

Transforming integrative maker education for STEM: Empowering pre-service teachers

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4 October 2023



Dr Ginny Chambers and Dr Kamryn York from Point Park University tell us about a project aimed at enhancing integrative maker education through the training of pre-service teachers, focusing on elementary education

In recent years, maker education has gained traction as a transformative approach to teaching STEM subjects. This innovative pedagogy engages students in hands-on, collaborative learning experiences, fostering creativity, problem-solving skills, and a deeper understanding of STEM concepts.

“Transforming Integrative Makerspace Education for STEM” (a National Science Foundation funded project) focuses on improving the quality and effectiveness of STEM education for pre-service teachers. The project builds on the knowledge about teaching and learning by creating, implementing, and assessing faculty development, interactive instruction, and STEM lesson plan development. This study fosters a more collaborative approach among education and STEM faculty, resulting in the revision and implementation of ten education courses to emphasize STEM experiential learning through makerspace pedagogy.

Two years into the National Science Foundation grant, the program is making strides in improving the quality and effectiveness of STEM education for undergraduate education students. The team leading the NSF grant at Point Park University are Dr Virginia Chambers as Principal Investigator and Dr Kamryn York and Dr Mark Marnich as Co-Principal Investigators.

Point Park University supported the project by opening two classrooms in the School of Education. The design and construction of Matt’s Maker Space Lab and Matt’s Maker Space 2 were approved by the Point Park University administration and a collaborative effort between the School of Education and Matt’s Maker Space. The labs are named in honor of local non-profit organization, Matt’s Maker Space, established by Noelle and David Conover in remembrance of their son, Matt, who passed away from cancer at age 12. The organization has created over 40 maker spaces in the Pittsburgh, PA, USA area, and Point Park University is the first university to house Matt’s Maker Space labs.

The essence of maker education

The makerspace movement is on the rise, and educators have expressed a heightened interest in maker-centered learning, particularly in STEM learning. Makerspace education involves working with one’s hands in interdisciplinary STEM environments that incorporate various tools, materials, and technologies. Students learn about STEM subjects in a project-based fashion that promotes interaction and engagement in activities around new topics and technologies. Maker-centered learning has shown an increased proficiency in STEM subjects and extended interest in STEM fields because of makerspace education. ⁽¹⁾

Maker education emphasizes active learning, creativity, and interdisciplinary collaboration. Students design, create, iterate, and reflect on their projects. This process enhances their understanding of STEM concepts and nurtures important 21st-century skills, resulting in a holistic learning experience. “Maker education develops skills in subject areas such as mathematics focusing on data analysis, spatial reasoning, and geometry,” explains Mark Marnich.

The challenge of implementation

Despite its promising potential, implementing maker education in schools comes with challenges, particularly regarding teacher preparation. A surprising 40% of teachers recently reported that they were underprepared to effectively teach in a maker environment. ⁽²⁾ This lack of preparedness is directly related to the lack of understanding and training in STEM education and maker-centered learning.

Traditional teaching methods do not always align with the dynamic and hands-on nature of makerspaces. Many educators feel ill-equipped to guide students effectively within these environments. To address this gap, a project was initiated to empower pre-service elementary teachers to embrace and effectively deliver maker education. “Maker Space teaching methods require students to become more aware of the design of the world around them and see themselves as people who can test their ideas, make changes and improve their results,” explains Kamryn York.

Empowering pre-service teachers

The project recognizes that transforming STEM education requires a two-fold approach: equipping future educators with both a strong foundation in STEM subjects and the pedagogical strategies necessary for successful maker education. Pre-service teachers learn to design maker-centered lesson plans, facilitate collaborative projects, manage makerspace environments, and assess student learning in innovative ways.

The project partners with two school districts, Mt. Lebanon School District and Manchester Academic Charter School, as the sites for the pre-service teachers to practice implementation of the interdisciplinary maker lessons. “This gives students hands-on learning experiences, and our teachers another lens and perspective into some of the modern, current education trends that they can include in their classrooms,” said Brett Bielewicz, partnering principal at Mt. Lebanon School District.

Interdisciplinary approach

One of the distinctive features of the project is its interdisciplinary approach. Pre-service teachers are encouraged to apply maker education across various subjects, fostering cross-curricular connections. For instance, a social studies lesson can involve creating physical models of historical landmarks using 3D printing technology, blending geography with engineering and technology concepts. This approach enriches students’ learning experiences and demonstrates the versatility of maker education.

Impact and future implications

As pre-service teachers enter the field, they carry their newfound knowledge and skills into classrooms, promoting a shift from passive to active learning. By embracing maker education, educators empower students to take ownership of their learning while boosting confidence and interest in STEM subjects. Moreover, the project's success lays the groundwork for continuous improvement in teacher preparation programs, fostering a new generation of educators adept at integrating innovative pedagogies. "It is our aim to not only be a part of this important movement and discussion among educators, but to help pave the way for students and teachers who will be the makerspace leaders of the future," said Chambers.

Conclusion

Point Park University's T.I.M.E. for STEM project represents a significant step towards revolutionizing traditional education paradigms. By preparing pre-service teachers to effectively employ maker education methodologies, the project bridges the gap between theory and practice and cultivates a generation of students with a profound appreciation for STEM subjects. As the landscape of education continues to evolve, the integration of maker education stands as a testament to the power of hands-on, collaborative, and interdisciplinary learning.

References

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