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## Applying the Design Framework to Technology Professional Development

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### Abstract

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*Building on contemporary research on teacher professional development, this study examined the practices of a technology-focused learning community at a high school in the United States. Over the course of a school year, classroom teachers and a university-based researcher participated in the learning community to investigate how technology can promote student achievement and engagement within the secondary English curriculum. This analysis used the design framework to identify key practices within the learning community, which included writing a mission statement, innovating with digital tools, engaging in critical discussion, and examining student work. Findings suggest that the design framework can offer a common discourse and visual representation to guide the design, implementation, and evaluation of professional development. (Keywords: technology, professional development, learning communities)*

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Research suggests that sustained, content-focused professional development is associated with positive changes in teachers' instructional practices (Desimone, Smith, & Ueno, 2006; Garet, Porter, Desimone, Birman, & Yoon, 2001). However, many inservice programs are short term and do not account for the ways that teachers learn (Borko, 2004). In terms of technology integration, this means that professional development is often ineffective and does not value teachers' sense-making processes, instructional practices, and beliefs about technology (Curwood, 2011a; Mouza, 2009).

Due to the increased focus on teacher accountability and student achievement,

Hochberg and Desimone (2010) argue that two key mechanisms of professional development are improving teachers' knowledge and fostering beliefs that align with reform initiatives. To that end, Desimone (2009) posits that it is important to account for "a theory of teacher change (e.g., that professional development alters teacher knowledge, beliefs, or practice) and a theory of instruction (e.g., that changed practice influences student achievement)" (p. 185), both of which are necessary to fully understand what makes professional development successful.

If our goal is to use digital tools to foster student learning, then teachers need access to effective professional development to cultivate their skills, beliefs, and practices with technology (Ertmer, 2005; Pickering, Daly, & Pachler, 2007). The present study explores the design, implementation, and evaluation of a technology-focused learning community at a high school in the Midwestern United States. Over the course of one school year, English teachers engaged in hands-on learning, critically considered the relationship between technology and pedagogy, designed new lessons, and analyzed student work. In this paper, I use the design framework (Halverson, Halverson, Gnesdilow, Curwood, Bass, & Karch, 2010) to identify key practices of the learning community and understand how they shaped teachers' technology integration within the secondary English curriculum. This analysis focuses on the following questions:

- What were the features and outcomes of this professional development initiative?
- What practices of the learning community promoted technology integration?

### The Design Framework

Design-based research involves making the implicit aspects of design explicit. It aims to produce new theories, artifacts, and practices that shape teaching and learning (Edelson, 2002; Barab & Squire, 2004). To facilitate this process, the use of representations can be instrumental. Representations are cognitive tools that facilitate the development of new knowledge (Norman, 1994). When representations are used within design-based research, they can create a shared discourse. The design framework can be understood within a theory of distributed cognition, where knowledge is distributed across individuals, contexts, and resources (Hutchins, 1993; Pea, 1993). Distributed cognition has significant implications for teacher learning and the design of professional development. Specifically, it suggests that, to cultivate teachers' instructional practices with technology, transmission models of professional development may be less effective than approaches that incorporate collaborative, hands-on, and self-directed learning.

The design framework functions as a cognitive tool and serves as a visual representation of the design process (see Figure 1, p. 90). The design framework centers on the construction, implementation, and evaluation of educational *artifacts*, which can be designed in local contexts or received from external sources (Halverson, 2004; Halverson & Halverson, 2011). They can take many forms, including large-scale educational reforms, school district initiatives, or individual lesson plans. Within a theory of distributed cognition, it is critical to look beyond an individual to understand how that individual interacts with materials, resources, and other people in

a given environment (Gomez, Schieble, Curwood, & Hassett, 2010). According to Halverson and Clifford (2006), studies that focus on an individual's knowledge and skills "miss the critical interactive aspects of how actors and artifacts together constitute practice" (p. 585). The features of a given artifact emerge from the *intentions* of the artifact's designers, such as promoting teacher accountability or improving student learning outcomes. Designers cannot always predict whether users will perceive these features as *affordances*. In fact, the designer may or may not have intended what users view as an affordance of a specific feature (Halverson et al., 2010).

Within the design framework, the *consequences*, or intended outcomes, are directly informed by the artifact's affordances and how users perceive them. Through an analysis of the consequences of a design, it is possible to see how well they relate to the original intentions. This allows us to ask whether, as a direct result of the implementation of this design, teachers used technology to a greater degree to promote student learning.

Finally, the design framework is subject to the *critical* perspective, which emphasizes how designs operate within particular social, historical, cultural, and political contexts. Far too often, when one design fails, the solution is to quickly move on to another design. The design framework, as a visual and temporal representation, encourages the close analysis of the relationship between designers' intentions, artifact features, users' perceived affordances, and outcomes. Consequently, it promotes fidelity within educational research and facilitates communication among key stakeholders (Halverson et al., 2010).

The design framework can be used before, during, or after the creation of an artifact. In this paper, I conceptualize a technology-focused learning community as an artifact in order to understand the key features, consider how they function as affordances or constraints, and examine the outcomes. I then apply the design framework to a study of a professional learning community.

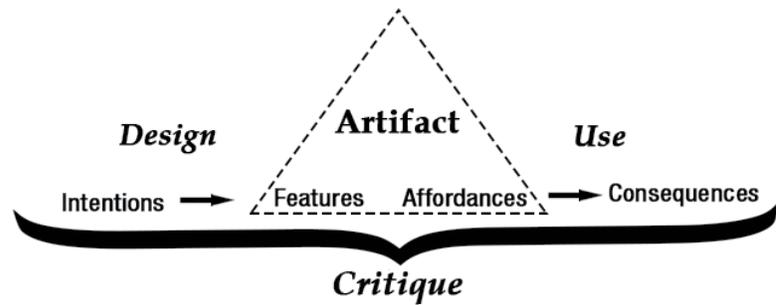


Figure 1. Visual representation of the design framework.

## Research Design

### School Contexts

Both of the research sites for this study, Avon and Milltown High Schools, can be characterized as technology-rich schools. (All names of cities, schools, and research participants have been changed). Avon High School had 1,500 students and 500 networked computers, with a 3:1 ratio of students to computers. Compared to nearby high schools, Avon had a higher number of computer labs, more recently updated hardware and software, and an increased use of interactive white boards and handheld devices. In addition, the school had more support staff, such as library media specialists and technology coordinators, who were available and interested in working with classroom teachers to design, implement, and reiterate lessons that integrated technology. Two of the school's annual goals focused on educational technology, and teachers were required to integrate technology into their content instruction. To measure these goals, teachers were required to submit evidence of how they integrated technology into their instruction. They were also asked to complete reflections and rubrics for each relevant lesson to identify the level of critical thinking and problem solving required of students. According to the year-end report, 93% of teachers were successful in meeting these goals, and over the course of the year, a total of 340 lessons integrated technology.

## Participants

As a university-based researcher, I served as the facilitator of these schools' professional learning communities. At Avon High School, the focal research site in this paper, five English teachers volunteered to participate in the school's learning community, which met once during the summer and bi-monthly over the school year. With one exception, all participants described themselves as novices with technology who used it only for the purposes of word processing, giving presentations, and creating blogs. One teacher had integrated other tools, such as social bookmarking, collaborative writing, and video editing.

## Data Collection and Analysis

In this study, I employed qualitative research methods and collected multiple forms of data. This approach allowed me to examine how professional development shaped technology integration and provided a way to analyze specific practices of the learning community. I used an ethnographic case study design (Curwood, 2011b) and looked at multiple forms of data across time and space. This included (a) an initial survey of teachers' knowledge of technology, content, and pedagogy; (b) 10 hours of transcribed audio recordings of interviews with participants; (c) 20 hours of transcribed video and audio recordings of learning community meetings; (d) field notes of my observations within the learning communities; (e) teachers' written reflections; and (f) artifacts, including school district policies and teacher lesson plans.

**Table 1.** Avon Research Participants

Name	Role	Age	Years of Teaching Experience	Relationship with Technology
Alice	English teacher, learning resource specialist, and department head	40	16	"My tech skills are developing. . . . I'm comfortable with using technology." (Interview, June 2009)
Rebecca	English teacher	58	27	"[Social media] creates panic in me. . . . The amount of time to manage it seems onerous." (Meeting, September 2009)
Kyle	English and art teacher	59	22	"Technology: I love it and I hate it." (Interview, June 2009)
Sara	English teacher and learning resource specialist	54	25	"I'm aware of the advantages of technology. . . . I know very little about hardware and software." (Interview, June 2009)
Elizabeth	English teacher	51	24	"With technology, I'm a beginner. . . . My students are much more comfortable with technology." (Interview, June 2009)

At the onset of this study, I used part of a quantitative survey developed by Schmidt, Baran, Thompson, Koehler, Mishra, and Shin (2009) to assess teachers' self-reported knowledge of technology, content, and pedagogy. I employed this survey at the beginning of the study to measure teachers' self-reported knowledge in these areas on a scale of 1–5. Teachers' scores averaged 2.668 for technology knowledge, 4.468 for content knowledge, and 4.572 for pedagogical knowledge. Notably, teachers reported substantially less knowledge of technology compared to the other two areas. However, as veteran English teachers, Avon participants were able to bring their years of experience in the classroom to bear on their work integrating technology.

Drawing on ethnographic approaches to data analysis, I then used thematic analysis (Boyatzis, 1998; Saldaña, 2009) to perform several repeated rounds of qualitative coding as well as discourse analysis (Bloome, Carter, Christian, Otto, & Shuart-Faris, 2005; Gee, 1999) to closely examine specific interactions within meetings of the learning community. For a full list of coding categories, see Table 2. I began by reviewing all data sources and focusing on the codes related to the affordances and constraints of media and technology. As this analysis conceptualizes the learning community itself as an artifact, these codes often

shed light on the core practices of the community that positively shaped teachers' technology integration.

## Results

### ***Intentions of Technology-Focused Professional Development: Creating a Mission Statement***

With professional development, it is vital that teachers and facilitators jointly shape the intentions. Not only does this value teachers' local knowledge, it also directs the content, scope, and goals of the professional development. In the first meeting of Avon's learning community, I began by posing a question to the group: "When your students leave your classroom at the end of the year, what skills, values, dispositions, or knowledge do you want them to have?" In phrasing this question, I intentionally avoided mentioning media or technology. Instead, I wanted the group to focus on students' learning outcomes rather than on digital tools. This led to a rich discussion in which teachers considered students' problem-solving, critical-thinking, and research-related skills; attention to audience and purpose; ability to work independently and in groups; communicative skills across multiple modes; self-awareness and self-advocacy; ability to access multiple resources; global citizenship; awareness of media bias; and ability to adapt to

**Table 2.** Coding Categories

<b>Instruction</b>
Metacognition
Design
Assessment
<b>Self in a Digital World</b>
Learning
Identity
Agency
<b>Artifacts in a Digital World</b>
Permanency
Accuracy
Ownership
<b>Affordances of Media and Technology</b>
Self-Advocacy
Research Skills
Problem Solving
Critical Thinking
Organization
Local and Global Connections
Engagement
Communication
Collaboration
Audience Awareness
<b>Constraints of Media and Technology</b>
Time
Inappropriate Use
Bias
Access
Comfort Level

emergent technologies. Throughout this discussion, teachers looked beyond narrow definitions of literacy and learning, such as when Elizabeth said:

I want students to be able to be able to advocate for themselves, make the shift from the parents being responsible to the kid being responsible. I want students to know generally how a scoring rubric is constructed. I want them to gain a continuing understanding of self-awareness, what their strengths are, what their interests are.

By seeking to cultivate students' sense of identity and personal responsibility, Elizabeth argued that these are often necessary before a student can actively engage in school-based learning.

Within the design framework, intentions become valuable when they are explicitly discussed and negotiated within the context of artifact creation.

As the teachers shared their desired student learning outcomes, it helped to set the focus for our learning community. Several key themes related to technology in general emerged here, including participatory learning, multimodality, and critical media literacy. As a facilitator, I chose to pick up on them and ask, “How are you presently using technology to reach some of these goals? Instead of thinking of technology as a means to an end, how could you use it as a powerful learning tool?” Alice, Rebecca, Kyle, Sara, and Elizabeth shared various ways they had integrated technology into the classroom to date, such as creating a class website to encourage students’ self-reliance, using VoiceThread to foster students’ literary analysis of a poem, and having students use Google Docs on collaborative research projects. During this discussion, Alice, the department head, noted, “[Our department] has show and tell ... sometimes. There’s always something new going on.” But while teachers shared lessons with other grade-level teachers, they didn’t necessarily know what technical skills students had acquired in previous English classes or how other teachers were using specific digital tools to facilitate students’ learning and engagement. In this respect, the discussion around the intentions of our learning community was a way for teachers to critically reflect on their current practices and consider different approaches to technology integration across the grades. By setting our intentions, it made certain practices and beliefs visible—and then open to change.

At the end of the meeting, we drafted a mission statement (see Figure 2) to clarify the desired learning outcomes for students and conceptualize the role of digital tools in their English classes. This document is important for several reasons. First, Avon High School’s technology initiative meant that all teachers were expected to use digital tools at least once per year. Teachers, then, operated on the *tacit assumption* that their colleagues were using technology to some degree. However, the English Department had not engaged in sustained dialogue about how technology could

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**We believe that Avon students should be able to use technology to:**

- Think critically in order to solve problems
  - Access, evaluate, and utilize multiple resources for a specific objective
  - Learn and troubleshoot digital tools
  - Foster involvement in a global community and a curiosity about the world around them
  - Communicate with diverse audiences for various purposes
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Figure 2. Avon learning community’s mission statement.

be used to facilitate student achievement and engagement. Second, the work involved in creating a mission statement moved the teachers away from operating under tacit assumptions to *stated intentions*. Not only did this clarify our goals for student learning, it also solidified our objectives as a professional learning community. Over the school year, we were then able to return to this mission statement to guide our collaborative work.

**Features and Affordances of Technology-Focused Professional Development: Hands-On Learning with Digital Tools**

Harris, Mishra, and Koehler (2009) explain that professional learning with technology is often marked by software-focused initiatives, large-scale technology-based educational reform efforts, structured and standardized professional development workshops, technology-focused teacher education courses, and demonstrations of sample lessons. They state, “Though different from each other, these approaches tend to initiate and organize their efforts to the educational technologies being used, rather than students’ learning needs relative to curriculum-based content standards—even when their titles and descriptions address technology integration directly” (p. 395). As the learning community’s facilitator, I knew that teachers would need time to learn about and explore new tools. Although I sought to avoid a technocentric approach, I also recognized that before teachers can make informed pedagogical decisions about technology, they must first know how to access, operate, and innovate with ever-changing digital tools (Curwood, 2012).

At the beginning of the study, most Avon teachers reported using a minimal amount of technology in the classroom. During the first semester, Alice and I often demonstrated various tools in a lab setting and supported other teachers as they learned how to navigate them. As a group, we then critically discussed how teachers could use a specific tool within the English curriculum and how it was qualitatively different from other ways that students could engage with literature and with each other. We intentionally focused on depth rather than breadth as we investigated different digital tools, such as blogs, discussion boards, and social bookmarks. When Alice and I shared a new tool, we provided a handout that gave an overview of the tool, relevant links, and space for note-taking. But we also added specific questions to aid teachers in designing, implementing, and reflecting on technology integration (see Figure 3). Consequently, the hands-on learning with digital tools and written reflections were key features of our learning community. As the facilitator, I designed these features, but they only became salient when teachers viewed them as affordances.

During the second semester, it seemed as though the teachers began to make progress in moving from legitimate peripheral participation to central participation (Lave & Wenger, 1991) as they designed and implemented technology-rich lessons. In terms of the design framework, the key features of the learning community—hands-on learning, critical reflection, and sustained dialogue—were instrumental during this process. As a result, this led our learning community to focus on the design of learning opportunities and the analysis of student

- If I wanted to use this in my classroom, what resources would I need, such as hardware, software, lab space, or wireless Internet access?
- What is my learning curve with this tool? How much training would I need to use it, and who could help me?
- How could I use this tool in lessons or units that I currently teach? Which ones would it fit well with, and why?
- By using this tool in my classroom, what are my anticipated student outcomes?
- After using this tool, what were my actual and observed student outcomes?
- After using this tool once, how would I modify or change how I used it in the future?

Figure 3. Avon learning community's reflection questions.

work with digital tools. At the end of the study, Kyle reflected on this process:

[Being a part of the learning community] absolutely has increased my use of digital tools.... We're all motivated by different things, but there's clearly a little peer pressure when you participate in a group and you commit to a circumstance and a focus. I found myself deliberately moving to adopt things that I might otherwise not have, or I might have told myself not yet, I'm not ready.... I could have provided excuses. The simple commitment piece was important for me. And, as it turned out, I learned a lot in the process about that.

It's important to note that Kyle's self-reported use of digital tools coincided with his collaboration with other English teachers to integrate online discussions in Advanced Placement English. Instead of just increasing his comfort level with digital tools, the learning community was a way for him to use technology to promote students' asynchronous communication and critical engagement with literature in an online space. Data analysis indicated that this collaboration outside of the learning community was instrumental in moving teachers to central participation within a technology-rich environment. Sara, for instance, did not share a common class with anyone within the learning community and sometimes struggled to conceptualize how she could integrate digital tools in meaningful ways.

### ***Consequences of Technology-Focused Professional Development: Focusing on Student Work***

Throughout the year, I found that teachers could readily discuss their beliefs about technology and were willing to engage in hands-on learning with a variety of tools. However, the shift to designing, implementing, assessing, and reiterating instruction with technology was more challenging. When teachers share student work as part of their professional development, it makes their instructional practices public, enhances the quality of their teaching, and improves students' subject learning (Garet et al., 2001). Research by Little, Gearhart, Curry, and Kafka (2003) found: "What teachers made of a given piece of work—the accomplishments or creativity they recognized, the struggles they detected—reflected their own conceptions of the subject area and of what it means to teach and learn it" (p. 189). Therefore, midway through the school year, I intentionally added a focus on student work to the learning communities to support teachers during the process of instructional design. Within technology-focused professional development, it can be challenging to create a balance between what Lankshear and Knobel (2006) call the "new technical stuff" and "new ethos stuff" of digital literacies. As I noted earlier, teachers need hands-on experiences with the "tech stuff" in order to learn about a variety of digital tools and work to integrate them into the English curriculum. To turn the focus to the "ethos stuff"—or the kinds of learning and thinking that can hap-

pen with technology—I decided to turn to student work.

The design framework supports an added focus on student work within the learning community by emphasizing the match between stated intentions and eventual outcomes. At the beginning of the school year, the creation of a mission statement helped us move from tacit assumptions to stated intentions. Within a longitudinal study of professional development, researchers and participants can sometimes lose sight of their original goals. By taking a design-based approach, I continually referred to our mission statement and sought to address how students could use technology within the English curriculum. At the onset of the study, a focus on student work was not one of my intended features of this project. However, by adding it midway through the study, a closer coupling between the intentions and consequences of our work together arose.

As I analyzed the video recordings and field notes from our meetings, I found that some teachers explicitly discussed how students were using the digital tools to think critically and work collaboratively. These were powerful moments that drew our focus to the process of student learning, rather than to the function of digital tools. As a result, these unintended features of the artifact served as affordances. As the facilitator, I chose to capitalize on this and add a focus on student work to the remainder of our meetings as a learning community. For example, Rebecca investigated how online threaded discussions in a Ning could be a way for her students to engage in peer review. She asked students to e-mail her their first drafts of their essays, and she gave them formative feedback. After the students revised their essays, she asked them to post their first paragraphs online and then read each other's essays. Rebecca gave specific questions to students to use as they offered constructive criticism, such as, "Is the thesis clearly stated? Does the topic sentence extend the how or why of the thesis? Are the quotes aptly selected? Do the warrants extend the thinking and do they provide enough context?"

Rebecca then brought up several examples on the projector and identified specific instances where students offered concrete suggestions for their classmates:

**Rebecca:** It's a real audience for the kid. And the kids, I think, are giving pretty good feedback to improve the thinking of the paragraph, and it's not just coming from me!

**Alice:** And it's captured so you can look at it, and they can't delete it by mistake [like they could in Google Docs].

**Rebecca:** I could use this as a teaching lesson.... But look at this, this is Tia. "Really good quotes. They really go along with what you are saying in your thesis. Maybe try and tell more about the explanation of it." Now, that's not particularly clear, but she's thinking on it. So I moved that kid! Because that's one of the things I saw in the first draft [that they sent just to me]. They can find the thesis, they can find the topic sentences, they can find the evidence, but they don't develop their warrants. And now the first step in fixing it is recognizing it, right? So can they recognize it, and then do they know how to fix it? I was just so excited about this.

In this exchange, Rebecca highlights how participatory learning and audience awareness (Magnifico, 2010) can be critical factors in developing students' writing skills. An additional feature of the learning community becomes relevant here: teachers' subject matter expertise and pedagogical knowledge. With the exception of Alice, all of the other teachers were in their 50s and had decades of teaching experience. This wealth of knowledge, coupled with prior experiences participating in communities of practice at Avon High School, served as a key affordance that allowed them to engage in a careful and critical examination of student work. The various features of the learning community, then,

worked together to support our stated intentions in the mission statement, our learning process with technology, and our examination of student outcomes.

### Discussion and Conclusion

Scholars have offered numerous critiques of traditional schooling, which often emphasizes decontextualized skills, rote memorization, and disembodied learning (Gee, 2004). However, most approaches to technology integration through professional development have simply replicated this ineffective model by focusing primarily on digital tools and technology skills and consequently have neglected to take teachers' own experiences, values, beliefs, and ideas into account (Ertmer, 2005). In other words, when digital literacies are presented as isolated skills, teachers by and large have been unable to effectively integrate them into their curriculum.

Wenger (1998) challenges the notion of learning as an individual, skill-based experience and asks:

What if we adopted a different perspective, one that placed learning in the context of our lived experience of participation in the world? ... What if ... we assumed that learning is, in its essence, a fundamentally social phenomenon, reflecting our own deeply social nature as human beings capable of knowing? What kind of understanding would such a perspective yield on how learning takes place and on what is required to support it? (p. 3)

This calls into question traditional models of professional development that focus on isolated skills or tools, which function to deprive individuals of agency and discount the importance of social learning. Decades of research on teacher professional development soundly support reform-oriented approaches, such as learning communities that feature a content focus, active learning, and collective participation over time (Desimone, 2009; Garet et al., 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Putnam & Borko, 2000).

This study builds on this research to suggest how the design framework can inform the work of technology-focused professional development. Here I have used the design framework post-hoc to analyze the developmental process and the effectiveness of a learning community. This served to make some of the implicit aspects of design explicit (Edelson, 2002) and highlight the most effective practices within the learning community. The mission statement, for instance, set our goals and intentions. As the facilitator, I intentionally added a focus on digital tools as a feature of our learning community. Over the course of the year, a focus on student work became an added feature and contributed to the close match between our stated intentions and the eventual outcomes of our work together. Notably, this included using digital tools in the English curriculum to foster students' achievement and engagement.

If technology is to become a central part of school-based learning, I argue that we must focus on how professional development can support teachers and positively affect student learning. This necessitates changes in how our schools enact educational policies, support digitally mediated learning, and design professional development. The design framework offers a common discourse and visual representation to guide such work. As Wilson and Berne (1999) propose, "The future of good research on teacher learning of professional knowledge lies in our ability to weave together ideas of teacher learning, professional development, teacher knowledge, and student learning—fields that have largely operated independent of one another" (p. 204). To this end, the design framework provides a cognitive tool that researchers and teachers can use to plan professional development, communicate their beliefs and practices, and assess the effectiveness of technology-infused lessons.

The National Educational Technology Plan (U.S. Department of Education, 2010) highlights the importance of learning communities and argues that professional learning "should support

and develop educators' identities as fluent users of advanced technology, creative and collaborative problem solvers, and adaptive, socially aware experts throughout their careers.... Technology-supported informal learning communities can connect teachers to university experts in content domains and in pedagogy" (p. 45). However, it does not suggest specific practices that can support teachers as they strive to integrate digital tools into the curriculum.

This study draws on the design framework to show how the use of a common discourse and representation can aid in the analysis of a technology-focused learning community. It also suggests that teachers and researchers need to critically consider the relationships among a professional development initiative's stated intentions, features, affordances, and eventual outcomes.

Future research can investigate how the design framework may be used in the initial design and during the process of implementation of technology-focused professional development.

At the end of the school year, Alice said that the learning community was integral to her professional growth: "I think what it did was change the way I used technology to be smarter, better thought out, more critical in terms of purpose and audience and technique. I feel I have developed a better skill in trying to match the tool with the task. I'm not as blind as I was before."

### Author Notes

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