

The National Energy Education Development (NEED) Project Impact on STEM Education in K-12 Schools

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Abstract: The Science, Technology, Engineering, and Mathematics (STEM) implementation can and should be indispensable in students' daily lives, with educational and practical applications. The National Energy Education Development (NEED) Project is a nonprofit association that mentors K-12 teachers on sustainable energy education through STEM topics and activities. The NEED Project offers a curriculum and mentorship to professors on how to use creativity to teach K-12 students and invent new ways of thinking and practicing sustainability addressing STEM topics. Students can effectively make changes that directly impact their community, building solid values of respect between men and nature from an early age. The NEED Project launched in West Virginia (WV) recently, successfully mentoring many teachers around the state. To express the importance of the NEED Project to the teachers and students in WV, there is a need to study the effects of the NEED Project approach in developing the pedagogical content knowledge of teachers and students. This research aims to use surveys to collect data from teachers around WV to discuss the effectiveness of The NEED Project on K-12 schools and the importance of implementing STEM topics in K-12 schools. Through surveys, a qualitative study is employed by interviewing WV teachers who have attended the mentorship and applied the NEED curriculum in the classroom. The survey contains demographic, challenges, and development perception questions regarding the NEED Project curriculum and practices. The survey results analysis will shed light on the effectiveness of the NEED Project for teachers and students. The research results will help to improve the NEED curriculum and mentorship, mainly bringing new ways to understand STEM topics and sustainability education in the state of WV.

Introduction

The STEM (science, technology, engineering, and mathematics) methodology emerged in the United States in the 1990s after students showed a lack of interest in science topics. Schools play a fundamental role in the education and information of children and teenagers, offering students the opportunity to do their part for a better and healthier world. STEM implementation can and should be indispensable in students' daily lives, with educational and practical applications.

STEM learning with hands-on resources allows children to explore, build and share an understanding of the world around them. In contrast, the fun aspect of such resources keeps them constantly motivated to continue learning inside and outside the classroom. Although STEM is not a settled curriculum, neither aims to take the place of the national curriculum parameters, STEM has the intention of providing flexible and enriching learning through practical and playful resources, encouraging both teachers and students throughout the process of making teaching and learning fun and rewarding activities for a long-term advantage ¹.

It is important for the teacher to be the mediator of the STEM pedagogical proposal. The way of teaching integrates the areas of knowledge and allows the student to use them for connections when solving daily problems. Advising on the format of classes, providing training,

and facilitating the STEM implementation process are a plus for the teachers. In 1980, The National Energy Education Development (NEED) Project was originated by K-12 teachers who stressed the need for sustainable energy education in schools, a lowering in our dependence on fossil fuels, increasing energy efficiency, and the use of renewable energy technologies ².

Recently, the West Virginia (WV) Office of Energy, The WV Department of Education, the Marshall University Brad D. Smith Schools of Business, and the Lewis College of Business launched a partnership with the NEED Project to work closely with teachers in WV and sponsor the materials for teachers' use in class. The NEED Project vision is "to bring energy efficiency, environmental, and sustainable education to K-12 Schools in West Virginia through community outreach, which will enable the students to encourage and assist their parents, families, and friends in making better energy choices that will benefit current and future generations" ².

The NEED Project offers a curriculum and mentorship to professors on how to use creativity to teach K-12 students and invent new ways of thinking and practicing sustainability addressing STEM topics. Students can effectively make changes that directly impact their community, building solid values of respect between men and nature from an early age. The main point is, how do the teachers feel about The NEED Project? What have the students accomplished with this project? And how would a more sustainable teaching impact the student's family and community? By applying surveys and collecting data from teachers around WV, there will be evidence to discuss the effectiveness of The NEED Project and STEM topics in K-12 Schools.

Literature Review

STEM education has provided enormous knowledge for students who demonstrate the need to act productively in different environments, whether at work or even in the social, political, and economic groups in which they live. To develop skills and abilities, this educational model has shown positive results, but there are still not many studies on how to implement it in K-12 schools. Fallon, Hatzigianni, & Bower (2020) proposed mapping the main characteristics of STEM education to help implement this model in schools ³.

Discussions focused on STEM education have increased in several fields, such as businesses and industries, as it is necessary and fundamental for increasing productivity and for facing the challenges brought by global competitiveness. To clarify some fundamental characteristics of this educational model, Bryan & Guzey, 2020 studied the benefit of STEM to educators in their future research, bringing approaches that start from the emergence of the acronym and how it drives the development of projects ⁴.

A study in 2019 shows the teachers' experience using STEM education in their discipline. For this, mixed methods were used to capture teachers' understanding regarding the various STEM education models. The main goal was to provide support to teachers to advance in the implementation of this educational model. It is possible to perceive that teachers are attracted by the STEM model that goes beyond the classroom, as hands-on activities and real-world examples, which is extremely important to share and discuss this model in schools ⁵.

Bibliographical research was placed to identify STEM disciplines' effectiveness, benefits, and limitations. The study portrays potential benefits in learning, which is more significant, and a greater desire for a career in the STEM field. The time restriction and lack of community involvement were portrayed as the main challenges to the development of the approach. However, it is clear that the strategies could bring significant professional development for teachers on the STEM approach, as well as the integration of the community, which consequently improves learning, where everyone, students, teachers, and the community has the opportunity to realize the importance of STEM education not only at school but for life in general ⁶.

A study collected through questionnaires generating qualitative and quantitative results was placed. The study intended to demonstrate the knowledge and strategies organized by school administrators to raise parents' awareness about STEM education. The survey brought concern to administrators as many parents were unaware of the opportunities available to their children at school and the importance of their involvement in preparing them for STEM-related careers. It is concluded that there are no strategies for school administrators to reverse the situation, where the involvement and awareness of parents are needed for the future success of these students, which consequently negatively affects the lives of teachers, parents, community, and students ⁷.

Integrated STEM and sustainability education approaches are increasingly popular throughout schools but remain challenging and elusive. There is much hope that implementing STEM education can help the next generation of students solve real-world problems by applying concepts that span multiple disciplines and critical thinking, collaboration, and creativity skills ⁸. Excellence in STEM education can affect jobs, productivity, and competitiveness across multiple sectors and fields, including healthcare, technological innovation, manufacturing, information distribution, political processes, and cultural change ⁹.

It is important to research how the NEED Project method affects instructors' and students' pedagogical subject understanding. To evaluate The NEED Project's impact on K-12 schools and the significance of incorporating STEM subjects into K-12 classrooms, this study will employ questionnaires to collect data from teachers across West Virginia.

Data Collection

For this research, in-person interviews will be performed with seven K-12 teachers in WV. The participants (i.e., teachers) would be selected based on simple random sampling. Each participant was chosen independently with no correlation to the preceding or proceeding subject. A total of seven participants were ultimately chosen. A qualitative study will be implemented based on teachers' shared experiences, training, and activities provided by The NEED Project. Part I of the survey contains demographic questions about the teacher's gender, age, years of experience, education attainment, teaching grade(s) level and subject(s), etc. Part II of the survey included issues/challenges questions, which indicates how teachers and students are integrating with The NEED Project curriculum and practices and how it influences on the STEM topics. Part III of the survey brings the development perception questions, which include opinions on how teachers and students can use the NEED program and STEM to improve the classroom and community. The same set of participants was used for answering all the survey questions.

The interviews ranged from 10 to 15 minutes. It began by asking the participant about his/her demographic information, then the issues and challenges in the NEED workshop and teaching STEM topics to students. Last, the researchers asked development questions regarding how the NEED Project can improve teaching workshops and how students can apply what they have learned outside school. This established a baseline of teachers' needs as a point of contrast to perceived needs and supports, allowing for integrated STEM approaches beyond their common instructional needs.

When the interviewees were asked how the NEED Project mentorship could prepare teachers to better address STEM topics in the classroom, most agreed that hands-on activities are the best way to get the students' attention and make the lecture more fun. The NEED Project offers various hands-on activities and teaches how to use them in the workshops. When the interviewees were asked how the students should continue practicing the NEED Project in their family and community, 58% said that students could apply the NEED curriculum at home and discuss their results in class, and 28% agreed that students could use the knowledge in their community. Finally, most interviewees mentioned that the students seemed to be very engaged and interested in the curriculum and activities regarding energy and efficiency conservation. Table 1 shows the interview questions and outcomes.

Table 1. Interview questions and outcomes.

Questions	Answers from the interviewees
Issues/challenges in the curriculum	
What are the main gaps between what you have learned about energy conservation/ efficiency and explaining it to the students?	3 - Background knowledge from students 2 - Simpler activities 2 - Not applicable
What is the level of engagement with the students regarding learning and practicing aspects of energy efficiency and conservation? Do they seem interested in working on projects related to STEM topics?	6 - The students seem to enjoy it 1 - Not applicable
In your opinion, how The NEED Project curriculum could help students understand STEM topics?	5 - Hands-on activities 2 - Understand the types of energy sources
In your opinion, how The NEED Project mentorship could prepare teachers to better address STEM topics in the classroom?	4 - By providing activities ideas and materials 3 - To become more comfortable with teaching science topics
Development perception	
In your opinion, how could The NEED Project educators improve the workshops to benefit the K-12 teachers and students?	3 - Marketing better the workshop 3 - Know the teacher's teaching grade for better activities selections 1 - Longer workshops
In your opinion, how should the students continue practicing The NEED Project outside school? Such as in their family and their community.	4 - Apply the activities at home and discuss in class 2 - Community education service 1 - Recycling the materials used in class

Data Analysis

Among the seven participants, 42% (3) were elementary school teachers, 29%(2) were middle school teachers, and 29%(2) were high school teachers, as shown in Figure 1. When the participants were asked, “what are the main gaps between what you have learned about energy conservation/ efficiency and explaining it to the students?” 44% (3) stressed students’ background knowledge, mostly from the activities given in class, which may apply to high school students but not to elementary school students, consequently involving 28%(2) requesting more straightforward activities for lower-level grades.

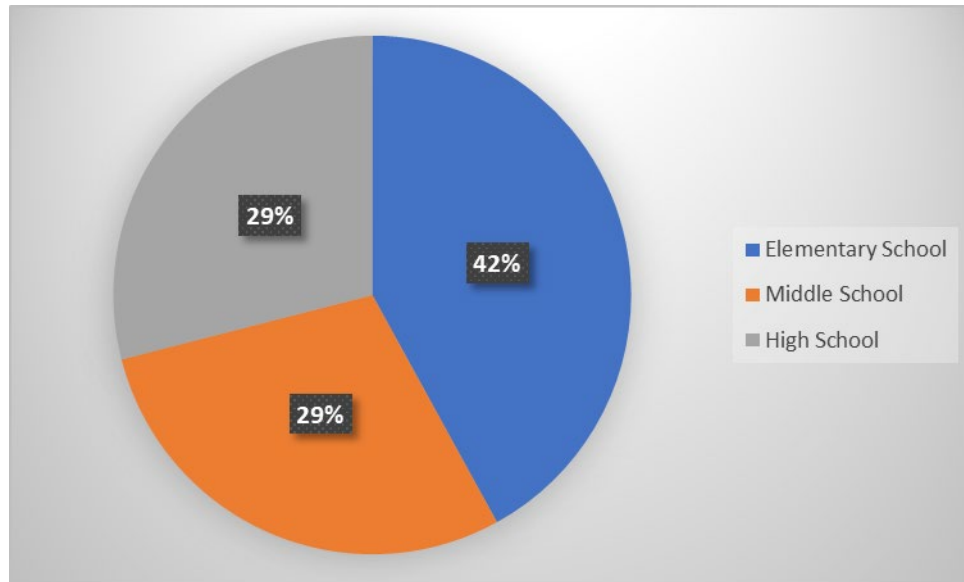


Figure 1. Teaching grade levels.

Teachers are notoriously pressed for time, and this is far from new as a challenge for them. In fact, the majority of the teachers surveyed noted that they had received an email from WV Kanawha County Schools regarding the NEED workshop, as shown in Figure 2. Most have complained about receiving emails for workshop dates, “most of the time, we do not even read the emails.” Marketing the program has been the hardest issue for the WV sponsors, and most of the teachers stated how great the workshops and curriculum have been for them and how effective it could be if the NEED Project and its WV sponsors could advertise better for a larger instructional time for integrated STEM activities or lessons.

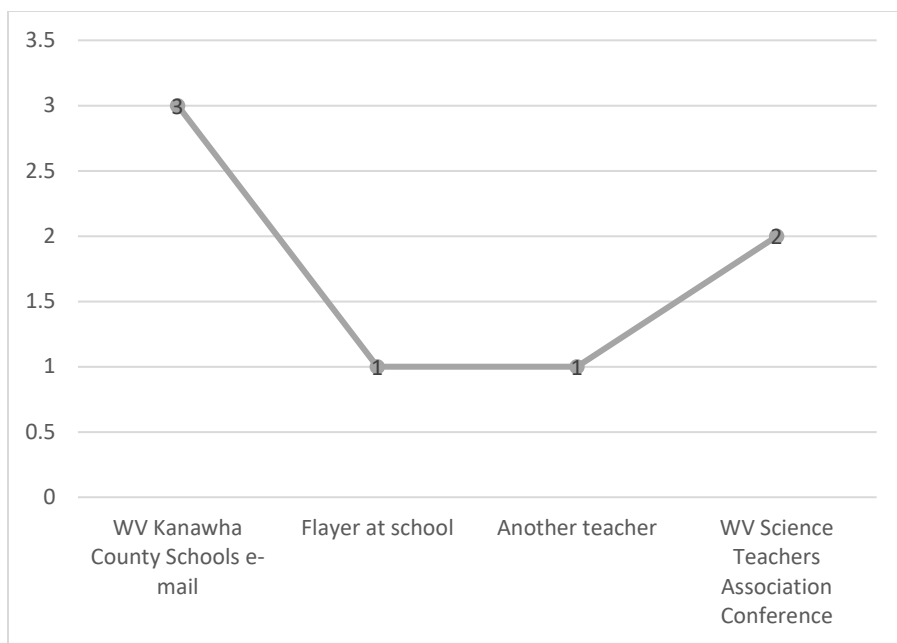


Figure 2. How did WV teachers find out about the NEED Project?

Result and Conclusion

This study performed a three-phase qualitative development needs assessment on integrated approaches to STEM education. Seven interviews were conducted to inform the NEED Program’s effectiveness through a questionnaire. It was sought to understand the greatest challenges and needs to be perceived by teachers across WV related to teaching STEM and sustainability subjects in an integrated manner and what supports could be most welcome in the effort to move towards the community, the project success, and the future to inform resources innovations.

Overall, the interviewees mentioned that the NEED Project mainstream is taking place in small pockets but is not yet widespread. Teachers in this study recognized that their ability to integrate innovative STEM activities and lessons is a plus for their careers and students’ achievements. Many teachers have gaps in knowledge of STEM topics, and they admitted that support is needed to help teachers with instructional approaches that organize knowledge around concepts, lectures, and activities ideas. They are interested in applying STEM education but do not believe they are prepared to implement its curriculum. The professors interviewed knew how to start working towards an integrated STEM approach. Still, they realized they needed help: more collaboration, more modeling, more examples, and more guidance, and the NEED Project has been providing this opportunity.

All in all, the world is changing drastically, and we must keep up with it. The NEED Project improves teachers’ and students’ knowledge by offering curriculum, workshops, training, and experience admired in any profession. It allows the young generation to be sustainable, look for

patterns, finds connections, and evaluate information. Furthermore, STEM education increases social awareness and communicates global issues to the community. Therefore, STEM opportunities move us towards a knowledge-based economy and enhanced sustainability education.

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