

# Middle School to Professional Development: Interdisciplinary STEM for Multiple Stakeholders

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**ABSTRACT:** The STEMITL project is an interdisciplinary collaboration between a Southeastern University's middle grades education department and local PDS partner school districts incorporating six full-day immersive projects for seventh-grade students. During the 2016-2017 academic year, seventh-grade students were brought to the university's newly constructed STEAM Center where middle grades practicum students implemented day-long interdisciplinary lessons co-designed by faculty and teacher candidates. Lessons incorporated social studies, science, mathematics, and literacy around a central theme of water pollution in China. The practicum student teachers (PSTs) fully executed the STEMITL curricula three times per semester allowing for hands-on application of lesson design and implementation as well as real-world teaching experience with integrated, interdisciplinary learning. Further, PSTs and middle school students collaborated with secondary school students and teachers in a partner school in Hong Kong via online communication, videos, and data sharing. Lessons learned are shared.

*NAPDS Nine Essentials: The NAPDS Essential that most closely matches the spirit of this project is 1 - A comprehensive mission that is broader in its outreach and scope than the mission of any partner and that furthers the education profession and its responsibility to advance equity within schools and, by potential extension, the broader community.*

Practicum student teachers (PSTs) often have limited teaching opportunities due in part to the nature of field placement and the mentor teacher's willingness to surrender instructional autonomy, particularly in an era of increased accountability. Even when provided team-teaching opportunities with their mentor teachers, affective factors such as teaching confidence and their pedagogy and content knowledge (PCK) may limit teaching effectiveness. To support PSTs in developing necessary PCK and increasing teaching exposure, the Science Technology Engineering Mathematics Integrated Teaching and Learning (STEMITL) project was designed and implemented during the 2016- 2017 academic year.

The Southeastern University where the STEMITL project was implemented has a Professional Development School (PDS) partnership with local schools and uses a clinical-based educator preparation model. The teaching methods courses are taught on local middle school campuses. During the semester, PSTs also participate in a 4-week, apprenticeship that provides them a mini student teaching experience. The following semester, PSTs return to their apprenticeship placement to complete their final student teaching experience.

While PSTs engage in applied practice in the clinical-based model, they have limited experiences in teaching interdisciplinary curricula. The Every Student Succeeds Act strongly supports the use of interdisciplinary curricula, STEM education in

particular, to develop integrated knowledge that learners can use successfully in today's tech-savvy society. The grant awarded STEMITL project was designed to provide PSTs with increased opportunities to design and team-teach an interdisciplinary STEM-based curricula to local seventh graders.

The STEMITL project was conceptualized by middle grades education faculty to provide (a) middle grades PSTs, (b) seventh-grade students (about 100 at a time) and their teachers, and (c) local high school students interested in the education profession the opportunity to engage in STEM teaching and learning. The setting was the university's new Science, Technology, Engineering, Arts, and Mathematics (STEAM) Center.

The STEMITL project curricula focused on water pollution in China, a seventh-grade social studies content standard. The curricula included instructional strategies and content standards in science, mathematics, and English language arts that aligned with the goals of the social studies standard and that addressed STEM education. Additionally, collaboration with a school in China was secured. The PSTs helped in designing the interdisciplinary curricula.

## Design and Implementation

Six local middle schools were invited to participate in a STEMITL learning day at the STEAM Center. All PSTs team-

taught subject-specific lessons of the STEMITL curricula to the middle schoolers. The middle schoolers began the day by learning about water pollution in general and then within two geographic contexts: China and their own state. The partnering school in China created videos about water pollution, which were incorporated into the social studies lesson. In science, students participated in an inquiry-based lesson on water pollution and measured water pH levels of one of the state's rivers and then drew conclusions about the health of the water and its effects on aquatic life.

Building on what was learned in science, students participated in a mathematics lesson utilizing the water pH data from both the state's river and that of the partner school in China. Graphs, vocabulary, and spreadsheets were used by the middle schoolers to analyze the pH data and draw inferences about water pollution in the local river compared to that of the Chinese River. During ELA, PSTs presented students with a real-world scenario asking them to take a critical stance on whether new business owners should be allowed or denied the opportunity to build on a local river. Students integrated the information they learned about water pollution and applied the modes of persuasion as they created products such as brochures using Apple technology applications such as Pages. High schoolers were observers and aided with teaching where needed throughout the day.

Lastly, to increase and extend communication and technology use beyond the STEMITL learning days, a website and blog were designed to allow students from China and the U.S. opportunities to interact. Students shared cultural aspects of their region such as favorite locations, foods, and interesting facts.

## Lessons Learned

The faculty conceptualized the STEMITL project to engage PSTs in the process of planning and implementing an interdisciplinary, STEM-based curricula. Thus, the final step of the project was to measure PSTs' experiences with STEMITL. PSTs completed an e-survey, with IRB approval, sharing their perspectives on the ease in which the content was delivered, the clarity of content integration, the impact team teaching had on their experience, the likelihood or feasibility of applying what they learned in their future classroom, and their overall satisfaction with the STEMITL experience.

### PSTs

Overall, the PSTs reported their participation in the STEMITL project as a positive learning experience. PSTs responded in a positive manner to each of the items noted above. Within an open-ended question focused on the most valuable component of the experience, two themes emerged: 1) the importance of ownership in preparing and providing instruction, and 2) an appreciation for engaging in a team-teaching experience with colleagues. Nearly all included

responses focused on themselves and what they learned from the experience rather than on what the middle schoolers gained from the experience. For example, on the most valuable aspect of project, one PST shared that, "It allowed us to prepare mini lessons and deliver content in all of our subject areas. It also gave us experience in co-teaching and working together as a team." Another student shared that "It helped me gain confidence in my content as well as classroom management."

One student commented on their curriculum experience and shared that "The most valuable thing about this experience was getting to see the interdisciplinary curriculum. That is truly something that is rare in the education system we have right now. It was great getting to see how it flowed and how I could incorporate that into my classroom/ teams at a middle school. Also, the hands on activities and the lesson plans were great. I took the handouts from each part of the lessons, so that I can use it in my classroom one day." Lastly, one PST commented on the partnerships developed across different contexts. They shared that "The most valuable attribute I gained from this experience was the connection between the university and school system."

While the purpose of the STEMITL project was to provide the PSTs more teaching opportunities, their responses highlighted the various developmental stages of concern teacher candidates move through as they learn to teach.

## Middle Schoolers

The middle school students who participated in the STEMITL project gained both increased knowledge and a clearer understanding of how to connect and use content knowledge across multiple disciplines. Through whole group mini-lessons, collaborative hands-on activities, and discussions, middle school students not only learned about water pollution, but the importance of engaging in scientific inquiry to answer questions, analyzing and interpreting data when drawing conclusions, and using evidence to support their claims or evaluate others'.

### Teachers

The project design showcased the value of interdisciplinary teaching, and several teachers expressed the desire to duplicate the process in their own teaching teams and schools. Additionally, the STEMITL project provided the opportunity to share the value of a PDS partnership.

## High Schoolers

The STEMITL project provided these future educators an opportunity to see an integrated curriculum and experience hands-on learning. The extra support was beneficial in the logistics of the day and a positive outreach from the university.

## Conclusion

The STEMITL project will be remembered as a positive learning experience for all stakeholders. The lessons and knowledge gained from the completed project will fuel other projects of this nature in the future and reinforce the PDS partnerships between the university and the local schools. Establishing collaborative partnerships with local schools is a critical first step in implementing a project similar to the STEMITL, followed by determining standards and instructional goals, and then engaging PSTs in designing appropriate curricula and planning instruction. <sup>SUP</sup>



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