that they would “agree” or “strongly agree” to pay for content. Table 1 shows the suggestions made for future online resources.

## Discussion

Designing a VLE is a skill in itself, and Carley and Macway–Jones in particular,<sup>4</sup> highlighted the need to resist the temptation to resort to “brain-dumping” and uploading information without thinking about the design of the lesson. A “blended” approach to learning, in which face-to-face teaching is combined with the use of web-based or online resources, has previously been reported.<sup>5</sup> It typically enables a formative focus on the development of knowledge and skills in the face-to-face encounter, followed by a normative focus on ongoing evaluation, and a restorative focus on the well-being of the participants through elements such as online chat rooms and forum discussions.<sup>6</sup>

Flipped classrooms invert this approach by “preloading” participants with information, which can generate questions that can be discussed at small-group, interactive teaching sessions. In terms of Bloom’s taxonomy, this can enable students to engage in higher-order thinking, which shows the synthesis and application of knowledge, rather than its mere acquisition.<sup>7</sup> There is also evidence that once knowledge is acquired, its short and long-term retention is better with this approach.<sup>8</sup> The acquisition of knowledge in both our groups,

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