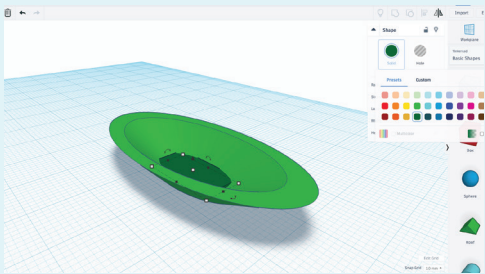


CASE STUDY

Research Shows zSpace Helps Students Develop Critical Thinking, Creativity, and Grit in Middle School Engineering-Design Tasks

The Challenge

“Soft skills” like critical thinking, persistence, resilience and grit are essential for the 21st-century workforce, but are difficult to teach, track and measure.



The natatorium echoes with laughter, shouts and cheering by students and their fans as they prepare to set their boats in the water and race across the pool. It’s time to sink or swim, cardboard-regatta style.

This annual race, where students design and build boats out of cardboard and duct tape, is an event students and staff look forward to all year.

But for one group of middle school students, the preparation for this year’s race included more than typical paper and pencil sketching. Sixteen middle school students employed augmented and virtual reality (AR and VR) technology and 3D modeling using zSpace for their engineering-design challenge. While completing the task, research suggests students developed essential “soft skills” including critical thinking, creativity, and grit.

These skills are typically difficult to measure. However, Dr. Rebecca Hite, assistant professor of STEM education in the Department of Curriculum and Instruction at Texas Tech University, and Andrew McIntosh, enrichment and technology teacher at South Orangetown Central School District in New York, put together a research project that focused on quantifying student growth in soft skills when working on complex engineering projects with VR/AR technology like zSpace.

The Critical Role of Soft Skills

Business professionals and educators agree that soft skills are essential for the next generation of workers. Soft skills include the “Four Cs” (4Cs) – creativity, critical thinking, communication and collaboration – plus other skills such as resilience, perseverance, and grit.

Continued on next page

The Solution

A university-led research study determines that virtual reality technology improves students' soft skills in a middle school engineering-design project.

“
zSpace technology breaks down the typical barrier between users and digital computer images by creating a multidimensional AR/VR environment[...]

”

The [Bureau of Labor Statistics](#) reported in 2019 that individuals are holding more jobs than ever, and as the workforce continues to change with technological advances and increasing global interconnectedness, transferrable abilities, like soft skills, will be key to creating solutions in a wide variety of fields and industries.

Soft skills are particularly important for STEM careers, which require individuals to solve challenging problems based on facts and knowledge, but also by deepening their capabilities to examine problems from various angles and synthesize known information with creativity and input from others.

“Looking at the big picture, practicing the soft skills is paramount to human development, no matter what field you’re in,” said McIntosh. “Providing students with opportunities to recognize and grow these skills leads to greater self-awareness and helps them grow as individuals.”

Engineering-Design with zSpace – The Process

The cardboard regatta provided an ideal engineering and design scenario for researching the effects of zSpace’s AR/VR technology by observing students’ soft skill use and analyzing how students self-reported their progress. Sampled students used Tinkercad to design their boat models, and then exported that model into zSpace Studio to view the design.

zSpace technology breaks down the typical barrier between users and digital computer images by creating a multidimensional AR/VR environment where immersive and interactive 3D content leaps out of the screen. Featuring 3D-screen technology, headtracking and lightweight glasses, the zSpace laptop and all-in-one PC provides immersive and interactive 3D educational experiences either at home or in person by allowing students to interact with STEM and CTE content in a flexible, user-driven environment.

zSpace brought the models to life for the students. Students could manipulate the boat design in ways that “they couldn’t do in real life,” according to one student. Students could generate a 360 degree view of their project, zoom in and out for micro and macro-level details, and dissect their boat into smaller components. Students reported that zSpace aided their engagement, stating that they enjoyed seeing their creations from a new perspective.

Continued on next page

“
The future for these students, and for others who are able to practice building their 21st-century and soft skills, is promising.”



zSpace Impacts Students' Use and Development of Soft Skills

The research findings, published in the book *Cognitive and Affective Perspectives on Immersive Technology in Education*, showed that zSpace had a significant impact on augmenting the several of the 4Cs particularly on creativity and critical thinking, skills that are both indispensable in engineering-design. Students reported becoming more aware of just how important critical thinking can be, observing how it can help avoid problems and lead to better work.

In addition, students and researchers observed additional soft skills attributed to their experiences with zSpace, such as grit. Akin to persistence and resilience, grit relates to one's interest in pursuit of a long term goal.ⁱ The ability to stick to difficult tasks is perhaps a better predictor of achievement than traditional measures, according to recent researchⁱⁱ, and providing multiple tools to complete a task, like zSpace, may have helped the students get through the toughest parts of the assignment.^{iii, iv, v}

Sink or Swim?

When it came time to launch the boats in the water, the students were ready. And it didn't matter whether they tipped over or water started to seep in – students had a great time and cheered each other on. Later, when they had time to reflect, they were able to recognize the engineering concepts they had learned (Why did my boat sink? What made another boat more agile in the water?) as well as the 4Cs and other soft skills that helped them complete their project.

The future for these students, and for others who are able to practice building their 21st-century and soft skills, is promising. If zSpace can help improve the 4Cs and other critical skills during a single boat-building project, there are endless opportunities to incorporate zSpace into a wide variety of curricula to study the ways zSpace contributes to students' preparation for 21st-century work and life skills.

ⁱStoffel, J. M., & Cain, J. (2018). Review of grit and resilience literature within health professions education. *American Journal of Pharmaceutical Education*, 82(2), 124–134. doi:10.5688/ajpe6150 PMID:29606705

ⁱⁱIvcevic, Z., & Brackett, M. (2014). Predicting school success: Comparing conscientiousness, grit, and emotion regulation ability. *Journal of Research in Personality*, 52, 29–36. doi:10.1016/j.jrp.2014.06.005

ⁱⁱⁱBazelais, P., Lemay, D. J., & Doleck, T. (2016). How Does Grit Impact College Students' Academic Achievement in Science? *European Journal of Science and Mathematics Education*, 4(1), 33–43.

^{iv}Muenks, K., Wigfield, A., Yang, J. S., & O'Neal, C. R. (2017). How true is grit? Assessing its relations to high school and college students' personality characteristics, self-regulation, engagement, and achievement. *Journal of Educational Psychology*, 109(5), 599–620. doi:10.1037/edu0000153

^vWolters, C. A., & Hussain, M. (2015). Investigating grit and its relations with college students' self-regulated learning and academic achievement. *Metacognition and Learning*, 10(3), 293–311. doi:10.1007/11409-014-9128-9