



Technology-Mediated Lesson Study: Facilitating Three-Dimensional Science With Rural Science Teachers

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Abstract: Rural science teachers have fewer collaborative and professional learning opportunities. To bridge the geographic isolation of these teachers, a professional learning model called Technology-Mediated Lesson Study (TMLS) has been developed. TMLS engages teachers with a team of colleagues in iterative, collaborative cycles of lesson design, teaching, observations via technology, and lesson redesign aimed at high-impact professional learning and enactment. This poster presents qualitative findings from the first year of the program.

Introduction

Science education in the United States is transforming toward a model that comprises three dimensions (3Ds): science and engineering practices, crosscutting concepts, and disciplinary core ideas (SEPs, CCCs, and DCIs; NGSS Lead States, 2013). Central to the new standards is the principle that students must make sense of science in a way that combines the three dimensions for richer, more authentic learning experiences. In one western state, urban school districts have implemented these standards for several years, including training teachers in 3D science teaching; however, most rural teachers in the state have received very little training on the new standards.

Isolation is a significant problem for many rural teachers in that they are often the only teacher of a particular subject or the only science teacher in a school. As a result, they have fewer or no opportunities for meaningful collaboration, even though collaboration is a crucial characteristic of effective professional learning (Svendson, 2020). When professional learning is up-to-date, ongoing, collaborative, practice-based, and connected to local contexts, it is more effective at changing teaching practices (Desimone, 2009; Kennedy, 2016). Lesson study is an established professional learning model that has shown success in meeting teachers' professional learning needs by improving collaboration, helping teachers examine their practice, and enhancing student learning (Kanellopoulou & Darra, 2019). Traditionally, lesson study is conducted in small groups that meet in person to create lessons, review each other's teaching, and revise lessons together; however, the very fact of rural teachers' isolation makes such in-person collaboration impossible.

Technology-Mediated Lesson Study (TMLS) was developed to utilize technology to connect otherwise remote teachers in a novel professional learning model that engages teachers in iterative, collaborative cycles of lesson design, teaching, observation, and lesson redesign with a team of colleagues, resulting in high-impact professional learning and enactment. Through this process, teachers meet and collaborate through technology-mediated methods; they work together to improve their 3D science teaching skills and develop high-quality 3D science lessons aligned with state standards. These lessons are now ready to be shared with other teachers in the state and across the country.

Primary goals and conceptual framework of TMLS

This research has three goals: first, *principles*: an innovative model for rural teacher professional development via technology-mediated lesson study that supports translating professional learning into classroom practice through social support systems; second, *people*: building expertise, capacity, and collaboration among teachers to support 3D science teaching; and, third, *products*: creating and disseminating high-quality 3D science lesson plans aligned with state standards and the Next-Generation Science Standards to be shared with teachers across the country.

The research design is built on an ecological model described by Sallis et al. (2008) and is applied to changing teaching practices to incorporate three-dimensional science teaching. The program targets, first, personal factors (e.g., attitudes, self-efficacy) by supporting rural science teachers' development of knowledge, self-efficacy, and positive attitudes about 3D science teaching; second, social factors (e.g., peer, administrator, and student expectations) via cohorts of subject-region teams to provide a sense of community and support for the instructional changes needed for the new state standards; and, finally, contextual factors (e.g., physical, material, and time resources) to support and evaluated these lessons in a variety of settings and teaching conditions.



Research method

Twelve rural science teachers were given in-person professional developmental instruction in the principles of 3D science and the lesson study process. Groups of four teachers were formed and each developed high school biology lessons aligned with state standards incorporating 3D science elements. One teacher in each group recorded themselves teaching the lesson to their students by using a Swivl robot. Other group members reviewed and commented on each lesson and then met virtually via video conferencing to discuss the lesson they watched and revise the lesson plan. This process was then repeated for each subsequent teacher, taking turns teaching the revised lesson and coming together as a group to review and revise the lesson. Qualitative discourse analysis was conducted on TMLS meeting observations and personal interviews.

Results

Qualitative analysis of personal interviews and observation of lesson review meetings indicates that new collaborations resulting from involvement in the TMLS process positively affect making new professional collaborations and connections. This improved collaboration was also seen by observing group meetings to review lesson plans. Group conversations showed a willingness and openness to work together and enthusiasm that they are “able to focus just on the content of the lesson rather than on other school issues” (e.g., discipline problems). Through interviews, teachers indicated that the TMLS process changed their thinking regarding 3D science. One participant said, “Anytime you can build a lesson plan and then implement that lesson plan, I think that's going to encourage growth. Watching all of the other teachers on Swivl and...going through that process helped a lot in just in my own instruction.” These results show that creating, discussing, and revising a lesson plan that uses 3D science principles with a group of other science teachers can help improve how each teacher views their ability to teach with these principles in their classes, and those involved in the TMLS process are incorporating 3D science principles in their teaching beyond the lessons they created as a group.

Conclusion

Technology-mediated lesson study assists rural science teachers in developing new connections with other teachers they otherwise would not have any contact with, and preliminary data from interviews and observations of group discussions indicate that the teachers value these connections as well as the TMLS process. These otherwise isolated teachers are finding new collaborations with colleagues from around the state. Some participants indicated wanting to incorporate the TMLS process with others in their schools, suggesting they see the value of co-creating lessons. Data also suggests that the TMLS process—including watching others teach—is helping teachers learn 3D science better and improve how it is incorporated into their classes. Participants specified that this process has allowed them to thoroughly think about all aspects of 3D science for the first time and helped them improve incorporating these principles when developing new lessons. Future studies will further explore how the TMLS process helps connect rural science teachers on an ongoing basis and how teachers can integrate 3D principles to change how they teach science.

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