



When Learners Become Teachers: A Review of Peer Teaching in Medical Student Education

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BACKGROUND AND OBJECTIVES: Peer teaching engages students as teachers and is widely used in K-12 education, many universities, and increasingly in medical schools. It draws on the social and cognitive congruence between learner and teacher and can be attractive to medical schools faced with a growing number of learners but a static faculty size. Peer teachers can give lectures on assigned topics, lead problem-based learning sessions, and provide one on one support to classmates in the form of tutoring.

METHODS: We undertook a narrative review of research on peer teachers in medical school, specifically investigating how medical students are impacted by being peer teachers and how having a peer teacher impacts learners.

RESULTS: Studies have shown that peer teaching has a primarily positive impact on both the peer teacher and the learners. In the setting of problem-based learning courses or clinical skills instruction, medical students' performance on tests of knowledge or skills is similar whether they have faculty instructors or peer teachers. There is also strong evidence that being a peer teacher enhances the learning of the peer teacher relative to the content being taught. It is common for peer teachers to lack confidence in their abilities to successfully teach, and they appreciate receiving training related to their teaching role.

CONCLUSIONS: We find evidence from several different educational settings that peer teaching benefits both the peer teachers and the learners. This suggests that peer teaching is a valuable methodology for medical schools to engage learners as teachers.

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Topping defines peer teachers as people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by teaching.¹ Peer teachers are usually fellow students who have less knowledge than faculty and who have little, if any, teaching experience. Peer teaching activities have

been described along three dimensions: chronological proximity (how close or far in age the peer teacher is to the learner), group size (teaching one peer versus many peers), and formality of the teaching encounter.² It is used in various settings from elementary school through graduate school.

At many medical schools, medical students have served as peer teachers for problem-based learning sessions, clinical skills courses, and in providing lectures on clinical content. Soriano recently reported that nearly 50% of US medical schools use students as peer teachers of small groups in basic science courses and doctoring courses. Nearly 25% of all schools use students as peer teachers in problem-based learning courses.³ Medical educators give several different rationales for making use of peer teaching. A common stimulus for utilizing peer teachers is to alleviate teaching pressures on medical school faculty.⁴ Worldwide, medical schools are currently increasing class size, but comparable increase in paid or volunteer faculty has not occurred.^{5,6} Some medical schools make use of peer teaching because of the expected benefits peer teaching brings to learners. By taking on the role of peer teacher, medical students gain teaching and learning skills that are important to physicians.⁷ Other medical educators support peer teaching since this activity is thought to help medical students gain teamwork skills and identify their personal strengths and weaknesses.⁸ Additionally, peer teaching is sometimes used because by teaching

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a topic, medical students might gain greater mastery of the topic.⁵

Methods

Relevant articles were retrieved from PubMed with the search terms “(peer teach* OR near peer teach*) AND medical student” and from Google Scholar using similar search terms. Citing articles identified by Google Scholar were also reviewed as were the references of retrieved articles. Studies of peer teaching of gross human anatomy were excluded since peer teachers in this setting often take the place of traditionally self-guided dissection with a lab manual or guided instruction by a “demonstrator” or teaching assistant, as opposed to a faculty member. Studies utilizing residents as peer teachers were not included in order to focus on research conducted on a more homogeneous population of learners. We determined the final list of articles through consensus of our expert group, with a preference for studies that brought new insights into practical educational issues for the general family medicine audience. The terminology used in different publications on peer teaching is not standardized. In this review, we use the term “peer teacher” for any medical student who teaches other medical students at the same medical school, either in the same year of study or in a different year. *P* values are provided in this review when an intervention results in a statistically significant difference. Effect size (ES), measured using Cohen’s *d*, is included when provided by the authors or calculable using data provided by the authors.⁹

Outcomes

Impact of Peer Teaching on the Peer Teachers

“To teach is to learn” (Japanese proverb).

It has long been suggested that through teaching a content area, the individual teacher develops a deeper and enhanced understanding of the concepts being taught.¹⁰ Research supports this outcome for peer

teaching in the setting of medical education. Gregory looked at knowledge gains of the peer teachers in a group of senior students asked to prepare to teach EKG interpretation and ACLS algorithms to more junior students. After preparing both topics, the senior students were randomized to teach only one of the two topics. The researchers compared subsequent exam performance of the peer teachers for content they did or did not teach. Peer teachers demonstrated increased learning after preparing to teach both topics but they had significantly larger gains in learning for content that the peer teachers actually taught ($P<.001$, $ES=2.1$). These significant learning gains were still present when subjects were retested 60 days later ($P<.01$, $ES=1.3$).¹¹ Peets studied small learning groups of medical students in a gastroenterology-hematology course spread over 22 small-group sessions during a 12-week block.¹² Two students in each group were randomly selected to be the peer teachers of the group for each learning session with each student performing the role of peer teacher three or four times over the duration of the course. Students gained greater knowledge about topics that they taught compared to topics for which they were learners without any teaching responsibilities ($P<.01$, $ES=.33$).

Knobe’s study of students randomized to teach musculoskeletal ultrasound found that students randomized to be peer teachers performed significantly better on a final examination ($P=.023$, $ES=1.12$) and an OSCE ($P<.001$, $ES=1.67$).¹³ Kooloos et al randomized 27 groups of 15 students to each of three conditions (A, B, or C). In condition A, all 15 students worked together to complete a group assignment; condition B split the 15 students into three smaller groups of five students who then completed a group assignment; condition C mimicked condition B but added a component of peer teaching on the assignment content after the assignment was complete. Students in the peer-teaching

group (Condition C) had higher test results on a knowledge posttest ($P<.05$) compared with students in the other two conditions.¹⁴

Significant gains are not always apparent as a result of peer teaching. Raupach found that medical students randomized to small-group peer teaching sessions performed better than those receiving traditional lectures on ECG ($P<.018$, $ES=.33$) when judged by a formative final assessment. A formative retention test 8 weeks later demonstrated similar gains for peer-taught students ($P<.017$, $ES=.38$). When both groups received a summative assessment that would contribute to their final course grade, there were not significant differences in exam performance ($P=.43$).¹⁵ Nestel and Kidd undertook a study in which senior medical students were assigned to peer teach first-year students about patient-centered interviewing skills.¹⁶ At the end of a five-session course, the peer teachers reported a higher level of confidence in their interviewing skills; however, the researchers did not observe any significant differences in the interviewing skills of the peer teachers compared to their classmates who did not participate in the project.

From our review of the literature we find that peer teachers often show learning gains from their role as a teacher, although this is not always true and may be moderated by the way learning gains are measured. Of note, we were not able to identify studies that have detected significant harm to peer teachers’ learning from participating in this activity.

Why Do Peer Teachers Benefit From This Role?

Several different mechanisms have been suggested to explain the learning benefits peer teachers gain from their teaching activity. Peer teachers may have enhanced motivation to learn the material they teach, and motivation is known to be related to learning.¹⁷ For example, Peets found that the peer teachers spent nearly

three times the amount of time (99 minutes versus 36 minutes) reviewing content that they taught compared to the other students in the course ($P < .001$, $ES = 1.3$).¹²

Peer teaching also results in deeper processing of information, which increases conceptual learning. Peer teachers are more likely to self-monitor their comprehension of new information than are other students, and this metacognitive skill facilitates learning.^{18,19} Roscoe and colleagues refer to this as reflective knowledge building and note that tension between effective explaining and a peer teacher's incomplete knowledge base may encourage peer teachers toward increased levels of self-monitoring. Explaining new concepts to other learners can also enhance learning because this activity aids integration of new information with prior knowledge.²⁰

Research on the psychology of memory retrieval suggests that the benefit of teaching is not only from organizing the information better in the minds of teachers but also from having to retrieve this knowledge during the process of teaching. Studies by Karpicke suggest that retrieving knowledge from memory about a topic that is being learned results in 45%–60% greater proportion of concepts recalled at 1 week compared to spending the same amount of time studying the topic.²¹ This is consistent with Gregory's finding that teaching new content after preparing lessons about the content resulted in more learning on the part of peer teachers when compared to the peer teachers who did not have the opportunity to teach the content.¹¹

Nurturing and Educating Peer Teachers

We find limited research and no consensus about the knowledge and skills that allow peer teachers to succeed in their teaching roles. Skills in leadership, communication, and trust building have been suggested by some educators.²² Others have suggested that knowledge of learning theory and practicing

teaching in a simulated setting are necessary to prepare learners to be peer teachers.²³ In a recent national survey, about half of the medical schools that use peer teaching reported that they offered medical students instruction in principles of effective teaching.³ Knowledge about adult learning principles and skills in small-group facilitation and providing feedback are typically included in this instruction.

In reviewing the literature on medical school programs from 1966 to 2005, Pasquinelli finds many examples of formal course work to assist peer teachers.²⁴ Generally, these curricula included varying amounts of formal teacher training in medical education principles and the specific content for which the peer teachers were to teach. Whether the general teaching skills or more specific content training were helpful is not clear because the interventions were largely evaluated by asking the participants for their perceptions of the programs.

There is extensive evidence that peer teachers have concerns about taking on this role. Knobe found that peer teachers experience anxiety about their ability to teach and about being able to fulfill the teaching role.¹³ Kassab reported that even though peer teachers were given higher ratings than faculty problem-based learning group facilitators, many of the peer teachers felt a need for training to prepare for this role.⁸ Bulte surveyed a convenience sample of students who served as peer teachers. The majority of the respondents reported they were positive about their experiences but felt less positive about the role of assessor or instructional planner. These peer teachers also wanted training in how to guide a group of learners and take control of a teaching session, how to handle difficult students, how to deal with questions, and how to balance interactive discussion in the group and formal presentations.²⁵ Based on the literature available, we conclude that peer teachers appreciate training in facilitation, feedback,

and assessment of learners, though there is a need for studies to evaluate whether formal training actually improves peer teachers' success.

Impact of Peer Teaching on Learners

In a recent systematic review, Yu identified 15 studies about learner outcomes that compared students taught by peer teachers with students being taught by faculty.⁴ This systematic review concluded that the impact of peer teaching on objective learning outcomes of medical students appears to be at least equivalent to that of conventional faculty-led teaching in selected contexts. No studies in which peer teaching resulted in less learning could be identified. Below we present exemplars of these studies in which the learning outcomes were in the domains medical knowledge and clinical skills.

Ten Cate undertook a retrospective comparison study of curricular problem-based learning (PBL) modules from 2005 to 2010 at one medical school. Over 1,200 learners had peer PBL facilitators and 8,722 had faculty facilitators.²⁶ Mean test scores were higher for faculty-led groups in five of the PBL modules while peer-taught groups scored higher in 29 courses. Overall, students taught by peers had significantly higher standardized test scores than those taught by faculty ($P < .05$, $ES = .17$). Steele studied a year-long PBL course in which small groups of second-year students were led by faculty or peer teachers who were randomly selected group members.²⁷ Students selected to be teachers led the groups for one PBL case. No differences were detected in student performance on an objective evaluation at the end of a PBL case based on whether the facilitator was a faculty member or peer. Kassab reported that learning gains for students in PBL small groups did not significantly differ for groups led by peer teachers recruited from the small groups compared to faculty-led groups.⁸ In this trial, 91 students

were divided into 10 groups during a 5-week hematology unit, and the groups were randomized to have either a peer teacher or a faculty teacher.

Heckmann investigated clinical skills learning within a neurology clerkship.²⁸ Learners were randomized to receive their teaching from peer teachers or from experienced clinical teachers. The primary endpoint was students' practical skills and knowledge tested at the end of the course by a written test and an OSCE. At the end of the clerkships the students showed similar clinical skills performance regardless of being peer taught or taught by clinical teachers. Haist's study of 93 first-year students learning physical exam found that the students showed no differences on a standardized patient exercise when they were taught by fourth-year peers compared to those taught by a faculty preceptor.²⁹ Additionally, the first-year students rated the peer teachers higher than they did the faculty preceptors. Hughes studied the mastery of advanced resuscitation skills by medical students as a result of being taught by peer teachers or experienced instructors.³⁰ Blinded assessment was conducted using an OSCE involving basic and advanced cardiopulmonary resuscitation and the recognition and treatment of ventricular arrhythmias. Pass rates were similar in the two groups.

Why Do Students Learn at Least as Well When Taught by Peer Teachers Compared to Faculty?

It may seem surprising that the learning outcomes of students taught by peer teachers and faculty are similar. Clearly, peer teachers have less knowledge to transmit than do faculty, but there is considerable research suggesting that teachers' knowledge about a specific domain has limited impact on teaching effectiveness.¹⁷ Research on problem-based learning has found that in some cases content experts have more difficulty facilitating learning sessions than

non-experts.³¹⁻³⁴ It has also been hypothesized that the effectiveness of peer teachers can be linked to their cognitive congruence and social congruence with learners.

Cognitive congruence is the result of peer teachers having a better understanding of the prior knowledge that their learners have and a better understanding of the learners' challenges with learning new concepts. Peer teachers also might be more likely to recall the approaches that helped them master these same concepts. For example, Kassab reported that students felt that peer teachers were better at understanding of the difficulties students face in PBL small groups due to the complexity of the problem or the difficulty of the topic.⁸ Zijdenbos found that preclinical students reported peer teachers have a better understanding of why junior medical students make reasoning errors. The students also report less fear of failure when taught by peers than when taught by faculty.³⁵

Social congruence between peer teachers and their learners results in the peer teacher creating a comfortable and safe educational environment for learners that promotes a free flow exchange of ideas.³⁶ Peer teachers have been found to be more supportive and encouraging and reduce learner anxiety through their ability to serve as a role model.^{8,38} Peer teachers cannot rely on using a learner's desire to avoid punishment as motivational technique and, instead, rely on connectedness with the learners.

Areas for Further Study

The literature suggests using peer teaching as a means of "unburdening faculty;" however, there is little formal research about this outcome. Using peer teachers to replace faculty might seem advantageous from a cost perspective, yet we have not found any formal analysis to support this claim. Although we find evidence that medical school peer teaching is associated with learning

outcomes similar to faculty teaching in the context of clinical skills and problem-based learning groups, there have been few studies investigating peer teaching of clinical decision making. This is surprising because medical residents and more senior medical students have traditionally been involved in teaching this content to medical students during clerkships.

Lastly, we are unable to find any outcomes that are relevant to the question of whether physicians who were peer teachers as medical students are better at patient education or at team work. Amorosa reports that medical students serving as peer teachers perceive that they will have a personal and long-term benefit from taking on this role, but we did not find any rigorously designed studies looking at this outcome.³⁹

Conclusions

Peer teachers are widely used in medical education, and there is a growing body of educational research that suggests benefits to medical students serving as peer teachers, to the learners taught by peer teachers, and potentially to faculty whose time may be freed up when students take on a teaching role. Peer teachers feel positive about their teaching experiences, though this is an area for further study. In many medical education settings, students taught by peer teachers learn at least as well as students taught by faculty. Although peer teachers are perceived as not being as knowledgeable as faculty, the cognitive and social congruencies they share with their learners support learning. No studies show any harm to learners, peer teachers, or to faculty through participation in peer teaching; it may be an excellent choice for medical school faculty looking to involve students as teachers.

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