The Implementation of Interdisciplinary Science Inquiry of Biology Teachers Compared to Physical Science Teachers
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Abstract
The Next Generation Science Standards provides a new framework that solidifies the importance of teaching interdisciplinary STEM courses. Specifically, the National Research Council has argued for the need to make biology education more interdisciplinary. Since biology teachers seem to have the most difficulty teaching interdisciplinary STEM, a comparative case study was conducted to understand which factors influence interdisciplinary teaching, and, if there are differences between biology and physical science teachers. Using the framework of work and professional learning inquiry (ISI), seven high school science teachers were compared to understand how professional development and subject pedagogical content knowledge informed their implementation of ISI. Findings of the study revealed a range of levels of implementation, with no notable differences between science teachers from different content backgrounds. Rather, there were common factors, such as time limitations due to the curriculum, and a teacher’s understanding of, and value placed on, ISI, which affected their implementation. Based on the results of this study, it seems that further efforts need to be made to help teachers develop a better understanding of what ISI is. In addition, teachers need to develop their subject content knowledge in all of the sciences, better enabling them to make interdisciplinary connections.

Materials and Methods
Due to the call to teach modern biology as interdisciplinary (NRC, 2003; NRC, 2009) and the struggles that biology teachers have in particular to implement interdisciplinary STEM (Asghar et al., 2012), the following research questions have been developed. These research questions are based on the context of a partnership that provides professional development in the form of summer research and professional learning community (PLC) experiences, which is meant to promote the teaching of interdisciplinary science and engineering.

(1) How does the summer research experience and participation in the monthly professional learning communities during the academic year impact the implementation of interdisciplinary science inquiry (ISI) by biology teachers compared to teachers in the physical sciences of earth science, chemistry, and physics?

(2) What relationship, if any, is there between teacher subject pedagogical content knowledge and the implementation of ISI by biology teachers compared to teachers in the physical sciences of earth science, chemistry, and physics?

(3) What challenges do biology teachers encounter in implementing ISI compared to teachers in the physical sciences of earth science, chemistry, and physics?

Research Questions
- Since there were seven different teacher cases, a detailed description of each case was described. Each source of data – the pedagogical content knowledge (PCK) test, observations, interviews, and artifacts – were analyzed to build each case. A cross-case synthesis was used to find similarities and differences among the cases (Creswell, 2013).
- In analyzing the results from the seven different case studies, it can be seen that there is not a difference in the implementation of ISI between the different science subject content teachers. Although the two biology teachers have a very low implementation of ISI in their classes and mostly limited their implementation to replicating their summer research experience in an after school club, similar types of results are also seen with some of the other subject science content teachers. All of the teachers have varying ideas on what ISI is and what it should look like when implemented. Rather than analyzing the results separately by science teacher subject, the results were analyzed as a whole, regardless of what science class they teach, as to factors that either promote or inhibit the implementation of ISI across all sciences. An overview and summary of the seven different science teachers can be found in the table.

Results

With the realization of the importance of teaching interdisciplinary science, comes the importance of preparing teachers to teach in this manner. Even though the teachers in this study have been provided with professional development, it is clear that there are still several factors that are limiting teachers from fully implementing ISI in their classrooms. Many resources will need to be provided to teachers to help with the implementation of the new NGSS standards (NGSS Lead States, 2013), which will most likely include changes in instruction and assessment. Based on the results of this study, it seems that further efforts need to be made to help teachers develop a better understanding of what interdisciplinary science teaching is, and to provide some more specific resources to help them with the development of curriculum materials that promote the teaching of ISI. It seems that teachers also need to develop their subject content knowledge in the sciences outside of those that they are certified in, better enabling them to make interdisciplinary connections. Even though this study did not show a difference in the implementation of ISI among biology teachers compared to the physical science teachers, it is something that should be considered in a larger sample size of teachers. It seems that the teachers in this study, regardless of what science they teach, seem to have difficulties making interdisciplinary science connections. With states in the process of adopting the NGSS, there is clearly a lot of work that will need to be done to prepare for interdisciplinary science teaching.

Conclusion

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Literature Cited


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