Transferring CSCL findings to face-to-face teacher practice

Celia Kaendler, Michael Wiedmann, Institute of Psychology, University of Freiburg, Engelbergerstraße 41, 79085 Freiburg, Germany
Email: kaendler@psychologie.uni-freiburg.de, wiedmann@psychologie.uni-freiburg.de
Nikol Rummel, Institute of Educational Research, Ruhr-Universität Bochum, Universitätsstraße 150, 44801 Bochum, Germany, nikol.rummel@rub.de
Timo Leuders, Institute for Mathematics Education, University of Education, Kunzenweg 21, 79117 Freiburg, Germany, leuders@ph-freiburg.de
Hans Spada, Institute of Psychology, University of Freiburg, Engelbergerstraße 41, 79085 Freiburg, Germany, spada@psychologie.uni-freiburg.de

Abstract: Collaborative learning is a well-researched instructional approach that is highly effective and often superior to individual learning. However, the fruitfulness of the collaboration depends on the quality of the student interaction. What do teachers need to know to monitor the quality of the group interactions? We developed a model describing teachers' competencies for Implementing Collaborative Learning in Mathematics (ICLM). We illustrate here how CSCL findings may inform monitoring, one major facet of teachers' ICLM competencies.

Collaborative learning is a well-researched instructional approach whose effectiveness is well established. However, this effect depends on the quality of the student interaction (Dillenbourg, Baker, Blaye, & O'Malley, 1996). Teachers play an essential role in ensuring that the student interaction in the classroom is beneficial for learning. In the computer-supported collaborative learning (CSCL) literature, methods for designing, monitoring, and supporting collaborative learning with computer-based tools are well-described. In face-to-face teacher practice, teachers also need guidance for monitoring the ongoing student interaction similar to tools in CSCL environments. We present a theoretical model describing teachers' competencies for Implementing Collaborative Learning in Mathematics (ICLM) and illustrate how CSCL findings may be beneficial for teacher practice, especially for monitoring student interactions. While we chose to situate the ICLM model in mathematics as the learning domain, the model may be transferred to other domains as well.

Theoretical framework

The Implementing Collaborative Learning in Mathematics (ICLM) model is based on the meta-cognitive framework of teacher practice by Artzt and Armour-Thomas (1998) that describes teaching in analogy to a cognitive process of solving a problem in three phases: a pre-active phase, an inter-active phase, and a post-active phase. The model describes which competencies are needed to successfully implement collaborative learning in the respective phases. While *planning* is part of the pre-active phase, *monitoring* and *supporting* take place during the inter-active phase. Additionally, an important element of the inter-active phase is *consolidating* the groups' work. Finally, in a post-active phase, *reflection* is of vital importance in helping teachers to improve the planning of collaborative learning situations in particular. In the current paper we focus on one facet of the model in particular, that is, monitoring.

While students are collaborating, the teacher has to monitor how they are working together to ensure the fruitfulness of the collaboration and support the students if necessary. In the CSCL literature, monitoring students' interactions is often supported by a teacher cockpit that visualizes live data from the interaction processes (Roschelle, Rafanan, Estrella, Nussbaum, & Claro, 2009), for instance the different amounts of oral and written contributions. The cognitive algebra tutor (Koedinger, 1998) that checks for students' errors in finding the solution for the mathematics problem at hand can be extended by an additional feature that allows for collaborative working on the cognitive tutor. This collaborative extension helps to identify how students behave in different roles, for instance as a tutor and tutee (Walker, Rummel, & Koedinger, 2009).

Teachers in the classroom especially face the challenge of monitoring the interaction processes taking place in several groups at the same time. Group awareness tools such as the "Lantern" (Dillenbourg & Jermann, 2010) are a simple implementation of a teacher cockpit that works for face-to-face collaborative learning. The different colors of the "Lanterns" give the teacher an overview of the collaborative working phases the different groups in the classroom are currently involved in and whether they need help.

While other sophisticated technological solutions that monitor how students are working together are not so easily implemented in face-to-face collaborative learning, the indicators underlying successful collaboration can be transferred. For instance, Meier, Rummel, and Spada (2007) developed a rating scheme to evaluate the collaboration of dyads in a computer-supported learning environment on multiple dimensions. Their indicators of successful computer-supported collaborative behaviors may help teachers to observe face-to-face interactions in the classroom as well, for instance whether students engage in argumentations or

explanations of ideas. We thus propose that teachers could use checklists with behavioral indicators targeting three dimensions of collaborative learning adapted from Meier and colleagues, namely collaborative, cognitive, and meta-cognitive activity. A successful collaboration for instance requires that all students are actively engaged and share information (Johnson & Johnson, 1998). Visible cognitive activities include asking targeted questions and giving elaborated explanations (Webb, 1989). Meta-cognitive activities are indicated by comprehension monitoring and checking for errors (Bannert, 2003). Teachers using such a checklist, based on indicators of fruitful collaborative learning behavior described by the CSCL literature, may find it easier to observe these relevant behaviors and not be distracted by aspects of the collaboration that are less determining for its learning success.

Conclusion

We aimed to illustrate how CSCL findings targeting monitoring of student interactions may be informative for teacher practice in face-to-face settings. We developed a theoretical model describing the ICLM competencies, planning, monitoring, supporting, consolidating, and reflecting collaborative learning. We stressed the monitoring facet here because it is essential to assess the quality of the groups' interaction and their progress in order to identify suboptimal collaborative, cognitive, and meta-cognitive activity. When suboptimal activity in a student interaction is identified, for example insufficient explanations among students, the teacher may choose to support the student interaction, which is also an important competence teachers should have to ensure a fruitful collaboration. Our theoretical model serves as a base for developing a tool to assess these competencies and for designing a training for teacher students. The teacher students learn to use checklists of fruitful collaborative behavior for observing student interactions and we are interested to see how this training affects the teacher students' monitoring competency.

References

Artzt, A. F., & Armour-Thomas, E. (1998). Mathematics teaching as problem solving: A framework for studying teacher metacognition underlying instructional practice in mathematics. *Instructional Science*, *26*(1/2), 5-25.

Bannert, M. (2003). Effekte metakognitiver Lernhilfen auf den Wissenserwerb in vernetzten Lernumgebungen [Effects of meta-cognitive learning aids on knowledge gain in networked learning environments]. *Zeitschrift für Pädagogische Psychologie, 17*(1), 13-25.

Dillenbourg, P., Baker, M., Blaye, A., & O'Malley, C. (1996). The evolution of research on collaborative learning. In P. Reimann & H. Spada (Eds.), *Learning in humans and machines. Towards an interdisciplinary learning science* (1st ed., pp. 189–211). Oxford, New York: Pergamon.

Dillenbourg, P., & Jermann, P. (2010). Technology for classroom orchestration. In M. S. Khine & I. M. Saleh (Eds.), *New science of learning: Cognition, computers and collaboration in education* (pp. 525-552). Springer.

Johnson, D. W., & Johnson, R. T. (1998). Cooperative learning and social interdependence theory. In R. S. Tindale, L. Heath, J. Edwards, E. J. Posavac, F. B. Bryant, & Y. Suarez-Balcazar (Eds.), *Social psychological applications to social issues; Vol. 4. Theory and research on small groups* (pp. 9-35). New York, NY US: Plenum Press.

Koedinger, K. R. (1998). *Intelligent cognitive tutors as modelling tool and instructional model.* Paper presented at the NCTM Standards 2000 Technology Conference.

Meier, A., Spada, H., & Rummel, N. (2007). A rating scheme for assessing the quality of computer-supported collaboration processes. *Computer Supported Learning 2*(1), 63-86.

Roschelle, J., Rafanan, K., Estrella, G., Nussbaum, M., & Claro, S. (2009). From handheld collaboration tool to effective classroom module: Embedding CSCL in a broader design framework. In C. O'Malley, D. Suthers, P. Reimann, & A. Dimitracopoulou (Eds.), *Computer Supported Collaborative Learning Practices: CSCL2009 Conference Proceedings* (pp. 395-403).

Walker, E., Rummel, N., & Koedinger, K. (2009). Beyond explicit feedback: New directions in adaptive collaborative learning support. In C. O'Malley, D. Suthers, P. Reimann, & A. Dimitracopoulou (Eds.), *Computer Supported Collaborative Learning Practices: CSCL2009 Conference Proceedings* (pp. 552-556).

Webb, N. M. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research*, *13*(1), 21-39.