

E-learning, collaboration, and group support in medical education

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In this issue of the *Polish Archives of Internal Medicine* (*Pol Arch Intern Med*), Kopeć et al¹ describe their prospective randomized study comparing performance at electrocardiogram (ECG) analysis, before and after a program of e-learning. A group of 60 fifth-year medical students at Jagiellonian University were randomized into 2 arms, both of which underwent the e-learning program. The first group studied the ECGs individually, whereas the second group analyzed the same ECGs collaboratively in 5 smaller groups, each comprising 5 students. The e-learning material was based on the Polish recommendations for ECG interpretation. The assessment was based on diagnosing a major abnormality in 10 different 12-lead ECGs. The authors should be commended for applying the same pass mark used in other exams at their institution (>56%), providing the students with a real-world authenticity, which is known to increase motivation and aid learning.

The authors concluded that group-based e-learning was superior to individual e-learning. This was based on a significantly higher pass rate in the collaborative learning arm relative to individual study (20 vs 13 passes, $P = 0.04$). As the authors noted, however, this was a small study, conducted at a single center, with a self-selected sample of students, but with a commendably low dropout rate. The authors highlighted the difficulties in demonstrating the long-term impact of collaborative learning due to the myriad of factors potentially influencing performance, most of which would be difficult to control for in the postgraduate period, as described by Vulkanovic-Criley et al.² This is a thought-provoking study that should make all of us question how we deliver medical education, specifically when teaching clinical skills such as the interpretation of investigations.

Several questions remain. For fifth-year medical students, who were nearing completion of their undergraduate studies, this may have been

more revision than new learning with relatively little gains in terms of improved knowledge of ECG's compared with more junior students. Furthermore, one should not assume the same effect would be evident in other year groups. It is a little surprising that the students were not asked about their experience of using the e-learning material and the groups to which they were allocated. It would also be interesting to know if the students had a preference regarding which group they may have had chosen. Would introverts have preferred or benefited more from individual study, whereas extroverts may have been more enthusiastic about group study? Did all the groups work effectively, or were there interpersonal conflicts which may have impaired learning? While the groups were randomly allocated, one wonders whether the composition influenced performance. While learning about ECG interpretation may be better in collaboration, this does not reflect the context of real-world medical practice, in which the students will soon be practicing in, where ECG analysis typically occurs in isolation, not in groups, and following an accompanying history and examination. It may have been more realistic and advantageous to provide accompanying medical history, examination findings, and investigation results.³ The surrogate endpoint of the "number of words used" within group discussion was an unusual marker of the "intensity of collaboration", and while this did correlate with the results, the authors might have been at risk of making a type I error. It was not clear what ECG training the students had already had received and whether the materials in this study were supplementary to, or a reworking of, core undergraduate content. The students' previous performance levels were not described either.

What does this study tell us about current practice and how can we use these findings to improve how we teach medical students? The optimum method for teaching ECG interpretation

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at undergraduate level remains unknown.⁴ What is clear is that medical education continues to move away from traditional cognitive techniques such as didactic, lecture-based teaching towards self-directed and problem-based learning models. The current article appears to support this. Typically, e-learning is an individual activity lacking interactive group work. Learning can be increased by making the process active, problem-based, clinically relevant, and constructively aligned with assessment.⁵⁻¹⁰ The current study suggests that group interaction may also maximize learning.

There are limited data regarding the teaching of ECG reading to medical students, and this is the first study to combine group learning and e-learning. Previously, Nilsson et al¹¹ evaluated a web-based ECG program, in response to student requests for additional ECG tuition. Their program was well received by the students who performed better on subsequent assessment, but clearly this was a highly motivated group. In a larger study, Raupach et al¹² divided 493 students into 6 groups: 2 groups followed self-directed learning, 2 groups attended lectures, and 2 groups underwent small-group, peer-led teaching with either summative or formative assessment. All groups were tested again 2 months later to check for retention. They discovered that “retention test scores were predicted by summative assessments but not by the type of teaching” and “performance levels and motivation did not predict performance decrease or skills retention.”¹² This reinforces the fact, as demonstrated by Kopeć et al,¹ that assessment provides the motivation for learning.

Rather than focusing on the method of teaching delivery, what about individual factors, not addressed in this study? Nilsson et al¹³ demonstrated that student-specific learning styles did not influence the decision to use a web-based ECG learning program, but they did not investigate the influence of individual learning styles on subsequent student performance, which, of course, is what matters. Rolskov Bojsen et al¹⁴ randomized 203 medical students either in short- (2–4 weeks), medium- (10–12 weeks), or long-term (18–20 weeks) follow-up after a standalone web-based ECG tutorial. The web-based tutorial improved performance in junior and senior medical students, with juniors improving the most. However, performance was significantly reduced even after 2 to 4 weeks in both groups. Thus, in addition to standalone e-learning programs, repetition appears key to retention. Finally, Mahler et al¹⁵ randomized 223 fourth-year medical students to workshop, lecture, or self-directed learning for ECG interpretation. All students were assessed before, immediately after, and 1 week after the workshop, lecture, or self-directed learning. All 3 groups demonstrated significant improvements in performance, but self-directed learning was the least effective, offering a counterpoint

to the notion that group learning is preferable, but again no assessment of learning style was made.

What about the future? A study with 4 arms comprising e-learning as individuals, e-learning in groups, didactic teaching as individuals, and didactic teaching in groups would tease out the relative influence of each factor. A longer follow-up to assess retention in each group, even during undergraduate studies, would be interesting. Why not test the students as individuals or, indeed, in groups, to see what influence groups have on assessment, not just learning? It would also be interesting to investigate if the findings of this study were consistent across other skills and clinical specialties, such as interpreting pulmonary function tests or electroencephalograms. Thinking more widely, is there a role for the gamification of medical education to further develop such knowledge, skills, and indeed, attitudes, while simultaneously avoiding burnout, depersonalization, and a diminished sense of personal accomplishment, which are often associated with medical studies? Finally, what about the role of multi-professional learning, such as with cardiac physiologists, advanced care practitioners, physician assistants, paramedics, and so forth, and not simply within the medical silo?

In conclusion, medical education increasingly employs online, distance-learning methods, and the popularity of problem-based learning has encouraged a collaborative peer discussion facilitated by a coordinator. As demonstrated by Kopeć et al,¹ there is growing evidence confirming that such an approach is more effective than simply learning by rote alone. Ultimately, what this and similar studies seek to demonstrate, but fail to address, is the need for improvements in understanding, not simply knowledge recitation.

NOTE The opinions expressed by the author are not necessarily those of the journal editors, Polish Society of Internal Medicine, or publisher.

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