Where is this Ship Going?

Insights from Early Stages of Infrastructuring Maker Education

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Abstract

Integrating maker education into formal schooling systems presents significant challenges due to entrenched educational infrastructures that resist change. This study explores the early stages of infrastructuring maker education through a design-based implementation research (DBIR) approach with a municipal partner. Despite the municipality's enthusiasm, evidenced by their investments in maker spaces and future plans to expand these efforts, foundational questions emerged regarding the purpose and disciplinary integration of maker education. The onboarding process revealed the need for iterative dialogue, visual tools, and concrete examples to bridge conceptual gaps and align visions. This journey underscores the importance of fostering shared understanding and direction in early stages of the infrastructure process. The findings contribute to the growing literature on infrastructuring for educational change, offering theoretical and practical insights into fostering sustainable, constructionist learning in schools.

Keywords and Phrases: Design-based implementation research, infrastructuring, maker education, policy-makers

1. Introduction

Integrating constructionist innovation in educational systems is often slow and challenging due to deeply embedded infrastructures that resist change (Papert, 1997). Infrastructuring has emerged as a promising strategy for facilitating transformative change in education by focusing on these foundational systems (Penuel, 2019). Maker education, an innovative pedagogical approach in the constructionist tradition (Blikstein, 2018), offers potential to disrupt the epistemological, social, material-technological, pedagogical, and organizational structures of traditional schooling (Riikonen et al., 2020). While interest in integrating maker education into K-12 schools continues to grow, its adoption remains limited in scale and impact (Valante & Blikstein, 2019). Recent research suggests that infrastructuring could unlock maker education's full potential as a constructionist pedagogy (Korhonen et al., 2023). This poster explores the initial steps of infrastructuring maker education with municipalities, focusing on the challenges and gaps that arise in the process. By addressing these barriers, we aim to enhance the integration and transformative power of maker education in formal schooling.

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2. Background

Maker education is gaining global traction, largely driven by decentralized grassroots efforts (Blikstein, 2018). However, this mode of diffusion often results in techno-centric or superficial implementations that overlook its constructionist pedagogy (Valente & Blikstein, 2019). Scaling maker education within formal educational systems requires careful consideration of its pedagogical roots and how it integrates with existing school practice (Godhe et al., 2019).

Educational infrastructuring offers a promising approach to addressing these challenges. Infrastructuring involves redesigning school components, relationships, and routines to support sustainable innovation. It aims to foster lasting change by coordinating activities across curriculum, assessment, and professional development, with the involvement of multiple stakeholders (Penuel, 2019).

While academic interest in infrastructuring is growing, its application in maker education remains underexplored. As part of a broader research initiative focused on infrastructuring for maker education, we are in the early stages of examining the challenges and gaps that emerge during the initial stages of collaboration. Specifically, this poster explores the question: *What infrastructural challenges and gaps arise when policymakers first engage in infrastructuring for maker education?*

3. Methods

This study focuses on the early stages of a design-based implementation research (DBIR) approach to developing maker education infrastructure in a municipality. DBIR is a research methodology that bridges the gap between learning theories and educational change by emphasizing iterative cycles of design, implementation, and analysis, while ensuring stakeholder engagement and broad scalability (Fishman et al., 2013). The municipality, home to approximately 25,000 residents, was selected as a partner due to its commitment to advancing maker education and its initial progress in this area. At the outset of the partnership, the municipality had an active educational innovations officer, several maker spaces, and plans to establish a new school featuring a central maker space. While some maker programs were already in place with support from paid consultants, stakeholders expressed concerns about their lack of connection to core disciplinary learning and limited depth. These challenges highlighted the need for a cohesive vision to integrate maker education fully into the municipality's educational system. This municipality was chosen after a broader screening process of potential partners, as it aligned with the research team's goal of building sustainable infrastructures that connect disciplinary learning with maker activities.

To explore the early partnership dynamics, we employed ethnographic tools within the DBIR framework. Our data included spoken and written discourse from eight meetings, eight email chains, and several phone conversations between the research team and municipal stakeholders. Using a microanalytic approach (Chinn & Sherin, 2014), we examined these interactions to uncover the complex learning dynamics and collaborative processes shaping the design of the maker education infrastructure. This analytic approach, grounded in DBIR principles, allowed us to focus on the iterative cycles of design, implementation, and reflection that are central to fostering educational change (Fishman et al., 2013).

4. Findings: Tthe Iterative Journey of Onboarding and Building Shared Vision

The process of onboarding municipal policymakers and fostering a shared vision for maker education was an iterative and deeply involved journey. Despite the municipality's strong commitment – evidenced by their investment in maker spaces, plans for integrating maker education into a new school, and willingness to partner – the early stages of the partnership revealed gaps in mutual understanding.

This challenge reflects a broader issue in adopting maker education: while its hands-on, technological aspects often spark interest, integrating it into broader educational goals and disciplinary frameworks is less intuitive. For example, during one meeting, the director of the municipality's educational department questioned how maker education could go beyond being a standalone activity to support non-STEM disciplines like history. In response, the research team provided examples of history teachers using maker spaces to construct historical artifacts, helping the director see how maker education could align with curricular goals. These moments of clarification emphasized the importance of grounding abstract ideas in concrete, discipline-specific examples to bridge conceptual gaps.

The partnership was characterized by a dynamic process of mutual learning. To build this collaboration, the researchers explained how their DBIR approach differed from traditional methods these policymakers had encountered, which often resulted in one-sided interactions that left them hesitant to engage. Policymakers contributed by sharing insights into their professional development processes, existing infrastructures, and the challenges they faced. Their questions pushed the researchers to refine their ideas and explore how maker education could be tailored to various disciplines and contexts. The iterative nature of this exchange deepened mutual understanding and underscored the critical role of continuous dialogue in co-creating a shared vision.

A key takeaway from this process is the importance of establishing clarity of purpose. Although the municipality and research team initially agreed to "board the same ship," policymakers raised fundamental questions such as, "What is this ship?" and "Why do we want to be aboard it?" Addressing these questions required significant effort to clarify shared goals and objectives. This metaphor illustrates a central reality of partnership work: agreeing to collaborate is merely the starting point, and aligning visions and frameworks is crucial for achieving meaningful success.

Ultimately, these findings underscore the necessity of ongoing dialogue, time, and iterative processes to build mutual understanding and shared direction. Even among highly engaged and invested stakeholders, onboarding is not a one-time activity but a continuous effort to meaningfully integrate new ideas into existing systems and practices. The early stages of this partnership illustrate that alignment is both a challenge and an opportunity to deepen engagement and clarify the transformative potential of maker education.

5. Discussion and Conclusion

This research contributes to the growing body of work on infrastructuring for educational change by examining the early stages of integrating maker education into formal schooling systems. Our findings highlight challenges in aligning innovative pedagogies with existing infrastructures, particularly the need for iterative processes

to foster mutual understanding between researchers and policymakers. This study also adds insight into how maker education is being implemented in schools and identifies barriers to adoption, such as confusion about its purpose and scope (Godhe et al., 2019). Practically, it demonstrates how effective onboarding processes and visual tools can bridge the gap between abstract innovations and the realities of school systems. Theoretically, it underscores infrastructuring as a key strategy for sustainable change, emphasizing the importance of addressing foundational systems to implement transformative practices. Ultimately, this work highlights the complexities of building partnerships for maker education and the critical need for collaboration and clarity.

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