International Society of the Learning Sciences

From Idea Consumers to Knowledge Co-Creators: A 3-Year Design Study of Sustained Creative Work Through Cross-Community Partnership

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Abstract: This three-year design-based research (DBR) study investigates how to shift students from being passive consumers of information to active co-creators of knowledge. Conducted in three iterative phases, the study progressed from a local Grade 2 classroom to a cross-national partnership between Grade 2 (Canada) and Grade 9 (Spain). Using a mixed-methods approach, including a novel AI-based analytical tool (StAS), results demonstrate a clear progression from students reproducing authoritative information to engaging in authentic knowledge synthesis and co-design. These findings provide a model for cultivating epistemic agency by progressively expanding the "public" for student ideas and utilizing multimodal tools for collaborative theory building.

Introduction and theoretical framework

At its core, Knowledge Building is defined by the production and continual improvement of ideas for the benefit of a community (Scardamalia & Bereiter, 2003). This process positions learners as epistemic agents: individuals who take responsibility for advancing a community's knowledge (Scardamalia, 2002). Yet a persistent challenge in education, and specifically within Computer-Supported Collaborative Learning (CSCL), is the gap between this vision and classroom reality. Students often remain in a "learning mode"—reproducing accepted facts from authoritative sources—rather than shifting to a "design mode," where they treat ideas as artifacts to be continually improved (Bereiter & Scardamalia, 2003). This distinction is critical. In "belief mode," typical of schooling, students treat ideas as personal possessions to be accepted or rejected based on authority. In contrast, "design mode" requires a shift in epistemic stance: ideas become public entities, distinct from the author, akin to a blueprint or a prototype. Just as engineers do not take personal offense when a prototype fails, students in design mode view the critique of an idea not as a personal attack, but as a necessary step in advancing community knowledge.

This paper documents a three-year design-based research (DBR) study that documents the iterative design of interventions aimed at fostering this capacity for sustained creative work. We argue that moving students from reproducing knowledge to co-creating it requires a carefully scaffolded approach that cultivates their epistemic agency. This is achieved by progressively expanding the "public" for their ideas, from the individual to the classroom and finally to a networked external community.

This scaffolded approach requires two key supports. First, an open and public community space, such as Knowledge Forum, facilitates discourse across geographical areas and allows for the emergence of shared goals (Gloor, 2006). Second, multimodality is essential for making ideas accessible and improvable. It allows creators to represent their thinking in generative and collaborative ways (Lewis, Pea, & Rosen, 2010), inviting others to build upon them in a manner that supports authentic learning and connection (Herrington & Kervin, 2007).

Methodology

Research approach and context

This study utilized a design-based research (DBR) approach (Brown, 1992) featuring iterative design interventions. The primary research site was a Grade 2 class at an independent school in Toronto, Canada. The curriculum focused on salmon life cycles, selected because it presented a complex ecological system requiring students to understand interdependence, human impact, and conservation efforts rather than memorize isolated facts. Study 3 expanded to include a second site with a Grade 9 class in Tarragona, Spain.

- Study 1 (Jan-Apr 2020): Baseline study establishing challenges in idea generation.
- Study 2 (Jan-May 2021): Implementation of a local, multimodal digital storytelling environment.
- Study 3 (Oct 2021-May 2022): Creation of a cross-national partnership (Grade 2 & Grade 9).

Each year involved a new group of approximately 22-23 Grade 2 students; Study 3 also included 60 Grade 9 students. The same Grade 2 teacher participated across all studies, providing crucial continuity.

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Data sources and analytical approach

A mixed-methods approach analyzed multiple data sources: (1) audio/video recordings of classroom activities, (2) student-generated notes within Knowledge Forum, and (3) student digital stories. Knowledge Forum is an electronic communal workspace designed to support Knowledge Building, allowing users to contribute notes, build on others' ideas via scaffolds (e.g., "I need to understand"), and organize inquiry through customizable views (Scardamalia, 2004).

Qualitative analysis utilized inductive coding (Charmaz, 2006). While conducted by a single coder, trustworthiness was established through prolonged engagement and peer debriefing to verify the alignment of codes with the theoretical framework.

AI-assisted content analysis (StAS)

To quantitatively track the shift from reproduction to creation, we utilized the "Similarity to Authoritative Sources" (StAS) tool (Khanlari, Huang & Scardamalia, 2024). This custom Python-based application uses a Sentence-BERT (SBERT) model to measure the semantic distance between student ideas and expert content. We established a consistent corpus of 10 expert-created videos on salmon life cycles. To validate the tool, we conducted empirical testing on the corpus itself. The average similarity between distinct concepts within the source material was 0.35, while direct paraphrases consistently scored above 0.70. Based on this, a similarity score of 0.5 was selected as a conservative threshold: notes scoring above 0.5 were classified as reproducing source material, while lower scores indicated the introduction of novel ideas or synthesis.

Findings

Study 1: Challenge of “design mode”

Study 1 revealed the difficulty of shifting students out of "learning mode." Students engaged in rich activities—raising salmon in a classroom hatchery, creating plasticine models, and hosting visiting experts. However, analysis of Knowledge Forum notes revealed that the digital environment was primarily used to record oft-repeated information from authoritative sources.

The StAS tool supported this observation. Many student notes had high similarity scores (average ~0.69). For example, notes such as "how do salmon eggs grow" (Score: 0.69) and "why do salmon have yolk sacs" (Score: 0.68) were near-direct paraphrases of the expert video transcripts. This highlighted the difficulty of getting students to practice self-regulatory processes, such as identifying "promising ideas" (Chen, Scardamalia, & Bereiter, 2015), iterating on plans based on new inputs, or identifying areas for further research.

Study 2: Multimodality and social connection

Study 2 introduced multimodal digital storytelling to address this. Students produced 18 digital stories, stitching together video and plasticine modeling to explain the salmon life cycle. While engagement increased, the artifacts often functioned as "end-of-term essays"—culminating products rather than improvable ideas. StAS scores remained high, indicating that while the medium had changed, the epistemic mode remained reproductive.

However, a crucial shift occurred in the social dynamics. Students began to exhibit characteristics important for sustained creative work: social-emotional connection (Immordino-Yang, 2016). Students posted congratulatory build-ons to convey feelings upon watching peers' videos:

> "Love your video... I didn't know that they eat that kind of food."
>
> "Wow that video taught me a lot Thanks."

This suggests that a Knowledge Building community was forming. Furthermore, we observed early attempts at collective theory building. In one thread discussing how salmon return to their birthplace, students built on each other:

Student A:	My theory - salmon can smell
Student B:	My theory - They memorize the smell of the place they were born in
Student C:	They can all lay 3000 eggs in the same place and there will be 3000 *so it will be 3000 x 3000 and then hunman can get the really big salmon*

This indicated that while reproduction was still high, the community was becoming "safe" enough for risk-taking, a prerequisite for the "design mode."

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Study 3: Cross-community co-creation

Study 3 sought to deepen agency by creating a networked public. The initial design (Oct-Dec 2021) kept the Grade 2 and Grade 9 classes in separate Knowledge Forum views to prevent disruption. However, this separation created an "othering" effect. The Grade 9 students viewed the Grade 2s as subjects to be observed rather than intellectual partners, while the Grade 2s lacked access to the sophisticated vocabulary and technical knowledge of the older students. Ideas generated in one view effectively "died" in the silo, with no mechanism for uptake or improvement by the other group. The lack of a shared workspace meant that epistemic agency was restricted to the local level, failing to leverage the distributed expertise of the cross-age partnership. Over four months, note production was low (126 notes for Grade 9s).

In Term 2, a significant design change moved both classes into a single, shared Knowledge Forum view. The impact was immediate: the unified community created 595 notes in four months. The classes connected with domain experts—Grade 9s with a biologist on sustainable cities, and Grade 2s with an expert on indigenous salmon stories. This set the stage for a culminating design challenge: "How would you design a new neighborhood?"

The co-design process began with collaborative brainstorming in the shared space, which was then translated by the Grade 9 students into a shared Minecraft simulation (Figure 1).

Figure 1

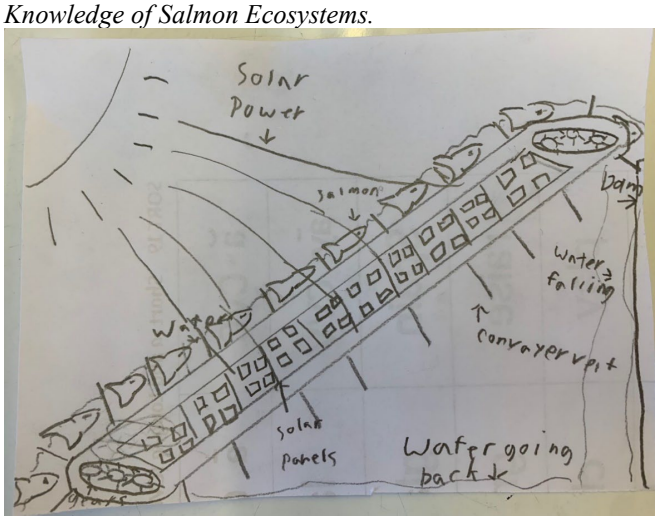
The Translation of Community Ideas into a Shared Artifact: The Grade 9 Students' Minecraft Simulation of the Co-Designed Neighborhood.



This partnership facilitated a shift to "design mode," enabling deep knowledge synthesis. The Grade 9 students confirmed this in interviews, noting that the Grade 2s "came up with the ideas, we researched and tried to see how it could work." This bond led to rotating leadership (Ma, Matsuzawa, & Scardamalia, 2016); at times Grade 2s led on salmon ecology, while Grade 9s led on energy sustainability. A powerful example of this synthesis is a Grade 2 student's design for a "solar-powered elevator to circumvent human dams" (Figure 2).

Figure 2

An Example of Knowledge Synthesis: A Grade 2 Student's Design for a "Solar Powered Elevator," Integrating Grade 9 Concepts of Sustainable Energy with Grade 2 Knowledge of Salmon Ecosystems.



This artifact represents a "rise-above" synthesis. The student explicitly integrates the Grade 9 students' research (solar power) with their own deep contextual knowledge (salmon migration). Unlike in Studies 1 and 2, the student is not repeating facts but proposing a novel technical solution, demonstrating a clear emergence of epistemic agency.

Discussion and implications

This study demonstrates that cultivating epistemic agency is a progressive, intentionally designed process.

1. *The Power of the Public Community:* A key implication is that agency is fostered when the "public" for student ideas expands. Students moved toward sustained creative work when they understood their ideas served a real partner (the Grade 9 class). This shifts the relationship between students and learning from consumption to collective responsibility. Fundamentally, this shifts the relationship between students and learning as they develop greater ownership and willingness to self-direct their inquiry.
2. *Multimodality as an Equity Bridge:* Multimodality served as a critical tool for equity. In Study 3, drawings and simulations acted as a common language, allowing Grade 2 and Grade 9 students to collaborate meaningfully despite age differences, validating diverse forms of literacy. This dynamic disrupted the traditional "expert-novice" hierarchy often seen in cross-age tutoring. Typically, the older student "teaches" the younger. Here, a reciprocal interdependence emerged: the Grade 2s provided the creative constraints based on their deep empathy for the salmon, while the Grade 9s provided the technical solutions based on their research into sustainability. The shared visual language of Minecraft and drawing leveled the playing field, allowing the younger students to lead the conceptual design while the older students led the technical implementation.
3. *Analytical Tools for Knowledge Building:* Finally, the StAS tool offered a diagnostic capability, identifying the prevalence of information reproduction in early phases. Future work should focus on developing such analytics to track the "rise-above" quality of synthesis seen in Study 3, further bridging the gap between classroom practice and Knowledge Building theory.

Limitations and future work

While this longitudinal study provides a rich account of cultivating epistemic agency, the findings should be interpreted within two specific boundaries.

First, the context was highly favorable: a single independent school with small class sizes and a dedicated teacher who participated across all three years. While this continuity allowed for deep iteration, it limits the immediate generalizability of the findings to resource-constrained public settings. Future work should explore how these design principles—specifically the cross-age partnership—scale in larger, more diverse classrooms where coordinating schedules between Grade 2 and Grade 9 poses greater logistical challenges.

Second, the StAS tool, while promising, serves as a proxy for epistemic change rather than a direct measure of idea quality. The tool measures semantic distance from authoritative texts; it does not inherently distinguish between a "misconception" (which is also semantically distant) and a "rise-above" synthesis. In this study, qualitative coding was required to validate that lower StAS scores corresponded to productive idea generation. Future development of the tool aims to integrate "promisingness" filters (Chen et al., 2015) to automatically distinguish between noise and genuine knowledge advancement.

Finally, regarding the qualitative analysis, we acknowledge the limitation of a single coder. To mitigate bias, we employed prolonged engagement in the field and peer debriefing strategies. Future iterations of this work will employ multiple coders to establish inter-rater reliability, particularly when classifying specific types of epistemic moves in the discourse.

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