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# An evaluation of online learning to teach practical competencies in undergraduate health science students

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ABSTRACT

The aim of this study was to evaluate the use of online delivery as a pedagogical approach to teach the practical and theoretical skills required for resting ECG electrode placement and interpretation.
*Results:* Comparable results were found for all variables between the two groups, apart from electrode placement, whereby students in the classroom based group were significantly more accurate than their counterparts in the online group ($p < 0.05$). The effect size of this difference was large (0.91), whereas the effect size for all other measured variables were classified as small (0–0.49).
*Conclusion:* Online learning is an effective study mode in both theoretical and practical application; however consideration must be taken of the types of practical skills which it is used for. More complex practical skills requiring haptic awareness may best be delivered within a classroom setting if feasible, whereby the instructor can provide immediate feedback.



## 1. Introduction

There is an ongoing drive within higher education institutions (HEI) to continually develop and enhance their pedagogical approach, whilst recruiting optimum student numbers. Online learning represents a study mode that may enhance both these factors and which is ever-increasing in popularity, largely due to advances in technological delivery modalities (Smith, Gillham, McCuthcheon, & Ziaian, 2011). Online learning represents a medium through which universities may deliver courses to students outside of its geographical catchment area, and increase the efficiency of on-campus delivery. There are a number of strengths and limitations associated with this pedagogical approach, which must be considered within the context of specific course objectives, before a decision as to appropriateness may be made. A key strength of online learning is the degree of flexibility that it allows, which may not be available in a more traditional classroom based course. For example, this educational mode provides the opportunity for asynchronous or threaded discussion, without the logistical difficulties of arranging times and locations for students to meet (Hillman & Corkery, 2010), thus increasing accessibility of university education to a wider student demographic (Paulius et al., 2010). In addition, online learning allows development of technological skills, which are of particular relevance in modern society (Bonk, 2009) and also employs many of the key tenets of student centred learning (Pederson & Liu, 2003), enhancing the development of higher order cognitive skills, including application, synthesis and evaluation (Lee, Mann, & Frank, 2010; Tsou et al., 2009).

There are however, pedagogical limitations associated with the use of online learning. Often cited within the literature as a negative aspect of online learning are issues related to engagement (McQuiggan, 2007), social isolation, lack of confidence in peer advice and knowledge, and technological difficulties (Petrides, 2002; Song, Singleton, Hill, & Dwa Koh, 2004; Vonderwell, 2003). It has also been suggested that a proportion of potential employers may not perceive online learning as an entirely credible process (Huss, 2007). While each of these factors must be considered, it is important to note that many of these limitations may be overcome with appropriate instructional design (Song et al., 2004), institutional support (Leist & Travis, 2010) and educator presence (O'Neill & McMahon, 2005).

At present there is a paucity of empirical evidence available that evaluates objective outcomes related to online learning as opposed to more traditional, classroom based learning techniques, particularly regarding the use of this study modality to teach practical skills. Practical application of skills with clients and patients is essential to the development and successful performance of health professionals. The limited evidence available does appear to suggest that online or distance modalities may be comparable to more traditional pedagogical approaches in relation to achievement of learning outcomes. For example, Cason and Stiller (2010) explored the efficacy of online versus classroom based first aid training for laypeople, and showed comparable learning outcomes for both groups when assessed by instructor. This study reported low achievement rates in both groups however, as ascertained through objective assessment criteria taken directly from the mannequin (Cason & Stiller, 2010). This raises questions as to the appropriateness of the

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course delivered relative to the desired learning outcomes, so impacting on the reliability of the information obtained. In addition, participants in this study were not randomised into the two groups, and self-selection as a result of an inherent preference for one study mode over another may potentially have biased the results. Maloney, Storr, Paynter, Morgan, and Ilic (2013) investigated the use of three different educational methods as an adjunct to traditional instructor-led sessions to teach practical skills in a group of third year physiotherapy students. These educational methods included traditional tutorial based teaching; pre-recorded video tutorials, integrated within the traditional setting and reflective self-video of clinical skills. All students performed comparably in the objective structured clinical examination (OSCE), although students allocated to the two alternative teaching groups reported a higher perceived educational value. This finding is in agreement with other literature that suggests comparable outcomes between video and "live" demonstrations (Chung, Siu, Po, Lam, & Wong, 2010). Collectively, the results from these studies appear to support the use of alternative educational methods to teach practical skills; however, the authors stressed the importance of considering the attributes of the clinical skill in question, along with other issues including IT support, and infrastructure. In addition, Maloney et al. (2013) evaluated a blended resource approach integrating the video resources seamlessly within the class. Limited research is available however, investigating the use of a teaching package delivered wholly online, without the presence of the educator. Further research of this kind is required, to assess the efficacy of online learning to teach practical skills as well as theoretical content.

Overall, the available evidence appears to indicate that online learning for practical skills may be an effective means of delivery for higher education institutions, although this assertion is not well grounded in empirical data, due to the aforementioned paucity of evidence. In addition, the constant development of technological aids and web influences create an ongoing evolution of the way in which online courses are designed and delivered (Song et al., 2004). Continued evaluation and research is necessary to ensure that an optimum learning experience is provided to the student. The aim of this study therefore was to evaluate the use of a wholly online learning package, as a pedagogical approach to teach the practical and theoretical skills required for resting electrocardiography (ECG) electrode placement and waveform interpretation in a group of first year undergraduate health science students.

## 2. Methods

First year undergraduate students from a School of Health Sciences were invited via email to take part in a session examining ECG theory, preparation and electrode placement, and randomly allocated to one of two groups. One group undertook a traditional classroom based model, as typically used within the school, while the other group took part in a session that was comprised entirely of online materials. Theoretical and practical competencies were assessed one week after the teaching session.

### 2.1. Population and recruitment

A recruitment email was circulated to all first year undergraduate students (n = 147) within a School of Health Sciences. Students were enrolled on one of four courses (diagnostic radiography, physiotherapy, occupational therapy or applied sport and exercise science). Any student that had prior knowledge or experience of ECG theory or electrode placement was excluded from the study to control for the confounding influence of prior knowledge. All students within these cohorts had previously completed a Scottish Credit and Qualifications Framework (SCQF) level 7 30 credit module in human anatomy and physiology and had a basic understanding of cardiac anatomy and physiology prior to participating in this research project. The aforementioned module was delivered as an online blended student centred course and assessed via multiple choice question (MCQ) examination. All students were therefore familiarised with this mode of delivery and assessment, reducing the possibility of biased results through greater familiarity with one mode of teaching over another. Participant confidentiality and anonymity was assured and all participants were reminded of their right to withdraw from the study at any time.

### 2.2. Teaching sessions

Students who volunteered for this project were randomly allocated to one of two courses (a classroom based or online course). Both of these courses taught the theory and practical application of ECG electrode placement and interpretation. The same teaching resources were used for both the classroom based and online sessions as outlined below. Classroom based students were provided with the teaching materials after the session was completed. The online course was uploaded to a purpose designed Modular Object-Oriented Dynamic Learning Environment (Moodle) page on the same day that the classroom based session was delivered and remained open for the next week. All students then returned for testing the following week, whereby they took part in both a practical and theoretical examination of knowledge. The Moodle page was password protected and accessible to participants in the online group only. Clear instructions were provided to all participants on the purpose of the study and the importance of not sharing materials with their counterparts in the other group.

### 2.3. Teacher led session

This session commenced with a short didactic lecture that revised basic cardiac anatomy and physiology. Theoretical information was then provided on the practical knowledge necessary to prepare the subject, place the ECG electrodes and interpret the resultant recording, in accordance with the waveforms and the corresponding phase of the heartbeat. The students were then provided with a brief break, which was followed by a tutorial, whereby the practical skills of ECG preparation and placement were taught, using the 4 stage approach to student learning, as proposed by Peyton (1998). These four stages included a demonstration phase, deconstruction phase, comprehension phase and performance phase (Greif, Egger, Basciani, Lockey, & Vogt, 2010). The didactic content was split up into smaller components ($\approx$20 mins) to maintain engagement and improve concentration (Stuart & Rutherford, 1978). A volunteer patient attended the practical session for demonstrations 1–3, and the students then took turns to connect this volunteer to the ECG monitor (Cortex Metalyser 3B, Cranlea, UK). While waiting for their turn to practice on the volunteer, students practiced electrode placement on resuscitation dolls that were made available during the session.

### 2.4. Online course

The same teaching materials were used for development of the online course. Audio visual materials were developed from the same PowerPoint™ presentation using Articulate™ software. This software allows the creator to record narration throughout a PowerPoint™ presentation. This presentation was then uploaded to a Moodle page that was created specifically for this project. In addition, four video clips detailing the 4 stage approach to practical demonstration were recorded using the Scotia Medical Observation and Training System (SMOTS™) (Scotia UK, Ltd) and the resultant video clips were uploaded to the Moodle page. These video clips followed the exact same 4 stage approach as used within the classroom based session, however the 3rd clip included pauses for students to provide instructions, while the 4th clip instructed the students to find a willing volunteer on whom to practice identifying landmark sites. Discussion forums were populated for students to ask any questions on the topics. Educator consistency was ensured, and the same researcher who performed the live demonstrations recorded the video clips, as with the presentation articulation and delivery.