Cultivating Effective Teacher-Game Partnerships in Science Classrooms

Teachers play a critical role in student success with digital game-based learning in the classroom. That is a key finding from a recent study conducted by the Friday Institute for Educational Innovation’s STEM Cyberlearning team in collaboration with The Concord Consortium, TERC and NC State’s Center for Educational Informatics to investigate how teachers utilized a digital genetics game to meet students’ learning needs.

Over the past few decades, researchers and educators have become excited about the potential of digital games to enhance student learning across a variety of disciplines. Digital educational games can be powerful instructional tools, as they offer students a motivating environment for learning core academic concepts in a more personalized and interactive manner. Furthermore, the open-ended exploration afforded by many digital educational games complements the science practices deemed essential by the Framework for K-12 Science Education and the Next Generation Science Standards.

To support scientific inquiry and learning of genetics concepts, the collaborative GUIDE project developed Geniventure through an NSF-funded grant (DRL-1503311). Geniventure is an immersive, digital game that presents students with an engaging narrative as they are tasked to save dragons from extinction through the breeding of dragons called drakes. Through scaffolded virtual challenges, students must combine various alleles to create drakes that have different physical traits. Then they dive deeper by zooming into cells and solving challenges by working with the proteins that give rise to those traits.

Geniventure also includes an integrated Intelligent Tutoring System (ITS), developed by the Center for Educational Informatics, that offers students a personalized and scaffolded learning environment with immediate feedback. The ITS provides three tiers of structured hints as students level up through the game. Geniventure offers teachers a dashboard where they can access individual and whole-class analytics to gauge progress and mastery of concepts.

Our research team conducted a yearlong study with 10 teachers across five states to investigate how they utilized Geniventure within their classrooms. We kept our research focused on the pedagogical practices that allowed students to fully engage with the inquiry-based nature of the game to learn the scientific phenomena.
Classroom observations, surveys of teachers and students, and teacher interviews revealed the various ways in which teachers enhanced their students’ learning experiences with Geniventure. Our findings suggest that teachers create powerful immersive learning experiences with digital games like Geniventure when they embrace the game’s novel technical features that support student learning, adopt the game narrative as a common reference point to extend applications of the scientific phenomena, and encourage students to use the game as an exploratory tool to experiment with scientific concepts.

Successful teachers aligned their pedagogy with the inquiry-based elements of the game by asking students probing questions that required them to synthesize what they had learned through gameplay and apply it to solve subsequent challenges. Teachers also leveraged the graphic and animated elements of the game that were simulating important genetic processes to serve as powerful visual aids. They often added dragon scenarios to worksheets and various sense-making opportunities outside of the game where students were encouraged to make scientific claims and support them with evidence from the game. These opportunities allowed the game to serve as a reference point for genetics concepts and a common language of shared understanding across the class. For example, students often referenced examples from the game to discuss scientific principles such as dominant and recessive traits and complete and incomplete dominance after gameplay.

**Practical Suggestions**

Based on these findings, we offer some practical suggestions for teachers wishing to adopt game-based learning into their classrooms.

- Don’t get discouraged if it takes a while to develop pedagogical strategies when adopting a new game. It may take multiple classroom implementations to perfect pedagogical strategies aligned with features of the game that can keep students immersed in the game-based learning environment.
- Encourage students to use the game environment to test and try out various solutions, embracing its design as an opportunity for students to learn critical problem-solving skills.
- Teacher-led interventions should not subvert the open-ended nature of game-based learning environments. Instead, teacher scaffolds should support student agency with regards to inquiry and investigation, using strategies such as probing questions and reflection. Remember, productive struggle often facilitates learning when properly supported by the teacher and peers.
- Adopt an active and facilitating role, circulating through the classroom to attend to students’ individualized needs. Also, initiate opportunities for discussion to ensure students are not harboring any misconceptions.

If combined with the appropriate pedagogical supports, immersive digital educational games can be powerful tools that support digital-aged learning. Thus, the role of the teacher in orchestrating student learning during student gameplay is paramount. Teachers enhance student learning when their pedagogy complements game features that encourage student inquiry and allow them to deliver customized student support.

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