Understanding Collaborative Design Practice Through Self-Study

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Designing online teacher professional development (oTPD) grounded in participatory practices is complex. An intense interdisciplinary collaboration of teacher educators, online learning experts, and instructional designers is needed. Achieving shared understanding is essential for successful collaboration, yet varied perspectives of interdisciplinary experts can cause tensions. Under the right conditions, conflict can be positive and productive. This study of collaborative design practice examined the process of aligning technology and pedagogy when designing participatory oTPD using the self-study methodology. Data analysis revealed relevant interrelationships and uncovered a consistent pattern related to purposeful use of technology.

While self-study was an effective inquiry method and provided valuable insights into our practice, it also fostered an environment of trust and collaborative knowledge exchange necessary for successful joint problem solving, cognitive synchronization, and innovation in interdisciplinary design teams.

Introduction

Teacher professional development (TPD) is critical for improving the quality of education and helping students acquire complex 21st-century skills (Darling-Hammond et al., 2017; Fischer et al., 2018). Effective TPD programs assist teachers in developing research-based pedagogical expertise as well as nuanced responses to emergent dilemmas and situated problems encountered in everyday practice, which necessitate shifts in beliefs, attitudes, knowledge, and practices, i.e., teacher change (Desimone & Garet, 2015; Guskey, 2002). Research has consistently identified TPD characteristics associated with teacher change and enhanced student achievement as being situated, collaborative, inquiry-oriented, and incorporating principles of active and adult learning theories within professional communities of practice (Borko et al., 2010; Darling-Hammond et al., 2017; Dede et al., 2009; Desimone & Garet, 2015; Penuel et al., 2007). Teachers' attitudes, beliefs, knowledge, and practices are further transformed when they see modeling of effective practices, experience them from a learner's perspective, integrate learning with issues in their daily practice, have opportunities for reflection, and receive feedback and expert support (Mezirow, 1997; Guskey, 2002). We characterize these TPD approaches as participatory, recognizing learning as a transformation in contrast to content-driven and objectivist instructional methods that view the learning process as a transmission or a transaction.

In response to the COVID-19 pandemic and pressures for more flexible and cost-effective solutions, teacher educators worldwide are generating innovative online and blended approaches where teachers can actively engage in learning on demand and at their pace, including participatory online TPD (Lay et al., 2020). Although implementing specific TPD features is contextually dependent and varies substantially (Opfer & Pedder, 2011; Parsons et al., 2019), research suggests that integrating pedagogy-based characteristics positively impacts teacher change independently of the delivery mode (Borko et al., 2010; Dede et al., 2009; Fishman et al., 2013; Powell & Bodur, 2019). Specifically, the pedagogical theory behind designs rather than the medium determines the achievement of learning outcomes (Fishman et al., 2014; Moon et al., 2014), clarifying the media comparison conundrum in the TPD context.

This reasoning provided a foundation for a larger design-based research project, of which this study is only a small part. In partnership with several local school districts, our university

had a successful in-person TPD program that included distance education elements and integrated technology. To serve a larger population of teachers, especially teachers in rural areas, we needed to transform the program for online delivery, and we invited local online learning experts and instructional designers to help us accomplish that. The alignment of technology with pedagogy was particularly interesting during this project's phase. We wanted to ensure we purposefully used available technology to accomplish our pedagogical intents and adapted the program design and processes to meet those requirements. This study examined collaborative decision-making in the context of designing participatory online teacher professional development (oTPD) and focused on aligning technology tool choices with the underlying pedagogy requirements using the self-study methodology (Berry, 2015; LaBoskey, 2004).

Background Literature and Theoretical Framework

Designing online teacher professional development (oTPD) grounded in participatory practices is complex. Successful oTPD design solutions

> *need to be actively developed with an eye firmly on our best theories of how people, and teachers in particular, learn. The other eye needs to look toward the affordances of new technologies and how they might be incorporated … to support teacher (and student) learning effectively and efficiently. (Fishman et al., 2014, p. 263)*

This quote highlights three aspects that need to be considered. First, careful attention needs to be paid to how teachers learn and transform their practice, recognizing and utilizing pedagogies that bring about the needed teacher change (e.g., Borko et al., 2010; Darling-Hammond et al., 2017; Dede et al., 2009; Guskey, 2002). This can be accomplished through identifying core attributes within the design's pedagogical layer (Gibbons, 2014; Darling-Hammond et al., 2017; Dede et al., 2008; Guskey, 2002). Second, selected pedagogies and instructional strategies should guide choices of technology tools based on how they promote learning and meaning making (Antonenko et al., 2017; Bower, 2009; Graham et al., 2014; Fishman et al., 2013, 2014). Third, engaging and integrating various theories from related yet distinct fields of teacher education, online learning, and instructional design in coherent and strategic ways is necessary (Ertmer & Newby, 2016; West et al., 2020; Yanchar & Gabbitas, 2011). Such efforts cannot be successfully carried out by an individual or a group of educators from a single field. Intense interdisciplinary collaboration is needed (Darling-Hammond et al., 2017; Dede et al., 2009; Fishman et al., 2014). The following sections will examine these three points more closely.

Core Attributes and Design Layers

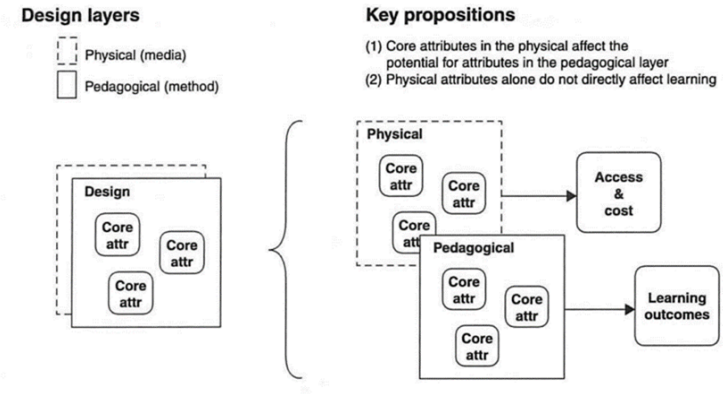
Successful oTPD solutions require careful attention to pedagogy during the design and development process. From teacher educators' perspective, this means bringing about teacher change by creating transformative learning experiences where deep knowledge and complex understanding emerge through dialogue and collaborative participation in carefully

designed, contextualized activities supported by experienced educators (Borko et al., 2010; Darling-Hammond et al., 2017; Dede et al., 2009). When these learning experiences occur in technology-mediated environments, design teams must carefully consider which technology tools to use to support teacher learning based on the functions those tools afford (Fishman et al., 2013, 2014; Hofmann, 2019).

Instructional designs can be conceptualized as structures of intersecting layers (Gibbons, 2014). Each layer has a function and is guided by its specific theories. Although layers may be viewed separately, they overlap and interact in multiple ways. "Decisions made within one layer constrain decisions within other layers either by eliminating or creating design possibilities" (Gibbons, 2008, p. 173). Synchronizing the layers improves overall instructional design and optimizes functionality. When designing oTPD, the two primary drivers are pedagogy and technology. To align these structures, designers should focus on the relevant design layers and adjust the remaining design to meet these primary conditions. Graham and colleagues (2014) simplified Gibbon's model to show how designers could research and manage design attributes to bring about desired learning outcomes, which was particularly relevant to this study. They explained that technology-mediated instructional designs could be envisioned as having two key layers: pedagogical and physical (See Figure 1). The physical design layer, exemplified by the surface features of presentation and delivery, is related to the medium, technology tools, and corresponding affordances. It strongly influences the cost and access options of the instructional solution, often making it the focus of the design and development process. The pedagogical layer and its core attributes are less visible, yet they enable the achievement of the desired learning outcomes and are critical for the overall success of the design (Graham et al., 2014).

Figure 1

A Visual Representation of Design Layers Proposed by Graham et al. (2014)



Core attributes within the pedagogical layer define the design's operational principles. It is the guiding instructional strategy, the essence of what makes the design work (Gibbons, 2014). A clearly articulated pedagogy-based instructional strategy could guide designers in deliberately arranging artifacts, orchestrating interactions, structuring interventions, and using technology to increase the likelihood of achieving intended outcomes. It directs designers in their choices of technological tools and how they are used for instruction, directly influencing which learning opportunities and experiences are available (Brown, 1992;

Gibbons, 2014; Graham et al., 2014). Graham and colleagues do not mention specifics of how to identify design core attributes and align the design layers. Brown, in her 1992 seminal piece, suggests we ground designing interventions in "theoretical descriptions that delineate why they work" (p. 143), asking ourselves, "what are the absolutely essential features that must be in place to cause change" (p. 173). Gibbons explains that to identify design's operational principles, researchers may meticulously isolate features and analyze their impact, while designers could take a more practical iterative subtraction and trial-and-error approach until they find the features without which the design no longer works as intended (2014).

Aligning Pedagogy and Technology

Several researchers focused on the process of aligning technology with pedagogy when designing technology-mediated instruction using the concept of affordances (e.g., Antonenko et al., 2017; Bower, 2008; Osborne, 2014). Affordances are broadly defined as 'action possibilities' that a tool provides to an actor (Bower, 2008). Bower (2008) proposed aligning the affordances of available technologies with the required affordances of learning tasks. Antonenko et al. (2017) suggested aligning the functional affordances of selected technological tools with the needs of learners and educators in specific educational contexts. Osborne takes on an ecological approach and suggests redefining affordances as 'transaction possibilities,' viewing technology as having the power to create environments suitable for intellectual work and collaboration, such as connecting, planning, negotiating, curating, editing, and reflecting (2014). He then puts forward the idea of using affordances as a design tool for aligning pedagogy and technology.

We carefully considered all these approaches and recognized that Bower's (2008) required affordances of learning tasks and Antonenko et al.'s (2017) needs of learners and educators were related to the core attributes within each design's pedagogical layer, i.e., what is needed pedagogically. On the other hand, the functional affordances of technological tools were related to Graham and colleague's physical design layer (2014), i.e., what technology can do and what kind of environments it can create. Viewing affordances as related to core attributes within individual layers creates a functional design tool to facilitate the alignment, enabling designers to intentionally select technological tools for pedagogical purposes and optimize the overall design solution (Antonenko et al., 2017; Bower, 2008; Graham et al., 2014; Osborne, 2014).

Collaborative Design

Collaborative design refers to the process of designing a product or solution through a collective effort involving multiple stakeholders—designers, subject matter experts, clients, users, and other relevant parties. Its main goal is to bring together diverse perspectives, knowledge, and expertise of different individuals to create a more effective, efficient, innovative, and sustainable outcome (Samaras et al., 2019; Tessier, 2020). In the TPD context, we often see co-design studies where teachers actively engage in collaborative design teams as a form of professional development, collaboratively adjust and develop curriculum, implement curriculum reform, and hone their knowledge, teaching practice, and design expertise in the process (e.g., Ke et al., 2023; Kelly et al., 2019; Ko et al., 2022; Severance & Krajcik, 2018; Penuel et al., 2022; Voogt et al., 2015, 2016). In contrast, this

paper focuses on the collaborative design practice of interdisciplinary experts, specifically decision-making related to aligning technology and pedagogy while designing oTPD. Teachers and program facilitators provided user feedback during evaluation cycles but were not directly involved in this collaboration.

Solving complex design problems, such as designing high-quality oTPD, demands intense interdisciplinary collaboration of experts with varied backgrounds. “Different team combinations can be put together according to the context and the problem investigated” (Tessier, 2020, p. 662). Careful orchestration of content, pedagogical, and technological expertise, as well as instructional design knowledge and skills, are needed. Our project engaged teacher educators and experts in online learning and instructional design. Each group brought the needed theoretical understanding and practical expertise from their discipline. Additionally, individuals had varied cross-disciplinary experiences. Literature suggests that interdisciplinary collaboration is conducive to creative thinking and innovation as varied perspectives of individual members help teams analyze broader contexts and solve multifaceted problems creatively (Augsten & Gekeler, 2017; Moirano et al., 2020; Severence & Krajcik, 2018; Tessier, 2020). Collaboration in interdisciplinary teams improves the resulting design, its enactment, and successful implementation. It also positively influences participants’ pedagogical knowledge, design knowledge, and related skills and practices (Samaras et al., 2019; Voogt et al., 2016).

Collaborative design efforts typically involve open communication, exchange of knowledge, shared decision-making, and a willingness to compromise to reach a common goal. In the early stage of the design process, the emphasis is on understanding the problem, defining constraints, establishing shared goals, brainstorming ideas, and finding an initial solution to the design problem (Tessier, 2020, 2022). Achieving shared understanding and a common mindset is essential for successful collaboration yet can be challenging due to tensions arising from different theoretical perspectives (Augsten & Gekeler, 2017; Piirainen et al., 2009; Tessier, 2020, 2022). We recognized early on that interdisciplinary collaboration between teacher educators, online learning experts, and instructional designers introduces many friction points and potential misunderstandings. Although all educators, each group has different goals and notions about learning, instruction, and design. Language use and terminology overlap but do not necessarily match. Views of the learner, the teacher, and their roles are different. Even overall theoretical orientation, specific theories and frameworks, and related methods may be fundamentally conflicting and seemingly incompatible. Tensions related to preferred models of instruction, the design process’s primary focus, and the theory vs. practice divide were particularly evident in our collaboration (Allman & Pinnegar, 2020). Such misunderstandings and frictions can be overcome by establishing an open atmosphere of mutual trust and respect, developing a commitment to working together, building a common language, and making reasoning explicit (Piirainen et al., 2009; Tessier, 2020; Samaras et al., 2019; Voogt et al., 2016). Others have suggested examining assumptions, both theoretical and philosophical, especially when incorporating multiple and potentially conflicting theories into the design (McDonald et al., 2005; Yanchar & Gabbitas, 2011). Thoughtful reflection and respectful dialogue allow group members to explore dilemmas and conflicts, uncover underlying assumptions and beliefs, and negotiate shared spaces (Tessier, 2022; Samaras et al., 2019).

As the project progresses, issues are covered in depth, participants share their tacit and disciplinary knowledge, join in decision making, and negotiate solutions capitalizing on each other's expertise (Tessier, 2020, 2022). Knowledge exchange and collaborative work stimulate the development of group members' individual expertise and the co-construction of new knowledge at the team level (Moirano et al., 2020; Samaras et al., 2019; Tessier, 2020; Voogt et al., 2016). However, integrating deep perspectives, generating novel ideas, and refining the design may introduce further tensions, disagreements, conflicts, and even epistemic clashes (Moirano et al., 2020; Tessier, 2020, 2022). Under the right conditions, the presence of conflict can be positive. It could overcome inertia, more deeply engage team members, focus group efforts, build stronger relationships, improve exploration of divergent viewpoints, and generate innovative solutions (Moirano et al., 2020). In fact, overcoming shared challenges and coming to an agreement in an environment of mutual trust may be one of the mechanisms for collaborative groups to iteratively build more robust communication systems, foster a higher level of cohesion, and transform working together into synchronized and synergistic efforts reflective of expansive transformation (Engeström & Sannino, 2010; Tessier, 2022; Voogt et al., 2015).

Purpose of the Study

This study of collaborative design practice examined decision-making in the context of designing participatory oTPD. Specifically, we explored the process of aligning pedagogy and technology using the self-study methodology. Two strands of inquiry were pursued: (1) to identify the elements, processes, and principles guiding the alignment of technology with pedagogy and (2) to better understand and improve our design practice and collaborative work.

Methods

The study was conducted within a larger design-based research (DBR) project (McKenney & Reeves, 2019) to redesign an in-person TPD program into an online modality while retaining its participatory character. The self-study methodology (Berry, 2015; LaBoskey, 2004; Pinnegar & Hamilton, 2009) guided the inquiry into the design process. It was selected as a suitable approach to guide a systematic and reflective examination of our situated practice to better understand and improve the practice (Pinnegar & Hamilton, 2009). Specifically, we examined decision making related to aligning technology with pedagogy during the oTPD design process by attending to the particulars and the context, reflectively uncovering assumptions and embodied understanding, and retrospectively reviewing enacted practice to identify patterns.

Self-study of teaching and teacher education practices, abbreviated as self-study, is a research methodology for collaboratively studying professional practice. Although typically conducted within teacher education contexts, it is applicable in other professional settings as "a way to move beyond technical rationality toward a more productive understanding of professional knowledge" (Bullock & Russell, 2012, p. 1). This relational ontology-oriented methodology positions investigators as the researchers and the researched, affording unique insights into patterns within the data (Berry, 2015). It is self-initiated, focused,

improvement-aimed, collaborative, uses multiple primarily qualitative methods, and defines validity as trustworthiness (LaBoskey, 2004). Rigorous cycles of dialogue with extant literature and critical friends—researchers, professionals, and practitioners—introduce multiple and alternative perspectives into the meaning-making process, enable a careful inspection of inquiry strands and emerging tensions, and allow an exploration of viable solutions (Hamilton & Pinnegar, 2017). The knowledge produced through self-study helps practitioners reframe their personal understanding of practice and stimulates the development of knowledge of practice within a practice community. Combining deep reflection about one's practice with reciprocal, thoughtful, and insightful feedback from peers in collaborative partnerships creates a hypothesis space where practitioners make tacit knowledge explicit. Over time, this understanding acts as a lever, transforming one's practice and building both individual and collective capacity (Samaras et al., 2019).

Participants and Data Sources

Participants in this study were the researcher, an instructional designer, and a senior teacher education faculty member. The researcher, a doctoral student in instructional design, has a background in applied linguistics and experience in TPD design, teaching, and research. The collaborating instructional designer has a Ph.D. in instructional design and broad K-12 teaching and online design experience. The senior faculty member, a teacher educator with extensive experience in curriculum design and pedagogies representing sociocultural theory, is also a scholar in narrative research and self-study qualitative methodologies.

Data consisted of nineteen collaborative conversation recordings and related artifacts analyzed in detail. Collaborative conversations took place regularly over six months; their average length was 60 minutes. The researcher analyzed recorded meetings and related artifacts working with the senior faculty member as a critical friend.

Procedures and Data Analysis

The following procedures within the self-study and DBR methodology guidelines were used to identify the elements, processes, and principles guiding the alignment of technology with pedagogy during oTPD design. First, the collaborative discussions and related artifacts were recorded, transcribed, and verified for accuracy, and the initial codes and conceptual categories were identified from the raw data. Process tracing (Bennett & Checkel, 2015) and constant comparative qualitative analysis techniques (Corbin & Strauss, 2008) were used to look beyond the initial codes for themes, patterns, and their relationships to the core phenomenon of aligning technology with pedagogy. The steps of standard qualitative analysis were followed (Cresswell & Poth, 2018). The process was iterative rather than linear, as data was continuously collected, analyzed, and interpreted, informing the subsequent cycles of inquiry. This recursive nature energized the research process and transformed our thinking, bringing new insights, uncovering oversights, generating additional questions, and revealing further directions (Pinnegar & Hamilton, 2009).

As part of the conceptual analysis, both similarity-based and contiguity-based relationships were explored (Maxwell & Miller; 2012). These two types of relationships are fundamentally different yet complementary and mutually support and improve the quality of qualitative data analysis. As is typical for qualitative research, similarity guided us to identify themes

based on the resemblance of common features. Attention to contiguity allowed the juxtaposition of data in time and space, identifying the 'actual' connections rather than the 'virtual' connections of similarities and differences, which was valuable while scrutinizing processes (Maxwell & Miller, 2012).

Trustworthiness

Trustworthiness in this study was established with multiple investigators, member checks, and reflexivity improving the account's credibility, dependability, and confirmability (Cresswell & Poth, 2018). Audit trail, exemplar validation, and negative case analysis were also used to increase the trustworthiness of the findings and reduce potential bias (LaBoskey, 2004). Additionally, attending to contiguity and similarity when exploring patterns in data guarded the researchers against overgeneralizing by aggregating data and losing diverse contextual connections potentially relevant to the analysis, further supporting the credibility of the findings and trustworthiness of the overall study (Maxwell & Miller, 2012).

Findings

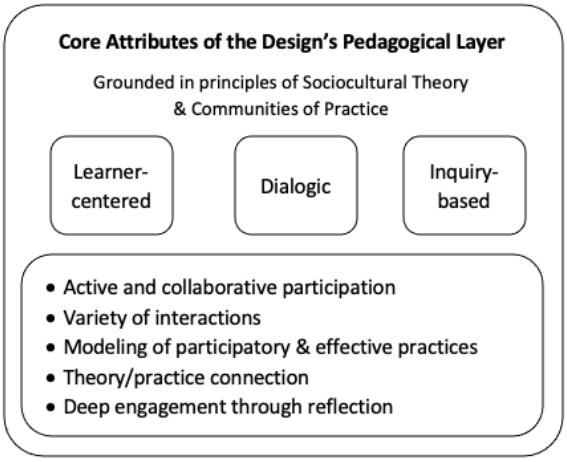
Several results are presented in this section. First, core attributes identified in the initial stages of the design process are reviewed. Second, themes identified in the analysis of collaborative conversations through axial coding are described. Third, patterns revealed by looking beyond themes for contiguity relationships are explained.

Design Core Attributes

During the initial design stages (i.e., front analysis), researchers identified design core attributes that were anticipated to lead to the desired learning outcomes. It was hypothesized that attending to the design core attributes during the design process would preserve the participatory character in the online modality and maintain the program's transformational power. The core attributes in the context of this study were determined based on the institutional and department specifications, extant literature related to effective TPD practices, and researchers' prior experiences with developing and implementing related endorsement programs. Other relevant design specifications, such as current state and federal requirements, also guided selection. The design core attributes were identified as (a) learner-centered, dialogic, and inquiry-based instruction grounded in principles of sociocultural theory and communities of practice, enacted through a design that (b) promotes active and collaborative participation, encourages a variety of quality interactions, models participatory practices, facilitates theory-to-practice connection, and fosters deep engagement through reflection (see Figure 1).

Figure 1

Identified Pedagogical Core Attributes



Themes Identified through Axial Coding

Next, the analysis of collaborative conversations carried out during the design and development stage revealed important elements related to the alignment of technology with pedagogy during the process. See Table 1 for a summary of themes and related elements identified from the data. Attention to tasks was identified as central to the alignment process. It was represented in the data as talking about one or more of the following: (a) the desired results of the instruction (e.g., overall goals, instructional objectives, learning outcomes), (b) acceptable evidence of learning (e.g., summative and formative assessments), and (c) learning activities and associated instructional components. All three elements were considered fundamentally interrelated, i.e., dynamically connected and mutually dependent.

Table 1

Themes and Elements Identified Through Axial Coding

Themes	Elements
Theme 1: Attention to Tasks	Desired results Evidence of learning Learning activities
Theme 2: Dimensions	Pedagogy Technology
Theme 3a: Core Components	Anticipated response to instruction Learners' needs Instructors' needs Task context
Theme 3b: Core Approaches	Collaboration Interaction Dialogic learning

Themes	Elements
Theme 3c: Core Methods	Modeling Scaffolding Coaching & mentoring Theory-to-practice connection Reflection
Theme 4: Quality and Effectiveness	Instructor support Course feedback Course evaluation

Two contexts or dimensions emerged from the collaborative discussions: pedagogy and technology (Theme 2 in Table 1). When tasks were discussed, it was done within either one or both dimensions. Ideas within the pedagogical dimension were related to identifying the learning event's parts or processes that would contribute to meeting instructional objectives and were tied to pedagogical thinking aiming to successfully 'translate' the learning event into an online modality. The dimension of technology represented similar ideas as the dimension of pedagogy. However, attention was paid to how the task could emerge in the online design, considering how available technology tools and their affordances might fulfill identified pedagogical purposes.

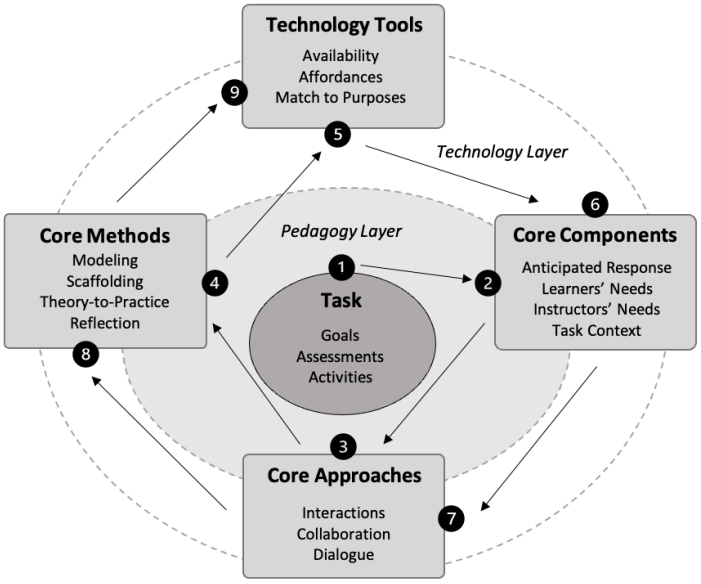
Analyzed data further suggested that the alignment between pedagogy and technology choices occurred as the participants paid attention to the core components of instruction (Theme 3a), strategically utilized core approaches to carry out the instruction (Theme 3b), and intentionally applied core methods to support the instruction (Theme 3c). The core components (Theme 3a) included ideas related to considering an anticipated response to the instruction, attending to the learner and their needs, attending to the instructor and their needs, and paying attention to the context of the task. The core approaches (Theme 3b) were represented as encouraging active collaboration, planning for a variety of interactions with content, peers, and the instructor, and facilitating learning through dialogue. The core methods (Theme 3c) were represented in the data as attending to modeling effective practices, scaffolding instruction, connecting theory to practice, and supporting regular and meaningful reflection. Finally, the theme of quality and effectiveness of the design with its elements represented topics related to instructor support, course feedback, and course evaluation (Theme 4 in Table 1).

Patterns of Contiguity-Based Relationships

Axial coding was further explored by looking beyond similarity for contiguity-based relationships, specifically temporal and spatial relationships within collaborative conversations (Maxwell & Miller, 2012). When the coding themes were reexamined with attention to the process (temporal relationship), a clear cyclical pattern appeared, confirming the existence of these themes in relation to each other (see Figure 2). Examining tasks (Theme 1) was at the center of the process, progressively attending to the core components (Theme 3a), making strategic choices using core approaches (Theme 3b) and methods (Theme 3c), followed by an intentional selection of technological tools to successfully enact specific tasks in an online modality (Theme 2). See Figure 2 for a visual representation of the observed process of alignment.

Figure 2

A Visual Representation of the Alignment Process



The process typically began with focusing on a learning task (1) represented by any or all its elements. Then the core components of instruction were examined (2): the learners' needs in specific contexts were considered, the learner's response to instruction was anticipated, and the needs of the instructor were considered. This was generally followed by attending to the core approaches (3), such as planning for a variety of quality interactions, active collaboration, and ways to promote dialogue. Next, the core methods that would support desired learning experiences were examined (4). This initial cycle of attending to pedagogy was followed by intentionally selecting technology tools that would enhance identified pedagogical purposes, attending to the tools' availability and affordances (5). Next, participants examined how the task would emerge as a learning experience for a learner using the selected technology, which involved attending to any or all of the core components (6), reexamining and adjusting types of interactions, collaborations, and dialogue required and enabled by the selected tool affordances (7), and finalizing and adjusting methods as needed (8). If necessary, more cycles were explored (9) until a satisfactory alignment of the pedagogical purposes with the affordances of selected technological tools was reached.

Discussion

This study explored the process of aligning technology with pedagogy in the context of collaboratively redesigning participatory oTPD courses. The goal was to better understand and improve our collaborative design processes and practice. To answer this study's research questions, we utilized the self-study methodology (Berry, 2015) within the design-based research approach (McKenney & Reeves, 2019). During the conceptual analysis, we also explored similarity and contiguity-based relationships (Maxwell & Miller, 2012).

Careful analysis of collaborative conversations revealed specific elements and interrelationships and uncovered a consistent pattern of aligning technology choices with the underlying pedagogy within the context of the study. Attention to tasks was identified as central to the alignment process, represented by desired results, evidence of learning, and instructional activities, reflecting the use of the backward design framework (Wiggins & McTighe, 2005) during the design process. Two dimensions were identified from the data. Tasks were always discussed either with attention to the underlying pedagogy or with a goal to enact the pedagogical intents in an online setting, taking advantage of the affordances of available technological tools. This finding is linked to our goal to align pedagogical and physical design layers (Gibbons, 2014; Graham et al., 2014) and to the iterative process of matching affordance requirements with the affordances of available tools (Antonenko et al., 2017; Bower, 2008; Osborne, 2014).

The analysis highlighted the importance of pedagogical thinking when designing oTPD. Although considering available technological tools with related affordances was essential, the underlying pedagogical thinking guided the alignment process and enabled the purposeful use of available technologies. Upon closer review, the core components paralleled Schwab's (1971) four commonplaces of curriculum making, suggesting that considering the learner, the teacher, the subject matter, and the milieu is valuable when designing online courses and individual tasks within those courses. Furthermore, identifying core approaches and core methods as key themes related to the alignment pointed to the utility of the core attributes during the design process, as suggested by Graham and colleagues (2014). Not surprisingly, core approaches and core methods resembled the core attributes identified during the front-end analysis. Repeated attention to these attributes suggested that pedagogical intent, a specific theory-based rationale, implicitly guided our design decisions and was the primary generator for the design under study. We defined pedagogical intent as a careful and repeated consideration of the intended learning experience for a specific group of learners in a specific context. It guided our selection of content, interactions, activities, and tools and their alignment with the affordances of available technology throughout the course design. Recognizing that theory-based rationale, design core attributes, and pedagogical intent are project-specific, offers the possibility to match the pedagogy to specific content-area and contextual requirements, revealing a flexible design principle.

Upon reflection, we realized that the alignment process and the process of bringing to light the details of our practice were only possible because of the close collaboration and specific expertise of partners working on the project. While self-study was a productive inquiry method and provided valuable insights into our practice, it also fostered an environment of trust and collaborative knowledge exchange necessary for successful joint problem solving, cognitive synchronization, and innovation in interdisciplinary design teams.

Implications for oTPD Design and Collaborative Design Practice

Designing a successful oTPD is multifaceted and requires rationales grounded in our current understanding of how teachers learn and carefully considering which technology tools could effectively and efficiently support such learning (Fishman et al., 2014). This demands a close

collaboration of teacher educators, instructional designers, and online learning experts, valuing and engaging each other's perspectives and expertise. The findings of this study indicate that it is possible to align the choices of technology with the underlying pedagogical demands and suggest how this could be done. Conceptualizing pedagogical thinking as pedagogical intent allowed us to attend to the pedagogy more purposefully when we made decisions about how we wanted specific learning experiences and tasks to turn out in a technology-mediated environment. Attending to pedagogical intent, rather than just focusing on learning objectives and outcomes or types of technology to be used, provided means for developing a more pedagogically driven and learner-oriented design and enabled purposeful use of technology. The presented pedagogy-driven design process may be informative to those who design technology-mediated instruction or need to convert in-person learning into online settings in any context. We recognize that all design solutions and processes are contextually dependent. Therefore, we do not expect practitioners to adopt our suggested practice. Instead, we hope they would consider broader concepts and principles presented in this study and employ those within the circumstances of their practice.

One feature of designing TPD is that it must center around pedagogy and pedagogical thinking. Teachers are not an easy audience. They recognize good practice and expect effective pedagogies to be part of TPD. Furthermore, modeling effective pedagogies and having teachers experience them firsthand positively impacts the adoption of these practices. Teacher educators are experts in teaching and understand this. They know what effective teaching looks like and how it is encouraged and designed. Their perspectives are valuable when collaborating in design teams.

Additionally, self-study as a methodology offered a powerful means of collaborative inquiry into our situated practice. Design professionals who want to better understand and improve their practice and collaborate in design teams may want to consider self-study as a valuable means of professional inquiry. Through its unique characteristics, self-study complemented the design-based research environment and facilitated collaborative work. It allowed the co-investigating participants to engage as critical friends in a dialogue generating the data and in a dialogue about the data while carefully attending to the context of knowledge construction (Hamilton & Pinnegar, 2017). Positioning the researchers as the researched offered a unique opportunity to understand the data firsthand (Pinnegar & Hamilton, 2009) and provided valuable insights into the design process decision making. The collaborative nature and shared interdisciplinary expertise within the unique coming-to-know process of self-study enabled negotiating robust solutions within the design constraints. It provided the right environment to intensely scrutinize our practices and bring multiple perspectives and expertise to action in the environment of trust. Self-study mediated open communication with peers and provided reflective and intense dialoguing opportunities. It created space for exploring dilemmas and tensions in an atmosphere of mutual trust and respect, leading to constructive resolution of conflicts and successful joint problem solving. Self-study has been reported as transformative for interdisciplinary collaborators due to its power to explore alternative viewpoints, foster deep understanding, and make complex connections (Pinnegar & Hamilton, 2009; Samaras et al., 2019). This was also our experience. The open and mutually respectful environment fostered by self-study enabled our design team to fully capitalize on the individual and group expertise. It encouraged effective collaboration, cognitive synchronization, and expansive transformation, resulting in creative design solutions (Tessier, 2020, 2022) and professional growth (Voogt et al., 2016).

Implications for Research

This study also presents notable implications for research. The study was conducted within a larger project guided by design-based research principles (McKenney & Reeves, 2019). The DBR approach fit the study's goals and guided the selection of specific methods and techniques to answer our research questions. As we closely collaborated with colleagues from the teacher education field, they suggested taking advantage of the self-study methodology (Berry, 2015) from their discipline and assisted team members in implementing this approach in the context of instructional design. We found that the self-study methodology integrated well with the design-based research. It was found suitable, accurate, and productive for studying collaborative design practice involving complex and sophisticated processes with the potential to generate reusable design principles and fine-grained theories.

This study also revealed the importance of attending to both similarity and contiguity-based relationships when exploring patterns and relationships among categories, especially when studying processes (Maxwell & Miller, 2012). Exploring relationships among data within its actual context and attending to data's temporal and spatial proximity and sequences revealed overarching patterns in the design process that would not have been visible otherwise. If we ignored the temporal flow of the data and looked only for patterns based on similarity, we might have missed the broad pattern of repeated attention to pedagogical intent, the construct that connected the elements of individual categories.

Limitations and Future Directions

While the current study outlines the alignment of technology with pedagogy during designing oTPD for this specific context and participants, there are limitations. Besides the apparent time and resource constraints, one methodological limitation arises from the fact that this study was exploratory and descriptive, looking for patterns in practice of only one group of collaborators, at one specific time, working on one project. The context of each course design is highly specific, and each collaborative design group and project is unique. Therefore, findings from this study are transferable to other design contexts only in limited ways. Another methodological limitation is related to the choice of self-study as a tool for inquiry. Positioning investigators as both the researchers and the researched affords unique insights into the data (Berry, 2015) but may weaken objectivity. To reduce potential bias, we used exemplar validation, negative case analysis, reflexivity, and member checks. However, it is important to keep in mind that the findings are still subjective. We explored our practice, pushed our boundaries, examined our assumptions and theoretical perspectives, and attended to conflicts and tensions that were important to us as a group and relevant to the project. Another potential limitation arises from the study's focus on the process of aligning pedagogy and technology. We could have focused on many other aspects of designing oTPD and collaborative practice. Still, many insights about effective interdisciplinary collaboration emerged as part of our inquiry. Specifically, how different perspectives, tensions, and epistemic clashes could be formative and lead to innovative thinking, creative design, and expansive transformation. The last limitation that we would like to mention is the lack of previous research studies on the topic. We found only a handful of literature about the alignment process, and no studies discussed the topic in the context of designing oTPD. Additionally, although we found a number of studies exploring co-design and collaborative

design as a form of TPD, only a few studies examined the collaborative design process or decision making while designing oTPD. Fortunately, we found studies of collaborative design practice and processes from other disciplines with insights related to our work.

Future work may explore the alignment process when designing different courses and conducted by a different group of researchers/practitioners. The efficacy of pedagogical intent guiding the design process in varied contexts could also be investigated. Furthermore, self-study methodology and its impact on interdisciplinary collaborative work could be explored in the instructional design contexts. Self-study could also be applied as a methodology investigating collaborative design processes in other settings and contexts. It is a robust methodology that harmonizes well with the principles of collaborative design and design-based research and could be very useful in exploring different aspects of collaboration. Based on this study's findings, we recommend further exploring the role of multiple perspectives and conflict in advancing creative and innovative thinking and identifying which conditions and processes are conducive to or block the progress of collaborative efforts.

Conclusion

Self-study methodology proved to be a valuable approach for exploring collaborative design practice. Closely examining decisions made during the design process led us to reflectively evaluate assumptions and knowledge underlying those decisions. We recognized that the emerging design, structures, and processes manifested our collective knowledge, assumptions, and theoretical orientation. Our collaborative conversations pushed our individual understanding beyond what we would ordinarily see in isolation and enabled us to examine perspectives and theories outside our typical comfort range. The interdisciplinary expertise within the unique coming-to-know self-study process allowed us to negotiate robust solutions and gain a deeper understanding of the processes involved in aligning technology with pedagogy. Our collaborative design efforts provided a window to reflect on our practice and understanding as we shared knowledge, made our reasoning explicit, and negotiated solutions, capitalizing on each other's expertise in an atmosphere of mutual trust and respect.

This study's findings suggest that aligning technology with pedagogy is possible, feasible, and potentially beneficial for enhancing the quality and effectiveness of oTPD and possibly other designs. Indeed, it seems that attending to the underlying pedagogy and carefully employing content and context-dependent practices (core approaches and methods), not just using innovative technological tools, makes effective instruction and learning online possible. Various technology tools can be effectively employed to improve instruction across modalities when used for specific pedagogical purposes.

Declarations

Data are available upon request by contacting the author.

The authors declare they have no conflict of interest.

All procedures performed in this study involving human participants were in accordance with the ethical standards of the university where the study took place.

Informed consent was obtained from all individuals participating in this study.

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