



Picture two fencers standing across from one another – their blades gleaming in the sun. Slowly, they inch closer to one another, noticing the small details in each other's stances. Informed by years of practice, at the exact moment when the other is in range, they strike.

In the sport of fencing, this pivotal moment is known as the engagement, and requires intense focus and concentration from each combatant. Because even the slightest movement can determine the victor, outside distractions fade into the background and by necessity, the competitors prioritize the present moment.

In the realm of education, research has shown that engagement is just as vital to learning and sustained academic success. Far from being something that's just "nice to have," for decades researchers have found strong correlations between student engagement and student achievement across all levels of instruction and subject matter, and for a wide range of educational activities.¹



Students at California's Escondido Union School District explore hands-on engineering concepts in Invention Project.®

Understanding How Engagement Relies on Interest

For both new and seasoned educators, these findings likely reaffirm what they already know to be true: Engagement leads to lasting and meaningful learning. For this to occur, however, students must first develop an interest in the subjects they are exploring.

While seemingly self-explanatory, the term "interest" is quite nuanced and is perhaps best described by influential researcher and psychologist Carroll E. Izard. In a paper published in the *Annual Review of Psychology*, Izard categorizes interest as an emotion that is at the foundation of engagement and contributes greatly to our overall well-being:

The emotion of interest is continually present in the normal mind under normal conditions, and it is the central motivation for engagement in creative and constructive endeavors and for the sense of well-being. Interest and its interaction with other emotions account for selective attention, which in turn influences all other mental processes.²

The connection between interest and well-being is one not commonly discussed. Yet, because interest has the potential to develop into passions – and even a sense of purpose³ – it represents an emotion that deserves to be nurtured and cultivated.

Unfortunately, students' relationship with and feelings toward school are not always positive. In a 2020 survey of more than 21,000 American high school students published by the European Association for Research on Learning and Instruction, for example, nearly 80% reported feeling stressed, and almost 70% said they felt bored. Though the students did express positive emotions including cheerfulness and pride, nearly 75% of those who took part in the survey also self-reported negative feelings related to their school experience.⁴

In his book "Why Don't Students Like School," Daniel T. Willingham, professor of psychology at the University of Virginia, attempts to address some of the reasons for students' dislike of school. A primary reason is just how difficult it is for educators to present "the sweet spot between to-be-learned content being too hard and too easy."⁵ While students are naturally curious, Willingham argues that educators inadvertently can overwhelm their classes if the information being presented lacks context or personal meaning.⁶

Exploring Self-Determination Theory in the Classroom

For one effective way to help students develop relevant connections with the topics and concepts they encounter in class, we can look to the principles of Self-Determination Theory (SDT).

1. Dyer, K. (2022, October 18). *Research proof points: Better student engagement improves student learning*. Teach. Learn. Grow. Retrieved March 15, 2023, from <https://www.nwea.org/blog/2015/research-proof-points-better-student-engagement-improves-student-learning/>

2. Izard, C. E. (2009, January 10). *Emotion Theory and Research: Highlights, Unanswered Questions and Emerging Issues*. Annual Reviews. Retrieved from <https://www.annualreviews.org/doi/full/10.1146/annurev.psych.60.110707.163539>

3. Swift, J. (n.d.). *The benefits of having a sense of purpose*. Cornell Research. Retrieved March 15, 2023, from <https://research.cornell.edu/news-features/benefits-having-sense-purpose>

4. Moeller, J., Brackett, M. A., Ivcevic, Z., & White, A. E. (2020). High school students' feelings: Discoveries from a large national survey and an experience sampling study. *Learning and Instruction*, 66. <https://doi.org/10.31219/ost.io/f3k87>

5. Gottlieb, R. (n.d.). *Why don't students like school?* (2nd. Ed.) by Daniel T. Willingham. Learning & the Brain. Retrieved March 15, 2023, from <https://www.learningandthebrain.com/blog/why-dont-students-like-school-2nd-ed-by-daniel-t-willingham/>

6. Ibid.,

First introduced by psychologists Edward Deci and Richard Ryan in their 1985 book “Self-Determination and Intrinsic Motivation in Human Behavior,” the theory suggests that human action is driven in large part by a need to grow and develop.⁷

For this type of growth to occur, SDT states that we need to feel the following⁸:

Autonomy: Individuals must feel they are in control of their own goals and behaviors. The belief that direct action is possible and that it will result in tangible change is foundational to helping people feel self-determined.

Competence: The feeling of progress leading to mastery is one that is crucial to believing that actions have meaning. When people see they have the abilities needed to succeed, they are more likely to take steps that will help them achieve their objectives.

Connection or relatedness: People need to feel a sense of belonging and attachment to others.

Within the context of a classroom, educators who can create environments that are conducive to SDT can help students feel greater levels of satisfaction, and therefore more engaged and invested in what they’re learning.

In an article published in *Critical Questions in Education*, Angela Ford, assistant director of doctoral programs in education at Judson University, argues that, informed by the principles of SDT theory, educators can “equalize educational opportunities” by ensuring that children from all backgrounds have access to “safe and clean buildings designed for learning” and classrooms that support their basic psychological needs.⁹

Quoting from Ryan and Deci,

“Social contexts that support satisfaction of all three psychological needs also facilitate more autonomous functioning, which in turn yields more effective performance and greater wellness, whereas social

contexts that fail to support and/or actively thwart these basic psychological needs tend to promote controlled motivation or amotivation, which in turn yields poorer performance and ill-being.”¹⁰

Ford readily admits that from the perspective of a school administrator, improving school facilities might seem the most direct (and visible) way of incorporating SDT. However, she instead recommends a more immediate solution: to create better classroom environments by training teachers to use SDT to improve students’ feelings of autonomy, competence and relatedness.¹¹



Two Invention Project participants from Escondido brainstorm to generate ideas for their invention prototypes.

Authentically Applying Self-Determination Theory Through Invention Education

As educators and policymakers continue to explore creative ways to engage their students, especially following the negative social impacts of the COVID-19 pandemic,¹² increasingly, more have looked to invention education to provide effective teaching strategies that can empower students and bring relevance to what they’re learning.



A Camp Invention® participant proudly shares their invention prototype.

7. Cherry, K. (2022, November 8). What is Self-Determination Theory? How Self-Determination Influences Motivation. Verywell Mind. Retrieved March 15, 2023, from <https://www.verywellmind.com/what-is-self-determination-theory-2795387#:~:text=Self%2Ddetermination%20theory%20grew%20out,Intrinsic%20Motivation%20in%20Human%20Behavior>.

8. Ibid.,

9. Ford, A. (2019). Examining and Improving Classroom Environments Through the Lens of Self-Determination Theory. *Critical Questions in Education*, 10(1), 65–77.

10. Ryan, Richard M., and Edward L. Deci. *Self-Determination Theory: Basic Psychological Needs in*

Motivation, Development, and Wellness. New York: Guilford Publications, 2017. Tanner, C.K. “Effects of School Architectural Designs on Students’ Accomplishments: A MetaAnalysis.” *Education Facilities Clearinghouse*, 2015.

11. Ibid.,

12. Drake, P., & Rudowitz, R. (2022, April 21). Tracking social determinants of health during the COVID-19 pandemic. Kaiser Family Foundation. Retrieved March 15, 2023, from <https://www.kff.org/coronavirus-covid-19/issue-brief/tracking-social-determinants-of-health-during-the-covid-19-pandemic/#:~:text=Over%20the%20course%20of%20the,people's%20health%20and%20well%2Dbeing>.

At its most fundamental level, this pedagogy invites participants to discover or “invent” solutions to real-world problems through the act of hands-on invention prototyping.¹³ Embracing this active approach to education places students in control of their learning and encourages them to incorporate their interests and passions directly into the problem-solving process.

In this way, the flexibility of invention education allows participants to authentically develop the precepts of SDT in the following ways:

Autonomy: In an invention education environment, students have complete control over how they plan to overcome a challenge. They have the freedom to take risks and turn their ideas into solutions.

Competence: By first brainstorming and then iterating on their ideas, over time, students build confidence in their abilities, which can translate into other areas of their lives. Understanding the relevance of STEM subjects also can help combat anxieties sometimes linked with these fields.

Connection or relatedness: Invention education encourages participants to work together and collaborate on common goals. Through this experience, they learn how diversity and teamwork can make their finished product even better.

Students who participate in invention education curricula that incorporate the lessons and teachings of accomplished inventors receive additional benefits. Not only does this approach improve the real-world relevancy of the instruction, but according to research conducted by Opportunity Insights, a nonprofit research organization based out of Harvard University, the sooner children are introduced to inventors, the more likely they will go on to become inventors themselves as they grow.¹⁵

As we collectively work to improve the levels of diversity within STEM (science, technology, engineering and mathematics) fields, students must have the opportunity, through invention

education, to identify STEM role models to whom they can relate. It's for this reason that for over 30 years, the National Inventors Hall of Fame® has continued to develop innovative STEM programming that incorporates lessons and stories from some of the world's most influential innovators – National Inventors Hall of Fame Inductees.

This authentic approach to invention education is why thousands of school districts across the country decide to partner with the National Inventors Hall of Fame to engage their students and ignite their natural curiosity.

“The Escondido Union School District was really purposeful in selecting the National Inventors Hall of Fame curriculum so that we can address the achievement gap, but also the engagement gap.”

– **Rick Oser**, Director of Extended Learning Intervention & Enrichment, Escondido Union School District, California

13. The National Inventors Hall of Fame. (n.d.). How NIHF embraces authentic invention education. National Inventors Hall of Fame®. Retrieved March 15, 2023, from <https://www.invent.org/blog/trends-stem/21st-century-skills-students>

14. Beilock, S. (2019, October 23). Americans need to get over their fear of math. Harvard Business Review. Retrieved March 15, 2023, from <https://hbr.org/2019/10/americans-need-to-get-over-their-fear-of-math>

15. Bell, A., Chetty, R., Jaravel, X., Petkova, N., & Reenen, J. V. (2017, December). Who becomes an

inventor in America? The Importance of Exposure to Innovation. Opportunity Insights. Retrieved March 15, 2023, from https://opportunityinsights.org/wp-content/uploads/2021/12/inventors_summary.pdf