

Orchestrating Change: A Narrative Analysis of Teacher Practice in a Post-Pandemic, Technology-Enhanced Learning Environment

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Abstract: This study examines the role of reflective practice in a technology-enhanced K-12 environment, focusing on a teacher's orchestration of game-based learning. It investigates how the teacher adjusts curriculum elements and facilitation techniques in response to integrating technology, especially in the context of post-pandemic educational challenges. Employing narrative analysis, the research traces the teacher's journey from professional development to classroom implementation, culminating in a retrospective interview. The study highlights the nuances of instructional strategies and the importance of reflective practice in navigating the complexities of digital learning environments. The findings provide a nuanced understanding of the teacher's instructional practices, highlighting the complex and multifaceted aspects of teaching and learning in a science classroom. This study emphasizes the significance of understanding teachers' orchestration experiences to inform the design and integration of technology-enhanced learning environments and to better support instructors in facilitating effective, adaptive, and engaging learning experiences for their students.

Introduction

Reflective practices offer a means to explore how teachers integrate technology and adjust practices to assess and refine their instructional approaches. Classroom orchestration is used as a metaphor to describe a teacher's responsibility to manage and regulate a classroom (Dillenbourg, 2013). However, the complexities inherent in technology-enhanced learning environments necessitate more empirical research to understand how teachers orchestrate the multifaceted dimensions within these complex settings. In particular, in the post-pandemic era, teachers encounter additional challenges in reverting to traditional practices. Incorporating reflective practices enables teachers to design, implement, and introspectively examine their instructional strategies, thereby enhancing their ability to orchestrate complex learning environments and adapt to new challenges by critically assessing their methods and interactions with students and technology (Blackley et al., 2017; Gibbs, 1988). The study employs narrative analysis and a case study method to explore a teacher's reflective practices and application of collaborative game-based learning in a K-12 setting. This study aims to explore the complexities of a teacher's orchestration practices, with a particular focus on instruction planning and adjustments during implementation, through two research questions:

- RQ1. How does a teacher plan and adapt curriculum elements to facilitate a collaborative game-based learning environment?
- RQ2. What strategies does a teacher utilize to adjust instructional practices during classroom orchestration?

Theoretical framework

In collaborative learning environments, teachers' orchestration student learning across various social planes (e.g., individual, group, and whole class) while navigating multiple constraints, such as time and space (Dillenbourg et al., 2013). In recent years, the notion of orchestration has expanded to be on a continuum, ranging from a narrow emphasis on teachers' responsibilities to a more open-ended understanding that involves power and agency, the role of students, technology, and other aspects of a classroom (Sharples, 2013; Schwarz et al., 2018). Researchers recognize the significance of understanding teachers' perspectives, instructional needs, and perceptions of using orchestration tools (e.g., Holstein et al., 2019; Van Leeuwen et al., 2021). However, there is a need to focus on involving teachers in the planning stage, documenting their reflective modifications in orchestration, and highlighting their active adjustment of instructional strategies using technology to boost student learning (e.g., Kollar & Fischer, 2013; Prieto et al., 2011). When integrating new technologies in their classrooms, it's crucial to understand how teachers manage their orchestration process from pre-class design and real-time orchestration to post-reflection. Orchestration practices in the classroom can be more challenging when teachers incorporate collaborative learning. Approaches such as collaborative inquiry, commonly used in STEM education, promote students' critical thinking, creativity, and active engagement (Hmelo-Silver & Jeong, 2022). In particular, the integration of educational games into inquiry-based learning within science classrooms underscores the necessity for teachers to adapt their pedagogical approaches and facilitation strategies (Annetta, 2008). Reflective practice

enables teachers to assess their actions and instructional decisions, revealing the narratives they construct and experience, thereby offering insight into their unique teaching practices (Brookfield, 1995). Reflection-on-action' (Schön, 1983) is a type of reflection where teachers retrospectively analyze and articulate their decision-making after instructional events, often employing techniques such as questioning and thoughtful introspection (Smyth, 1992; Loughran, 2002). Focusing on 'reflection-on-action', this study aims to explore how a K-12 teacher orchestrates game-based learning in science classrooms, examining their reflective practices, instructional experiences, and the integration of the educational game through narrative analysis.

Methods

Learning context

Crystal Island: Lost Investigation (Rowe et al., 2011) is a single-player, narrative-driven educational game designed to encourage scientific inquiry centered microbiology. In the game, students assume the role of special agents assigned to investigate an infectious disease affecting a group of scientists on Crystal Island, a remote science outpost. A player is randomly assigned to diagnose either salmonellosis or influenza using one of three contaminated food sources: eggs, milk, or toast. Throughout their investigation, the player interacts with a variety of pedagogical agents in order to learn about the game's narrative, investigate diverse reading materials, and conduct virtual lab experiments. In addition, they utilize a diagnostic worksheet to record their diagnostic process, report their findings, and specify a treatment. Situated in a Midwest charter school, the study centers on Mr. Benson, the lead STEM teacher responsible for teaching all three classes comprising the entire STEM program, accommodating students from 6th to 8th grade. During the period from 2021 to 2022, the program witnessed a notable enrollment increase from 60-70 to 117 students. With eighteen years of STEM education experience, Mr. Benson served as the lead science teacher for 13 years. Upon reaching out to Mr. Benson in Fall 2021, he expressed readiness to support the research, noting students' limited collaboration opportunities due to increased enrollment and the transition from remote to in-person learning. Consent forms were provided to both the teacher, students, and their guardians.

Study design

The study was divided into three phases: 1) professional development (PD) sessions; 2) implementation of the game unit within the teacher's STEAM program; and 3) retrospective interview sessions. During Phase 1, four PD sessions lasting 30-40 minutes each were conducted to enhance Mr. Benson's skills in integrating the game into the curriculum. Video data captured interactions between Mr. Benson and the researcher, leading to collaborative instructional decisions. In Phase 2, camera operators collected two types of video data in classrooms: student interactions in pairs and footage of Mr. Benson, capturing his orchestration practice during lessons. Phase 3 comprised video-stimulated recall interviews using clips from classroom footage to prompt Mr. Benson's reflection on his actions.

Narrative analysis

Narrative analysis, a qualitative research approach prioritizing human subjectivity and individual voices, empowers participants to share and interpret their experiences, bridging dualistic boundaries between researchers and participants (Cortazzi, 1994). Participants' accounts offer valuable insights beyond personal storytelling, as they not only reveal the hidden motivations shaping their perspectives and decisions, but also illuminate their underlying values and identity positioning (Dennis, 2016). In this study, narrative analysis was used to interpret, reconstruct, and present Mr. Benson experiences and reflection when orchestrating game-based learning in his classrooms. To ensure validity and reliability, multiple video data sources, including PD sessions, classroom implementation, and the retrospective interview, were utilized to construct Mr. Benson's narrative. PD sessions facilitated discussions on instructional objectives and implementation plans, which were further examined during the semi-structured interview. Classroom video recordings confirmed his facilitation strategies, strengthening the validity of his reflections. Reflexivity played a central role in shaping my research approach. This involved organizing and labeling video data daily, creating content logs to capture key moments, maintaining a researcher's journal for documentation, and engaging in discussions with data collection volunteers to validate and broaden perspectives.

A narrative about Mr. Benson's orchestration practices

The narrative analysis findings address RQ1 by presenting instructional decisions and respond to RQ2 by reflecting on orchestration actions during implementation, along with relevant recommendations for orchestration.

Decision-making for orchestrating collaborative learning

In 2021, Mr. Benson transitioned to a STEAM program format for his science classes, accommodating nearly 120 students, double the previous year's population, leading to the division of students into three classrooms. Due to the tightening of Mr. Benson's schedule, there are limited opportunities for engaging in collaborative inquiry projects. Consequently, our collaboration in designing the orchestration aimed to address this issue. In addition, Mr. Benson aimed to reframe the game's original purpose to connect it with the pandemic, leveraging students' interest in health and well-being, in alignment with the curriculum theme of 'humanity.' As a result, it was decided that students would work in pairs to play the game, promoting collaborative inquiry, while being seated in groups of four to ensure peer or cross-group support. To familiarize students with pair work and facilitate learning of basic scientific terminology and microscope skills, Mr. Benson prepared them by conducting experiments with Petri dishes to cultivate bacterial samples in pairs before implementation. Mr. Benson emphasized that a key outcome he envisioned for students through the game was the ability to transfer their newly acquired scientific terminology to real-world situations reflected in the game (Pedaste et al., 2015). He wanted them to understand practical applications of science, pondering questions like, "Where are microscopes being used? Who is using them? Why are those tools and methods of science being used to solve real problems?"

Another decision involved the design of physical workbooks. These workbooks serve as paper-based scaffolds, providing structure, guiding problem identification and hypothesis generation, and facilitating active participation in the inquiry process. Later in the interview, Mr. Benson noted the instrumental role of physical workbooks in enabling students to write, discuss, and generate ideas, expressing their significant utility in understanding students' learning processes and planning his instruction accordingly.

Adaptive instruction during orchestration

The section outlines three scenarios in which Mrs. Benson adjusted her teaching methods to address the challenges that arose during classroom orchestration. In the first few days, Mr. Benson decided to redirect the use of Accountable Talk (Michaels et al., 2008) in pair discussion. Accountable Talk was introduced to students as a principal method for sharing, exchanging ideas, and engaging in reasoned arguments and discussions. However, students noted that the provided sentence starters sounded too formal and structured. A major reason is that students who were affiliated with the elementary school in the same system were already accustomed to similar discussion norms, such as 'I want to build off of...' and 'Could you say more...'. Thus, Mr. Benson encouraged students to adapt Accountable Talk in their own way. However, he also noted that Accountable Talk sentence starters were particularly useful for students who encountered communication challenges, proving especially beneficial for students with Individualized Education Programs or social needs to enhance their learning and participation in discussions.

A second scenario showcasing Mr. Benson's adaptive instruction was highlighted through his support for a specific student: Alex and Jason. During a check-in, Mr. Benson fostered Alex's understanding of the human body's response to various pathogens by incorporating the student's personal experience with COVID vaccines into the discussion. Inspired by this engaging encounter, I prompted Mr. Benson to elaborate more, leading to his reflection on his educational philosophy and instructional strategies. Mr. Benson, motivated by a 'power of respect' training he had attended, adopted the concept of 'disrupting education' to challenge and transform traditional educational norms, thereby promoting student ownership as a means to boost learning. For Alex, who faced challenges with a learning disability and memorization, Mr. Benson reasoned, "if I could get him to talk about his own experience and teach me, he would understand it a lot better."

The third scenario occurred while supporting a pair of students, Liam and Peter. They approached Mr. Benson with a complex question about cultivating viruses in a Petri dish. Mr. Benson openly admitted, 'I don't know that' encouraging them to research independently. Recalling the interaction, he noted, "it was a moment where I wanted them to see that there is a lot to learn. We do not have all the answers, but we can use tools to find those answers." After learning that a virus can grow in a Petri dish with a cell culture, Liam and Peter realized the necessity of living host cells for viral replication and presented their investigation to the class at Mr. Benson's request. Mr. Benson also pointed out that external resources, including internet searches, can enhance classroom activities and encourage student-led inquiry beyond the predefined instructional design.

Redesigning instruction for enhanced orchestration

During the reflection, Mr. Benson looks forward, contemplating how he might refine his instruction to better his orchestration. Mr. Benson expresses his ambition to employ an orchestration tool that would enable him to track student progress and assess their knowledge of game-based learning material. In line with Mr. Benson's attention

to groups and students who need help, he envisioned a dashboard tool that could swiftly identify learners with similar struggles, offering insights for tailored group formation. This feature would enable Mr. Benson to quickly reorganize students into new groups for collaborative problem-solving or to pair them with advanced peers who can serve as peer tutors. Regrouping is particularly crucial for short-term projects where immediate adjustments are more practical.

Conclusion

Understanding teachers' narratives can unravel the dynamics of technology-enhanced learning environments. Through the lens of Mr. Benson's experiences, this study provides a window into the lived experience of teaching in technology-enhanced environments. Utilizing narrative analysis, I explore his trajectory from setting goals to classroom implementation and reflective practice. Teachers play a crucial role in leading student-centered, technology-advanced learning environments. This study extends beyond the current literature focus on facilitation and orchestration tools, offering an in-depth look at a teacher's reflective journey in orchestrating K-12 classrooms. It sheds light on how teachers, like Mr. Benson, navigate the integration of new technologies, adapt their curriculum, and refine instructional strategies amid the evolving landscape of post-pandemic education. By focusing on the nuances of a teacher's journey in implementing game-based learning, this study offers insights into the dynamic orchestration required for effective technology integration.

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