Moving From Content to Discovery: STEM for Younger Learners

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Abstract: This poster addresses the question "What are the implications for STEM-focused games and interactive media spaces when pedagogical foci shift from content-based to discovery-based approaches?" The intended audience is broad, from educator to researcher to developer. Information presented includes not only content from literature and industry reviews, but also from field professionals following their own professional applications of STEM in the development and implementation of learning environments. The target outcome is to address current challenges and opportunities prompted by shifting STEM pedagogies from content-driven to discovery-driven learning environments. In embracing these pedagogical shifts, the development and application of game and interactive media spaces serve to provide young learners with deeper foundations on which to build long-term STEM literacy and achievement.

Games as a Vehicle for Shifting Approaches to STEM Learning

At its core, Science, Technology, Engineering, and Math (STEM) pedagogy is about fostering curiosity and discovery. It is about instilling in children the desire to find out on their own, not always to be taught (Fisher, Bryant, Akerman, & Fischer, 2010). While discovery is a natural inclination of children, it is has not been a fundamental goal of today's traditional science and math pedagogy. While standards-based educational frameworks are changing to include practices of science and engineering and crosscutting concepts (NRC, 2011), traditional pedagogical structures focus much more on disciplinary content. Ideally, STEM is about encouraging exploration of the environment, asking questions, and being curious beyond initial comprehension. Doing so fosters the ***mindset*** of STEM rather than the facts of STEM. This poster argues that games are a key medium in which to support children's development of a STEM mindset.

Sometimes fostering a STEM mindset is as simple as giving a child the space to wonder, and the tools and encouragement to try out ideas. Games and interactive media spaces can be powerful environments for such wondering and experimentation to playfully take place. They are ripe with opportunities for meaning-making. Play that takes place within game spaces requires high level of textual understandings. Game worlds require players to make sense of signs, moving back and forth between interactions with known and unknown information. Players gain understanding by interacting within the world, and by making interpretations that shift and change based on the way the players use signs and symbols in different ways (Salen and Zimmerman, 2004). What play through various media allows is the possibility for children to create patterns of knowing and understanding based on experimentation, discovery, and role negotiations. Mediated play, therefore, becomes a tool with great promise for STEM supportive environments for younger learners.

A Poster to Identify Implications for Development, Implementation, and Research

With so many products proliferating the market, particularly those claiming to have educational merit, how can developers, educators, and researchers evaluate existing products to identify critical elements of STEM play? Beyond this, how can researchers and developers understand media needs, trends, and opportunities in order to further develop STEM supportive products and platforms? This poster will identify issues regarding the development, implementation, and research of games and other interactive media platforms for supporting STEM learning for young audiences, particularly preschool and early elementary ages.

Statement Samples for Inclusion From Industry Professionals

Carla Engelbrecht Fisher

Founder, No Crusts Interactive

Games are a perfect opportunity to grow this mindset as well as help reeducate adults about STEM learning experiences. Intergenerational play, including cooperative simultaneous play as well as pass-back-and-forth interactions, are increasingly supported by the various gaming technologies. Game designers and researchers should leverage these trends to explore the STEM educational

opportunities for both children and adults, particularly through games that foster cooperation, trial and error, and holistic systems thinking.

David E. Kanter
Director, SciPlay
In my early work, I explored the impact of project-based science curricula in formal classroom settings. Such curricula were designed to support students working on real-world projects. My findings were interesting in that I could show that these kinds of curricula brought about improvements in students' meaningful understanding, but students' affect did not improve in parallel as initially anticipated. While I believe such curricula are a good approach for developing meaningful understanding across disciplines, I have become concerned about their negative impact on affect due to the significant mental effort they require, resulting in a situation that is at odds with ideal classroom practices and thus negatively experienced by students. Taking a different tack, I have recently begun to explore the potential of guided play games to improve both affect and learning. I believe that play in an informal setting can be carefully guided as a game-with-rules that integrates science content in a compelling and intrinsic manner. Also, such play may serve as an important bridge from the informal to the formal setting to promote deeper understanding while also building students' positive affect toward science.

Scot Osterweil
Creative Director, MIT Education Arcade
While harnessing the natural curiosity of children in the service of exploration is a necessary first condition of STEM education, it is not in itself sufficient. As children explore the world, their curiosity leads them into observation and sometimes hypothesis formation, but it can also lead them to misconceptions and even magic thinking. Properly taught, STEM education helps students understand that the formation of knowledge comes through systematic modeling, testing and iterating as well as exploring. Traditional education kills the exploration by emphasizing the memorization of facts, but it also fails at promoting systems thinking by reducing it to a "scientific method" that flattens the experience for students, and drains the sense of wonder from what should be inspiring engagement with real phenomena. Happily, though this form of systems thinking does not come easily, it does emerge in the ways children engage with the models and simulations that animate most electronic games. Through game-play children do learn to reason about cause and effect, test hypotheses, and control for variables. The challenge of designing opportunities for reflection into the game ecology is second in difficulty only to the challenge of designing a genuinely engaging game, but it is a challenge well worth the effort.

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Acknowledgments

We are exceedingly grateful for the support of the industry professionals who provided statements, whose work in media design and STEM education is directly making the world a more playfully engaging place for kids to learn.