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Learning-by-teaching. Evidence and implications as a pedagogical mechanism

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ABSTRACT

In order to create an initial framework for learning-by-teaching, this article reviews a body of relevant research, from a historical perspective, gathering evidence about the potential and the limits of this pedagogical mechanism. Results indicate that the more complex the teaching activity is, the more opportunities there are to learn by teaching. This explanatory framework may help to develop a conception of teaching and learning consistent with the Knowledge Society and to promote the incorporation and extension of practices that provide opportunities for students to learn by teaching their peers, such as cooperative learning, peer tutoring or peer assessment.

KEYWORDS

Learning-by-teaching; peer learning; peer tutoring; cooperative learning; innovation

Introduction. From personal experience to scientific evidence of learning-by-teaching

We can recognise many situations in our daily lives in which we have learned by teaching others. And as teachers, we also have experiences of having learned something in order to teach our students, or we have learned through helping students to learn. Great masters have been quoted on the matter over the years: 'Teaching is learning' (Seneca); 'He who teaches, learns' (Comenius); or 'To teach is to learn twice' (Joubert).

But is it true? Some scientific articles merely repeat those sentences or mention an invented research study, attributed to the National Training Laboratories in Bethel, Maine, United States, which indicates that teaching is the best way to learn. Teaching others undoubtedly involves an active role by the tutor. But, it cannot be posited that this activity is an effective way to learn unless the claim is backed up by the available scientific knowledge. That is the purpose of this article.

With the double objective of finding evidence of learning by the person who teaches and building an explanatory framework of learning-by-teaching, a review of scholarly literature through APA PsycNET has been carried out, searching for the expression 'learning by teaching' (38 studies) and 'Learning through teaching' (15). From these, only empirical studies focused on what the person who teaches learns were included (18), excluding all those that made reference to learning how to teach or learning as a cause of teaching. This first corpus of research was completed with previous studies (6) and explanatory findings (18), in reference to the same that satisfied the aforesaid criteria for inclusion. The results section summarises the most relevant research, following historical criteria (including research from the last decades) and the teaching sequence (pre-and interactive behaviour). The second part of the article

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considers the implications of learning-by-teaching in formal education by presenting instructional practices that include this principle, though not always in an explicit way.

Results. Evidence of learning-by-teaching

Students learning by teaching their peers

Early empirical studies of the learning benefits for the tutors themselves come from the evaluation of peer tutoring practices, when definition of peer tutoring corresponded to an archaic view (Topping, 1996), in which tutors were seen as mere substitutes for teachers and performed their role with a small group of learners. This differs from the current view that defines peer tutoring in terms of individuals belonging to similar social groups that are not professional teachers, but who help each other to learn, and thereby learn themselves, generally in pairs (Topping, 2005).

In the late 60s, some studies documented the fact that – surprisingly – peer tutors progressed more than their own tutees (Cloward, 1967). The first reviews and meta-analyses on peer tutoring (Allen, 1976; Cohen, Kulik, & Kulik, 1982; Goodlad & Hist, 1989) revealed evidence of learning by the tutor in their role of 'teacher'. These findings, which are still referred to in current studies (Robinson, Schofield, & Steers-Wentzell1, 2005), caught researchers' interest in explaining the phenomenon of learning-by-teaching. Teachers' experiences and initial research evidence indicate that teaching produces a more enriching experience than learning for oneself.

But what really explains the learning potential offered by teaching? At what point does it occur? In order to report on the available evidence and integrate it in an explanatory framework, we will consider the different elements that form part of the complex process of teaching: preparation, explanation and feedback.

Learning to teach, better than learning for oneself

It seems that learning something for oneself and learning to teach others involve different mental processes. Gartner, Kohler and Riessmann (1971) synthesised the cognitive benefits that seem to arise in the course of learning to teach. At this stage, the teacher or tutor must: revise the material, organise the material for presentation and identify the basic structure.

These general ideas were contrasted in an experiment by Bargh and Schul (1980), who compared students who learn for themselves (to pass a test) with students who learn in the belief that they will need to teach the content, even though they do not actually do (expectancy). The results were better for the students who learned in expectancy and the authors confirmed that this condition altered the learning process, promoting greater effort to select the relevant elements and organise them into a meaningful representation. This initial experiment, however, had significant limitations, but it encouraged further work, such as Benware and Deci's (1984) replica, in an educational context, with identical results.

Learning and explaining, better than just learning to teach

Later studies went a step further and included situations where participants were asked to explain what they had learned, often to an examiner or to a video camera. Explaining things to others is a way to test how our mind reviews and reformulates information to turn it into knowledge, just like we consolidate our thoughts explaining them to friends. And this is also true of situations when there is a passive listener, which is known as the audience effect (Zajonc, 1966).

The most significant study in this area (Annis, 1983) divided 130 students into five different situations, where they all learned the same content. One group was taught the material; another read it; another read the material and was also taught; another learned to teach the content, but did not actually do so (expectancy); and, finally, the last group learned and explained the content. Controlled the intervening

variables, students were assessed in terms of cognitive benefits. Students who were asked to prepare to teach performed better, especially those who actually had the opportunity to do so.

These results concurred with already referenced findings, but the author goes a step further, adding that such cognitive benefits were not only the product of preparing to teach, but also of presenting the material to the tutee. Although Annis points out that interaction with the tutee is a key factor in the tutor's learning, her work focuses solely on expository explanation and it is only in later research that this issue is taken into account.

Following Annis' work, other research provides similar results (Ehly, Keith, & Bratton, 1987), even when the content variable is controlled (Lambiotte et al., 1987). The comparison between these two situations of learning-by-teaching (*learning to teach* and *learning and explaining*) still attracts interest nowadays. A recent study by Fiorella and Mayer (2013) argues that both situations promote learning, but prepare and produce explanations for others increase, in long-term, assessments.

Self-explanation promotes cognitive activities that lead to new knowledge (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). These mechanisms that are responsible for learning in self-explanations should also be involved in explaining to others. Furthermore, Webb (1989) argues that explaining to others potentially offers more opportunities to learn than explaining to oneself, because those who receive the explanation can also identify gaps and inconsistencies and may demand clarification or confrontation. To resolve these discrepancies, the explainer has to search for new information and build more in-depth knowledge. It is worth noting that Webb gets the tutor to interact with the learner, whereas previous studies only focused on presenting information to a passive listener. Out of the five levels of interactivity in an explanation – to oneself; to a passive and anonymous listener; to a passive listener; to someone with a limited response, and mutual explanation (Ploetzner, Dillenbourg, Praier, & Traum, 1999) – the greatest potential for explaining to others would be achieved with higher levels of learner participation.

But, the apparent supremacy of explaining to others is not completely supported by research. Ploetzner, Dillenbourg and Praier (1999) report some studies that do not find substantial differences between the two forms of explanation, although the authors identify procedural problems in them: self-explanations may have been aimed not only at oneself, but also at the experimenter; and the experimenter's status may have affected students's motivation.

A thorough review of research on tutor learning in peer tutoring, produced by Roscoe and Chi (2007), sheds some light on this controversy. Like explaining to oneself, explaining to others offers ample opportunity for the tutor to become involved in the process of *reflective knowledge-building* that leads to learning: producing quality explanations, recognising their own areas for improvement, reorganising their own knowledge and inferring to repair the errors. In addition, using examples or representations may allow the explainer to deepen their own knowledge. In order to do so, the tutor must perform an important metacognitive activity: assess their own knowledge and check whether their explanations make sense and are logical.

However, their review of research indicates that tutors do not always take advantage of the opportunity to learn by explaining. It seems that rather than *building* knowledge, many tutors limit themselves to *knowledge telling*. They tend to offer explanations as built responses to questions, summarise information or describe procedures with little preparation. *Telling* knowledge can have a positive impact on tutors' own learning (fixing memorisation) and forms the basis of the construction process. But, it is a pity that tutors do not take advantage of their role and learn more and better, through building knowledge. This is possible if tutors recognise their own Zone of Proximal Development (ZPD), which is the difference between what they are able to teach and what they have not yet had the opportunity to teach (Roscoe, 2014) and whether they receive training (Topping, Dekhinet, Blanch, Corcelles, & Duran, 2013).

There is another body of research that goes beyond the reasons why we can learn by teaching and uses this potential to develop instructional software, called *Learning-by-teaching paradigm*. Biswas, Schwartz, Leelawong and Vye (2005) have designed *teachable agents* (computer programs that simulate a learner to be taught), so that the student can learn by teaching. This suggestive line

of research implies varying degrees of interaction, with interesting results that can potentially be extended even to pre-school education (Anderberg, Axelsson, Bengtsson, Håkansson, & Lindberg, 2013); and that progressively incorporate higher degrees of interaction and human appearance agents (Matsuda et al., 2013).

Teaching by interacting, better than teaching by explaining

With learners playing a passive or limited role, research shows the potential of learning-by-teaching. We must now consider what happens when tutors interact with learners. As Roscoe and Chi (2007) point out, the other common activity in teaching, along with explaining, is questioning. Tutors ask questions to introduce topics and to guide the tutees' line of thinking, and answer questions arising from the tutees' confusion.

Asking implies putting a problem into words and articulating the question to generate an answer, organising and integrating concepts and high-level reasoning. Questioning becomes more beneficial when questions are more profound and require the integration of prior and new knowledge, reorganisation of mental models, generation of inferences and metacognitive self-regulation (King, 1998).

Tutors can benefit from formulating questions that help the tutee to think in depth: they may ask the tutees to contrast concepts, apply them or find causal relationships. Therefore, tutors have to think in order to generate questions, but they also have to think about ideas, relationships and principles required to produce a correct answer. They thus reorganise their own understanding and have the opportunity to discover their own gaps. So, questioning and answering can increase the tutors' involvement in the reflective construction of knowledge and their own learning, overcoming the phase of *telling* knowledge.

But as Roscoe and Chi show, tutors, when teaching tutees, spontaneously tend to *tell* knowledge, except when being instructed to go further. In measurements of comprehension and recall, tutors trained to ask and answer questions outperform those that are less trained in terms of their own learning. At the same time, studies that have focused on the analysis of the interaction between tutor and tutee show evidence of the benefits of the tutor having to answer questions. Tutees' questions prompt collaborative dialogue towards joint understanding. The quality of the questions is a key factor to explain reflective construction. But, unfortunately, as the authors conclude, no studies have been specifically devoted to analysing the benefits for tutors of their own questions.

If questioning has strong potential to support tutors' learning, we must ask whether the usual teaching and learning contexts currently allow for this form of interaction. The classical structure of educational discourse in classroom interaction, known as IRF (Sinclair & Coulthard, 1975), holds that the sequence of interaction consists of three phases. Initiation (I), generated by the teacher in the form of a question; response (R), from the student and feedback (F) from the teacher to the student's response. This limited pattern responds well to the interactions between a teacher and many students, but what happens in one-to-one contexts, such as peer tutoring?

If students usually experience the IRF pattern in their learning experiences, it seems logical that pairs would tend to follow it in spontaneous tutorial sessions, as reported by Graesser, D'Mello and Cade (2011). But when students receive initial training in resolving learning activities together, this pattern changes, going from three phases to five. This richer structure, called IRFCE (Graesser & Person, 1994), consists of the following: the tutor asks a question or poses a problem (Initiation); the tutee provides an initial Response; the tutee offers brief Feedback; the tutor and tutee establish a round of dialogue to improve the quality of the first reply (Collaboration); and, finally, the tutor evaluates whether the tutee has understood the response (Evaluation).

The most interesting processes occur in the collaboration phase, when participants develop a joint action to build knowledge (Graesser, Bowers, Hacker, & Person, 1997). In it, the tutors, recognising the ZPD, offer adapted help with different levels of scaffolding. In this same vein, Duran and Monereo (2005) identified the presence of the two aforementioned sequences and one other: ICE, characteristic of reciprocal peer tutoring, which begins with Initiation (I), but from here tutor and tutee enter a cycle

of Cooperation (C) to jointly build the response through questions and hints. After this, Evaluation (E) by the tutor takes place.

All these processes, which occur in the enriching interaction produced in peer learning or one-to-one formats, bring us closer to the tutors' own construction of knowledge. The increased opportunities for interaction between teacher and learner may thus be responsible for learning, no longer by the learner alone, but by the teacher himself.

From a very different perspective, but with completely aligned results, we conclude this section with a study about the ways learning takes place in different workplaces (Cortese, 2005). After collecting evidence of 282 personal learning experiences, the results showed that the greatest learning experiences were, in this order: participation in groups; reading; receiving training; receiving help from colleagues; attending training classes; learning from others' experiences; learning from their own experiences; and learning from … teaching.

For the author, the role of a teacher in professional settings (called tutor, instructor, coach, mentor, expert …) has high potential for learning. But learning through teaching needs a bi-directional interaction, in which learners are encouraged to interact with each other, ask questions, suggest topics and create challenges for the tutor. Conversely, teaching offers little opportunity for learning if it is uni-directional or transmissive.

Discussion. Educational implications of learning-by-teaching

Everything suggests that we are starting to find evidence and have sufficient knowledge to understand the potential and limitations of learning-by-teaching. Providing evidence to support this possibility may have important implications for formal and higher education. Although learning-by-teaching obviously has effects on teaching performance itself or how teachers can learn by teaching their students (Leikin & Zazkis, 2010), we will focus on those effects that are directly related to a change in teachers' conceptions and the use of this principle as a pedagogical mechanism.

Conception of teaching and learning in the Knowledge Society

Recognising the possibility of learning-by-teaching can help teachers – and also the rest of the educational community: students and families – to overcome the obsolete conception of teaching and learning based on the idea of teacher-centred transmission of knowledge (Pozo, 2006), and instead, adopt a more complex one, suited to the Knowledge Society, in which we all have to learn throughout our whole lives.

In this conception, the role of the teacher is to act as a mediator within the ZPD (Vygotsky, 1978), providing scaffold help, guiding participation and offering the learners opportunities to practice and appropriate the knowledge. The tutors' participation in the ZPD also offers them opportunities to learn, as made possible by an expanded view of the zone (Wells, 1999). It is an opportunity for all participants, including experts, to learn with and from others. However, not all learning situations have mediators who know what to teach. In our society, things are not always stable, defined or understood previously; and are learned as they are created, in expanded learning, building collective ZPD, in bi-directional and complex processes of learning and teaching (Engeström, 1999).

Life-long learning leads us to believe that the activities of teaching and learning will be daily occurrences in the Knowledge Society (Longworh, 2003). And if we have to learn in 3D, it will be impossible to do so only through professional teachers. Teaching will have to be democratised and we are all going to need to teach, as well as learn. Or, better still, to learn by teaching.

Providing opportunities for students to learn by teaching

Providing evidence of the potential of learning-by-teaching can have an important effect on promoting practices that enable students to learn by teaching their peers. Establishing and spreading such

practices can enrich the quality of education and allow the teacher to develop a new role, closer to that of a facilitator and organiser.

In fact, formal education has been increasingly and deliberately incorporating practices that are implicitly or explicitly informed by the principle of learning-by-teaching. Of course, there are no practices *of* learning-by-teaching, as if it were a pedagogical method. Rather, there are enriching and complementary practices – along with others that teachers use – that include this principle. Here are some examples.

(a) Learning by developing educational materials

Along the lines of expectancy, students learn something in order to present it via a didactic material that will allow others to learn at a later stage. For example, making video tutorials (November, 2012).

(b) Learning by replacing the teacher in front of the class

Whilst there are many practices across all levels of the education system where students replace teachers for some functions, it is at university where such practices have been documented for the longest time. In a review of *peer teaching* experiences, Goldschmid and Goldschmid (1976) identified discussion groups led by students who, having already studied the subject, helped other students in groups.

Although the focus was originally on the learners, and the assistant students were seen as substitutes for the teacher (Goodlad & Hist, 1989), many of these practices have progressively been incorporated into curricular activities, evaluating the assistant student's own learning. One example is the model called LdL (*Lernen durch Lehnren* or Learning-by-teaching), in which students prepare lessons (Grzega & Schoner, 2008).

(c) Learning-by-teaching through cooperative learning techniques and methods

All cooperative structures, understood as pedagogical designs that promote positive interdependence and individual participation (Johnson & Johnson, 2009), include episodes of learning-by-teaching, to a greater or lesser extent. Perhaps that is why the traditional conception of teaching and learning, which considers that students offering pedagogical support are missing opportunities to learn, often resists the spread of these practices (Sharan, 2010).

The best known and most researched cooperative learning method is undoubtedly the Jigsaw technique (Aronson & Patnoe, 2011; Slavin, 1995). In Jigsaw, each member of the team learns to become an expert on a specific topic that is only a part of the whole that they need to learn in order to achieve the didactic goal; and then share it with their teammates, thus learning-by-teaching.

(d) Peer tutoring, students learning by teaching peers

As seen in the previous section, the first evidence of learning-by-teaching came from the use of peer tutoring, which demonstrated that tutors also learned, even more than their tutees (Topping, 1996). In a formal context, we can understand peer tutoring as a peer learning method based on the creation of pairs, with an asymmetrical relationship, derived from their respective roles: tutor and tutee (Duran Gisbert & Monereo Font, 2008). Moving away from simple pair work, peer tutoring involves a more able student helping another and this requires previous planning of the interaction between both members, so that the student tutor can learn by teaching and the tutee can also learn by receiving personalised help.

(e) Peer assessment, learning by correcting and providing feedback

Having the opportunity to evaluate their peers (and to be evaluated by peers) can also be a good way for students to learn, reflecting on how others have dealt with the same activity, learning from their mistakes and providing feedback. Therefore, peer assessment has been considered a form of peer learning (Falchikov, 2001).

Student evaluators have the time to provide their peers detailed support, in the form of constructivist help that acts as guides or clues to improve the work (Boud & Molloy, 2013). As not all forms of feedback are effective (Topping, 2010), it is worth training the student evaluators. Choosing the right level

of support will enable students – as evaluators – to become involved in the construction of reflective knowledge, and therefore, to learn by teaching.

(f) Students as co-teachers

The existence of established practices of co-teaching (between two teachers), and the growing use of peer learning in North American schools, has given rise to a new form of co-teaching: students acting as co-teachers (Villa, Thousand, & Nevin, 2010). From interesting practices reported in secondary schools, but easy to transfer to other phase of education, the authors propose different ways of sharing teaching with students.

Conclusions. Learning and teaching in the Knowledge Society

Having sufficient evidence to create an initial explanatory framework to better understand learning-by-teaching, with advantages and limitations, could significantly contribute to the advancement of formal education, in much the same way that the concept of *learning by doing* did in its time. Firstly, it can help us move beyond the transmissive conception of teaching by understanding these processes as part of the Knowledge Society, where teachers encourage students to help each other in classrooms that are turned into communities of practice, where everyone learns, including the teacher. This involves not only sharing with students the ability to teach, but also deliberately and systematically fostering situations in which students learn by teaching their peers.

In many of these initiatives, student tutors receive initial or additional training on how to perform their role, how to teach, whilst in other cases, teachers offer models for instruction and teaching techniques or resources. All of this is, undoubtedly, a real process of teaching to teach. In a society where continuous learning is highly valued and indeed expected, many university profiles will necessarily start to include teaching skills as a future professional need. For example, at the University of Monash teaching is considered part of a nurse's role, so students teach laboratory techniques to novice students in order to learn to teach (McKenna & French, 2011).

As these trends become generalised and teaching skills start to be highly regarded and evaluated, we would be faced with the emergence of a new skill that would help to build a sustainable and democratic Knowledge Society, where we all learn from everyone (and we all teach each other).

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No potential conflict of interest was reported by the author.

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References

Allen, V. (1976). *Children as teachers: Theory and research on tutoring*. New York, NY: Academic Press.

Anderberg, E., Axelsson, A., Bengtsson, S., Håkansson, M., & Lindberg, L. (2013). Exploring the use of a teachable agent in a mathematical computer game for preschoolers. *Lund University Cognitive Studies, 154*, 161–171.

Annis, L. F. (1983). The processes and effects of peer tutoring. *Human Learning, 2*, 39–47.

Aronson, E., & Patnoe, S. (2011). *Cooperation in the classroom: The jigsaw method*. New York, NY: Pinter & Martin.

Bargh, J., & Schul, Y. (1980). On the cognitive benefits of teaching. *Journal of Educational Psychology, 75*, 593–604.

Benware, C. A., & Deci, E. L. (1984). Quality of learning with an active versus passive motivational set. *American Educational Research Journal, 21*, 755–765.

Biswas, G., Schwartz, D., Leelawong, K., & Vye, N. (2005). Learning by teaching: A new agent paradigm for educational software. *Applied Artificial Intelligence, 19*, 363–392.
Boud, D., & Molloy, E. (Eds.). (2013). *Feedback in higher and professional education: Understanding it and doing it well*. New York, NY: Routledge.
Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13*, 145–182.
Cloward, R. D. (1967). Sudies in tutoring. *The Journal of Experimental Education, 36*, 14–25.
Cohen, P., Kulik, J., & Kulik, C. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American Educational Research Journal, 19*, 237–248.
Cortese, C. (2005). Learning through teaching. *Management Learning, 36*, 87–115.
Duran, D., & Monereo, C. (2005). Styles and sequences of cooperative interactions in fixed and reciprocal peer tutoring. *Learning and Instruction, 15*, 179–199.
Duran, D., & Monereo, C. (2008). The impact of peer tutoring on student self-concept, self-esteem and satisfaction. *School Psychology International, 29*, 481–499.
Ehly, S., Keith, T. Z., & Bratton, B. (1987). The benefits of tutoring: An exploration of expectancy and outcomes. *Contemporary Educational Psychology, 12*, 131–134.
Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engeström, R. Miettinen, & R. L. Punamäki-Gitai (Eds.), *Perspectives on activity theory* (pp. 19–38). Cambridge: University Press.
Falchikov, N. (2001). *Learning together. Peer tutoring in higher education*. London: Routledge Falmer.
Fiorella, L., & Mayer, R. (2013). The relative benefits of learning-by-teaching expectancy. *Contemporary Educational Psychology, 38*, 281–288.
Gartner, A., Kohler, M., & Riessmann, F. (1971). *Children teach children: Learning-by-teaching*. New York, NY: Harper and Row.
Goldschmid, B., & Goldschmid, M. (1976). Peer teaching in higher education. A review. *Higher Education, 5*, 9–33.
Goodlad, S., & Hist, B. (1989). *Peer tutoring: A guide to learning-by-teaching*. London: K. Page.
Graesser, A., Bowers, C., Hacker, D., & Person, N. (1997). An anatomy of naturalistic tutoring. In K. Hogan & M. Pressley (Eds.), *Scaffolding student learning: Instructional approaches and issues* (pp. 145–184). New York, NY: Brook Line Books.
Graesser, A., D'Mello, S., & Cade, W. (2011). Instruction based on tutoring. In R. E. Mayer & P. A. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 408–426). New York, NY: Routledge Press.
Graesser, A., & Person, N. (1994). Question asking during tutoring. *American Educational Research Journal, 31*, 104–137.
Grzega, J., & Schöner, M. (2008). The didactic model Ldl (Lerner durch Lehren) as a way of preparing students for communication in a knowledge society. *Journal of Education for Teaching, 34*, 167–175.
Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher, 38*, 365–379.
King, A. (1998). Transactive peer tutoring: Distributing cognition and metacognition. *Educational Psychology Review, 10*, 57–74.
Lambiotte, J. G., Dansereau, D. F., O'Donnell, A. M., Young, M. D., Skaggs, L. P., & Hall, R. H. (1987). Manipulating cooperative scripts for teaching and learning. *Journal of Educational Psychology, 79*, 424–430.
Leikin, R., & Zazkis, R. (2010). *Learning through teaching mathematics*. New York, NY: Springer.
Longworh, N. (2003). *Lifelong learning in action*. London: Kogan Page Limited.
Matsuda, N., Yarzebinski, E., Keiser, V., Raizada, R., Stylianides, G. J., & Koedinger, K. R. (2013). Studying the effect of a competitive game show in a learning by teaching environment. *International Journal of Artificial Intelligence in Education, 23*, 1–21.
McKenna, L., & French, J. (2011). A step ahead: Teaching undergraduate students to be peer teachers. *Nurse Education in Practice, 11*, 141–145.
November, A. (2012). *Who owns the learning? Preparing students for success in the digital*. Bloomington, IN: Solution Tree Press.
Ploetzner, R., Dillenbourg, P., Praier, M., & Traum, D. (1999). Learning by explaining to oneself and to others. In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and computational approaches* (pp. 103–121). Oxford: Elsevier.
Pozo, J. I. (2006). La nueva cultura del aprendizaje en la sociedad del conocimiento. In J. I. Pozo, N. Scheuer, M. del, P. Pérez Echeverría, M. Mateos, E. Martín, & M. de la Cruz (Eds.), *Nuevas formas de pensar la enseñanza y el aprendizaje* (pp. 29–53). Barcelona: Graó.
Robinson, D. R., Schofield, J., & Steers-Wentzell, K. L. (2005). Peer and cross-age tutoring in math: Outcomes and their design implications. *Educational Psychology Review, 17*, 327–362.
Roscoe, R. (2014). Self-monitoring and knowledge-building in learning-by-teaching. *Instructional Science, 42*, 327–351.
Roscoe, R., & Chi, M. (2007). Understanding tutor learning: Knowledge-building and knowledge-telling in peer tutors' explanations and questions. *Review of Educational Research, 77*, 534–574.
Sharan, Y. (2010). Cooperative learning for academic and social gains: Valued pedagogy, problematic practice. *European Journal of Education, 45*, 300–313.
Sinclair, J., & Coulthard, M. (1975). *Towards an analysis of discourse: The English used by teachers and pupils*. London: Oxford University Press.
Slavin, R. (1995). *Cooperative learning*. Boston, MA: Allyn & Bacon.
Topping, K. (1996). *Effective peer tutoring in further and higher education*. Birmingham, AL: SEDA Paper.

Topping, K. (2005). Trends in peer learning. *Educational Psychology, 25*, 631–645.
Topping, K. (2010). Methodological quandaries in studying process and outcomes in peer assessment. *Learning and Instruction, 20*, 339–343.
Topping, K., Dekhinet, R., Blanch, S., Corcelles, M., & Duran, D. (2013). Paradoxical effects of feedback in international online reciprocal peer tutoring. *Computers & Education, 61*, 225–231.
Villa, R. A., Thousand, J. S., & Nevin, A. I. (2010). *Collaborating with students in instruction and decision making: The untapped resource*. Thousand Oaks, CA: Corwin.
Vygotsky, L. S. (1978). *Mind and society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
Webb, N. M. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research, 13*, 21–39.
Wells, G. (1999). *Dialogic inquiry*. Cambridge: The Press Syndicate of the University of Cambridge.
Zajonc, R. B. (1966). *Social psychology: An experimental approach*. Belmont, CA: Wadsworth.