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Discussion Facilitation Strategies and Design Skill Development: Examining the Relationship

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ABSTRACT

Case-based instruction (CBI) provides a way to vicariously engage preservice teachers in their future teaching realities. However, little research has considered how different discussion facilitation strategies relate to the development of preservice teachers' instructional design (ID) skills. We used an embedded mixed methods case study research design to compare differences in how preservice teachers approached the ID process when engaged in one of two strategies: discussions guided by pre-constructed prompts and a facilitator and discussions guided by pre-constructed prompts only. Findings revealed that preservice teachers who participated in discussions guided by a facilitator analyzed case problems more deeply, as they identified more sources of inspiration to guide their design choices; considered learner, environmental, and content characteristics more often; and reported spending more time understanding case problems. While most preservice teachers believed they could apply what they learned from participating in CBI to their future profession, preservice teachers receiving prompts only were more positive about the discussion aspect of CBI.

Keywords: case-based instruction, problem solving, discussion, facilitator role, teacher education, instructional design

Introduction

Each day, teachers make decisions regarding how to design, develop, and implement instruction to meet their learners' needs (Hammerness et al., 2005; Lachner et al., 2016). With many potential ways to create teaching and learning products, instructional design (ID) represents a complex process (Ertmer & Stepich, 2005; Goeze et al., 2014), and teacher educators should consider using methods that effectively advance design skills in their students (Hammerness et al., 2005). While problem-centered methods, such as case-based instruction (CBI), have been used to prepare teachers for the complexities of future professional realities (Goeze et al., 2014; Shulman, 1992), the goals, format, and facilitation strategies vary across implementations (Goeze et al., 2014; Gravett et al., 2017; Yadav & Koehler, 2007). Although discussion is considered a key aspect of CBI (Ertmer & Koehler, 2014; Levin, 1995), little research has considered how discussion facilitation strategies support the development of ID skills in preservice teachers. This study was designed to fill that gap.

Literature Review

Teaching Expertise

Expert teachers approach the design and teaching process in a dynamic manner (Soslau, 2012), with a clear vision and set goals (Block et al., 2002). Additionally, they understand their learners; recognize key elements of their instructional environments; complete detailed analyses of their instructional contexts; make connections among environmental conditions, learner cues, and content; and determine which aspects of the instructional context deserve attention (Block et al., 2002; Lachner et al., 2016). Finally, expert teachers are adaptive and flexible (Hammerness et al., 2005; Soslau, 2012).

With endless options for approaching the instructional design process and with many factors to consider, the instructional process comprises a complex activity. As such, expert teachers actively engage in problem solving (Goeze et al., 2014). That is, on a daily basis, expert teachers solve complex problems that require them to simultaneously manage many different tasks with many different learners (Darling-Hammond & Baratz-Snowden, 2007).

Comparing the instructional design work of expert teachers to that of beginning teachers reveals some striking differences. Based on their limited experiences and field knowledge, beginning teachers have difficulty interpreting classroom events, balancing tasks, and making predictions about student behaviors and missteps (Berliner, 1988). Thus, when designing instruction, they often encounter problems when selecting and implementing effective methods, addressing learners' needs, and working within environmental structures and classroom constraints (Darling-Hammond, 2003). Scholars point to at least three reasons for these challenges: preconceptions of the teaching profession (Darling-Hammond & Baratz-Snowden, 2007; Feiman-Nemser, 2001), underestimation of the complexity of teaching (Hammerness et al., 2005; Strangis et al., 2006), and linear methods of training (e.g., starting with objectives and ending with evaluation; John, 2006; Strangis et al., 2006). Overall, the preparatory methods often used with preservice teachers are misaligned with the complex instructional problems they must solve in order to be successful teachers: In K-12 education, designing instruction is too often viewed as lesson planning, an isolated affair, instead of a complex, evolving process involving many considerations.

Case-Based Instruction: Role of Discussion and Facilitation Strategies

Problem-centered methods can facilitate the development of problem-solving skills in learners by providing opportunities to consider real-world, professional content (Tawfik & Jonassen, 2013; Tawfik & Kolodner, 2016). Specifically, CBI has been used to help learners explore authentic problems situated in their future professions (Goeze et al., 2014; Gravett et al., 2017). Although CBI can be implemented using various methods (e.g., video cases, case libraries), more commonly it is used to present learners with real-world situations in narrative form. Learners are then prompted to analyze and solve the professional problems by connecting case content with contextual principles, discussing key case aspects, and reflecting on the problem-solving process (Smith & Ragan, 2005; Stepich et al., 2001).

Discussion is commonly used as part of the CBI process (Ertmer & Koehler, 2014; Goeze et al., 2014; Levin, 1995). Because students often find the open and complex nature of cases challenging (Goeze et al., 2014; Gravett et al., 2017), discussion during CBI enables learners to make sense of the complexities involved in the case while considering diverse ideas from others (Ertmer & Koehler, 2014). Specifically, in preservice teacher education, CBI discussion provides a medium for thinking through the design process while receiving feedback.

Another challenge associated with the effective use of CBI relates to measuring the learning that results from participation (Yadav & Barry, 2009; Yew & Yong, 2014). Recently, researchers have examined the content of case discussions to determine the extent to which the "targeted problem space" is covered (Ertmer & Koehler, 2014, 2015, 2018; Hmelo-Silver, 2013), thus providing a rough measure of the learning that occurred during the discussion. The targeted problem space of a case study comprises those topics, ideas, and concepts needed to solve the given case problems (Hmelo-Silver, 2013; Teasley & Roschelle, 1993). By comparing the potential problem space against topics actually covered during discussions, Hmelo-Silver (2013) concluded that group discussions can effectively engage students with problems of practice and cover a considerable amount of content (e.g., conceptual ideas, disciplinary topics). A meaningful case discussion, then, is defined as one that promotes consideration of specific problem-solving topics and maximizes coverage of the targeted problem space.

Although research underscores the importance of discussion in CBI (Austin, Heskett, & Bartlett, 2015; Ertmer & Koehler, 2014, 2015, 2018; Goeze et al., 2014), few researchers have considered how the specifics of this instructional method (e.g., facilitation structure, discussion strategies) connect to learning outcomes (Ertmer & Koehler, 2015; Goeze et al., 2014; Koehler et al., 2019). As such, different facilitation methods have been used with novice teachers. For instance, Goeze et al. (2014) examined the impact of providing preservice teachers with support via hyperlinks during case analysis and small group discussion. Their findings revealed that the implementation of the hyperlinked supports resulted in deep perspective taking and application of content knowledge. Gravett et al. (2017) investigated the effectiveness of implementing small-group discussions paired with whole-group discussions guided by a facilitator. Their results documented several affordances realized from the case process, including appreciation for the complexity of teaching.

Comparing these two CBI discussion approaches reveals important differences. First, the format of the support varied. In the first instance, the hyperlinked content was predetermined and created based on researched teacher and learner perceptions (Goeze et al., 2014). In the other application, "broad questions" were used in combination with a

facilitator who elicited small group comments for the benefit of the entire class, provided timely prompts to relevant literature, and summarized discussion themes (Gravett et al., 2017). Second, the role of the instructor or facilitator varied across approaches. While both discussions required advanced instructor preparation, students using the hyperlinked supports bore more responsibility for making sense of case content. The types of support offered in these two instances are commonly described in the CBI literature: instructor-facilitated strategies (e.g., facilitator using timely strategies to guide the discussion; Flynn & Klein, 2001; Levin, 1995; Stepich et al., 2001) and self-guided methods (e.g., pre-constructed strategies that learners use at their own discretion; Choi & Lee, 2009; Ertmer et al., 2008; Ge et al., 2010). Examining student learning experiences and outcomes across these two common approaches can help inform best practices for facilitating case-based discussions.

Purpose

By prompting students to consider real-world situations, problem-centered methods such as CBI are often implemented with the goal of facilitating the development of problem-solving skills in learners (Pease & Kuhn, 2011; Wirkala & Kuhn, 2011). Discussions are commonly used to generate productive discourse during problem-solving activities, as they prompt students to consider diverse ideas (Gravett et al., 2017). However, little consideration has been given to specific facilitation strategies (An et al., 2009), especially examining how these strategies relate to learners' problem-solving approaches, including how they approach ID work (Ertmer & Koehler, 2014, 2015, 2018). Although previous research indicates that both pre-designed discussion prompts and a discussion facilitator are effective options for supporting learning during CBI, little research has compared these two approaches for effectiveness and efficiency. Because case facilitation can be challenging and time-consuming, instructors can use their time more effectively if research verifies that using pre-determined prompts is as effective as an active facilitator. The following question guided this research: How do preservice teachers' approaches to designing instruction vary after participating in CBI discussions guided by pre-constructed prompts and a facilitator compared with discussions guided by pre-constructed prompts only?

Methods

Research Design

We used an embedded mixed methods case study design (Terrell, 2012). By focusing our primary analyses on multiple qualitative data sources across several cases, a robust interpretation was possible (Baxter & Jack, 2008). Additionally, by including a quantitative data strand, a "broader perspective" of preservice teachers' design processes was possible (Terrell, 2012, p. 270). Several qualitative data sources were generated that allowed us to examine students' ID approaches: sources of inspiration for their developed lesson plans, reported discussion topics, and end-of-the-course evaluations. Simultaneously, to fully investigate the end-of-the course evaluations, quantitative data analysis was used. Qualitative and quantitative data sources were collected and analyzed concurrently (Harwell, 2011). Diverse data integration allowed us to examine similarities and differences in students' approaches to designing instruction after participating in different discussion formats.

Expertise in ID comprises a problem-solving process. As such, a problem-solving lens was used to guide data analysis. Problem solving was conceptualized as comprising two processes: problem finding (PF) (e.g., developing a clear articulation of the problem) and generating solutions (GS) (e.g., describing how articulated problem elements should be addressed) (Ertmer & Stepich, 2005; Chi & Glaser, 1985; Eseryel et al., 2011). Using a problem-solving lens allowed us to deeply consider the participants' problem solving as a complete process from conception (sources of inspiration) to execution (reported discussion topics) and finally reflection (end-of-the-course evaluations). At the same time, these data sources offered the chance to make comparisons across discussion facilitation strategies at different points in the problem-solving process.

Participants and Setting

Participants included 125 undergraduate students enrolled in an introductory educational technology course at a large Midwestern university during the spring 2014 semester. Although a primary goal of this course was to build learners' understanding of successful technology integration strategies, teaching learners how to design effective instructional solutions was equally emphasized. Most individuals in this course were majoring in education (n=116), female (n=92), and either a freshman or sophomore (n=101). Students not majoring in education (n=9) were included in this investigation, as their limited educational experiences were not unlike the majority of the participants.

Each week, students met on Monday in a large group (2 sections) and on Wednesday for smaller lab groups (8 sections). Demographic makeup of each section was similar across major, gender, and college level or age. This study focused on the Monday meetings. During these fifty-minute sessions, a flipped classroom approach was utilized (Herreid

& Schiller, 2013), in which students reviewed course content via a learning management system prior to class and then completed collaborative case activities during class.

The same advanced graduate student instructed both sections. She had previously taught the lab section several times previously and used a case approach to teach business courses in a K-12 setting as well as an advanced instructional design course at the graduate level. Six teaching assistants (TAs), with varying previous experiences teaching the course, led the lab sections. TAs received training prior to the start of the semester on their primary role of offering support to students during collaborative work time. When interacting with students, TAs were asked not to offer solutions, but instead to use questions to prompt learners to think through the instructional design process on their own.

During the 16-week semester, students worked in groups to complete four case analyses. Starting in week four, the case analysis activity repeated a three-week process. In the first week, students participated in discussions. The discussion format for each section varied. Students enrolled in section one participated in instructor-facilitated (IF) discussions (nIF=59). In this setup, students were prompted to actively consider case content through a variety of activities (e.g., role playing, sharing, brainstorming, synthesizing) that were guided by the instructor. In section two, although students were supported by the instructor, they received prompts only (PO) to guide their discussions (nPO=66). That is, students received discussion prompts similar to those used in section one (See Table 1 for a comparison of prompts used in each section.). Although the instructor encouraged students to use the prompts, she did not facilitate the discussions, and thus prompts were used, at students' discretion, to lead their self-guided discussions. While students worked, the instructor circulated the classroom to see how students were progressing. For each case, the prompts and discussion activities focused on different aspects of the ID process (Case 1- analysis; Case 2- design and development; Case 3- implementation; Case 4- evaluation).

During the second week, students used the course meeting time to collaboratively create solutions. Regardless of section, the instructor and TAs interacted with students as they worked—answering questions, providing feedback, and observing student discussions. In week three, students completed closure activities to wrap up the case. The cases focused on a variety of topics, contexts, and audiences: developing a lesson for non-native English-speaking middle school students, creating an afterschool STEM-focused activity for at-risk students, implementing cyber-security professional development for teachers, and integrating a game into a high school personal finance course.

Students sat at round tables that could seat up to six individuals, allowing for multiple groups composed of two to three students each. In the PO section, there were 23 groups per case. In the IF section, there were 23 groups for cases 1 and 2 and 20 groups for cases 3 and 4, due to decreased enrollment over the semester. Group composition changed for each case analysis to afford students the opportunity to work with a diverse set of individuals.

Data Collection and Analysis

As discussion represents an important space for problem solving in CBI (Austin et al., 2015; Goeze et al. 2014), all data sources focused on the role discussions played in the design decision-making process.

Sources of Inspiration and Case Discussion Form

Students completed a form (one form per group of 2-3 students) describing the topics they discussed and how they decided which topics to discuss. Additionally, as part of the instructional solution they created, students were asked to share what inspired their work (See Table 2 for an example group response). Specifically, students were prompted to provide "a full description of what inspired your lesson including where you found information about the lesson content, technology, and teaching method." Across all four cases, 167 group responses related to the discussion (nIF=82, nPO=85), and 123 group responses related to instruction inspiration (nIF=64, nPO=59) were collected and analyzed.

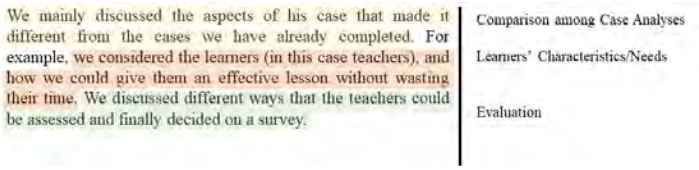

Figure 1: A coded discussion response

For each data source, course section was removed from the group responses and initially coded by the lead researcher, who was also the course instructor. Working inductively, descriptive codes were tentatively assigned to ideas shared in each response. Using these original codes, the research team reviewed student responses several times, identifying additional codes, deleting irrelevant codes, and combining codes. Figure 1 shows a coded discussion response. Once coding was finalized, related codes were grouped into categories (Miles et al., 2014). Figure 2 shows how several coded segments from the inspiration data were combined to form the Research and Investigation theme. Additionally, for the discussion data, main ideas from each category were used to create descriptions, and deductive methods were used to

identify how the themes fit within the PF and GS framework. For instance, in Figure 1, the first two codes were labeled as PF and the evaluation code was labeled as GS. Finally, the number of occurrences for each category was compared across sections.

At first, we looked at the state standards for fourth and fifth graders,	Standards
In searching ideas for our lesson, we reviewed journal articles that emphasized the importance of STEM education and how to effectively educate students in these areas... We discovered the Tornado in a Bottle demonstration for a website full of scientific demonstrations...	Journal Articles
The inspiration for the paper airplanes came from a video that we viewed online.	Online Video
We were inspired to create this lesson plan by speaking with a local 4th grade teacher who said she teaches a lot of force and motion lesson plans.	Expert

Figure 2: Combined coded segments from the inspiration data

End-of-the-Course Evaluations

At the end of the semester, students were asked to complete an anonymous, electronic course evaluation. We examined responses to four Likert-scale questions related to perceptions of CBI experiences and two open-ended questions. Students were not required nor offered an incentive to complete the evaluation. Likert-scale responses were compared across sections. Descriptive coding was used to analyze key phrases in the responses (Miles et al., 2014). After completing the initial coding, highlighted phrases were grouped into positive and negative perceptions for each question and compared across sections. From these comparisons, descriptions of student perceptions and reactions to the case analyses, design process, and discussions were created.

Findings, Discussion, and Implications

Results are presented based on each data source: sources of inspiration, reported discussion topics, and course evaluations. Subtopics for each data source are discussed in each section.

Sources of Inspiration

Students' inspiration came from four main areas: 1) previous participation in or observation of a learning experience, 2) consideration of student attributes and learning environment characteristics, 3) research and investigation, and 4) personal knowledge and interests (see Table 3 for frequencies). Also, students sometimes cited multiple sources of inspiration in the same category. For example, in the first case, one group stated the following:

> We used personal experiences from school as inspiration for our lesson. In high school, our schools hosted Physics Olympics, where students would take a day to compete against each other in various physics-related events… The inspiration for the paper airplanes came from a video that we viewed online… The last activity, Broom/Ball, was inspired by our Physics 215 course here at Purdue.

Here, students described using their experiences learning physics in high school and in a physics class at college. Also, they located additional ideas via YouTube. Overall, across all four cases, IF groups cited 195 sources of inspiration compared to 94 sources of inspiration reported by the PO groups. Table 4 provides an overview of the sources of inspiration for each section. The number of groups per case is reported for each theme.

Previous Participation in or Observation of a Learning Experience

Groups shared that inspiration came from participating in K-12 learning experiences (nIF=25, nPO=24), participating in or observing a college course or field experience (nIF=1, nPO=7), and considering previous content covered in the current course (nIF=2, nPO=1). Additionally, two groups indicated that feedback on previous cases guided their solution processes (nIF=1, nPO=1).

Groups reported using previous experiences to understand their intended learners and overcome limited knowledge on the topic. For instance, in Case 1, groups were asked to create a lesson for middle school English-language learners. One group explained that their lesson was inspired by their experiences learning a new language during middle school: "We tried to throw around ideas that would represent the kind of topics that were realistically likely to be covered in a beginning level 6th or 7th grade English class...." Another group relied on their field experiences to direct their efforts: "The activities that we came up with came from one of our group member's TIP [Theory in Practice] experience." Most often, personal learning experiences were cited along with other sources of inspiration. However, in 1 instance in the IF section and 12 instances in the PO section, groups listed personal experiences as their sole source of inspiration.

Consideration of Student Attributes, Needs, and Interests and Learning Environment Characteristics

Groups often discussed designing a lesson that was useful or motivational for students (e.g., "By incorporating a game [http://playspent.org/], we realize that the students are more likely to be engaged and actively learning than if we went to a more traditional lecture format") (nIF=13, nPO=2).

Additionally, students sometimes considered the lesson audience for inspiration (e.g., "We decided what we were going to do by going over how we, as teachers, would like to be taught about safe online communication") (nIF=4, nPO=1).

Groups also referenced specific learner (nIF=17, nPO=9) and/or environmental (nIF=19, nPO=4) characteristics as the inspiration for designing their lessons. For Case 2, groups were asked to design an afterschool learning activity for learners who had been at school all day. Many groups mentioned that this factored into their planning. In a couple of instances in the IF section, groups noted that part of their inspiration came from considering how their lesson could impact the community. Finally, groups' efforts were also directed by the appropriateness and importance of the topic (nIF=9, nPO=8) or methods (nIF=14, nPO=8) for meeting case lesson requirements. For instance, as Case 4 dealt with personal finance, many students found inspiration in the importance of this topic: "We thought that by teaching students how to budget and weigh the decisions they have to make, [it] would help them in their future." Overall, inspiration based on student attributes, needs, and interests and learning environment characteristics was used as the sole source in 24 cases (nIF=12, nPO=12), but was more frequently combined with other sources, especially in the IF section (nIF=37, nPO=16).

Research and Investigation

Groups shared that personally researching and investigating aspects of case/lesson requirements, learners, or appropriate resources provided lesson inspiration. For instance, many groups reported looking at websites to find lesson plans and other ideas (nIF=11, nPO=12) or using video resources (e.g., YouTube) to learn more about the topic (nIF=7, nPO=2). In some instances, groups examined specific resources for help: academic journal articles (e.g., "Additionally, our whole lesson centers around skit/scene-building. This is a central tenet of one of the research articles which we incorporated") (nIF=10, nPO=2), state standards (e.g., "We based our lesson plan on perimeter and area due to the journal article we found and because it also fit with the state standards") (nIF=6, nPO=0), books (e.g., one group member remembered a book from an elementary literacy course she took that addressed "ESL students and ideas for how to teach them literacy skills") (nIF=0, nPO=3), and experts (e.g., "After consulting someone who had experience teaching English as a second language, we determined that students can often learn from each other through group interactions") (nIF=2, nPO=1). In two instances, IF groups indicated that the course discussion inspired their lesson design.

Personal Knowledge and Interests

The least cited inspiration source was personal knowledge and interests (nIF=3, nPO=9). In these instances, groups indicated that the topics and/or lesson elements were influenced by their personal knowledge (nIF=2, nPO=2) or interests (nIF=1, nPO=7). Five groups, all in the PO section, listed personal preference as the sole factor that inspired their lessons. In all other references, this source was paired with another source. In Case 2, groups had to pick a STEM topic for their lessons. One grouped shared, "We decided that we both love animals and thought that would be a fun topic for the children..." Another group explained that personal knowledge was the source of their inspiration: "This lesson was inspired by one of our group member's experiences with Lego robots... This idea was further refined by the group member's experience as a FIRST Robotics Competition mentor."

Discussion and Implications of Findings related to Lesson Inspiration Sources

Students' reliance on previous learning experiences was especially true with the first two cases, which focused on topics that likely were more familiar to students and prompted memories of their K-12 educational experiences (e.g., learning a foreign language, participating in a STEM activity). With Cases 3 and 4, students likely were less familiar with the topics and referenced previous learning experiences less. This was especially true with the IF group, and for Case 3, which asked students to design learning activities for teachers. Furthermore, as references to previous learning experiences decreased, the other areas referenced did not increase. Rather, students just used one less source to build their lessons.

A point of concern with students using their previous learning experiences is that they appeared to take them at face value. That is, many students expressed experiencing a lesson and replicating the exact lesson without considering its strengths and weaknesses:

> Our inspiration for our lesson plan came from our high school classes. In high school we had to take early Spanish classes so we thought back to those activities we did when we were trying to learn a new language.

Although prior learning experiences can be very meaningful and productive, basing a lesson only on those experiences is limiting. Previous research has shown that preservice teachers approach the design process with many preconceived ideas (Dunn & Dunn, 1979; Feiman-Nemser, 2001; Lortie, 1975).

The fact that participants relied heavily on their personal experiences when approaching the design process is not surprising. While prominent reliance on personal experience was apparent in both sections, students in the PO section relied more heavily on personal experience as a sole source of inspiration, considering other potentially helpful sources or methods less often. In contrast, preservice teachers in the IF section appeared more likely to consider additional options to support their design efforts.

Perhaps part of the challenge facing preservice teachers in this study was their lack of experience with a problem-centered learning environment: "Many students are the result of traditional school culture which strongly influences their assumptions regarding good teaching models, i.e. models featuring a traditional teacher-led approach" (Häkkinena et al., 2017, p. 26). For instance, although preservice teachers in the PO section were connecting the case topics to previous learning experiences, unfamiliarity with effective problem-centered learning processes paired with a lack of an active facilitator resulted in an experience that could have been much more productive. Because preservice teachers need to meaningfully consider multiple sources of inspiration during their ID efforts, this finding suggests that while preservice teachers are working with limited experiences and knowledge of how to best initiate the process (which is characteristic of other novice problem solvers; see Tawfik et al., 2017), CBI discussion provides an appropriate and effective medium to help them do this—when specific facilitation strategies are implemented.

During Case 1, students in both sections were prompted to consider where they might gain ideas for the instruction they were developing. In the IF section, when the instructor prompted learners to consider this topic, some students shared that they could use previous learning experiences. In response, the instructor asked students to consider the strengths and weaknesses of this source. In this instance, and likely many others across the case discussions, the instructor worked in a dynamic way—going beyond the initial prompts to use questioning techniques (Jonassen, 2011). Although students in the PO section were prompted to consider lesson content sources and to review validity of brainstormed sources, students did not indicate that they had done so, suggesting that prompts alone were not enough to fully vet previous learning experiences as meaningful sources for lesson planning.

For almost every case, nearly twice as many IF groups as PO groups considered learner and environmental aspects when designing their lessons. Although it is encouraging that the majority of IF groups used these characteristics to guide their lessons, it is concerning that only a small number of PO groups used this technique. Despite being given the same discussion prompts to consider while designing their lessons, the PO groups did not appear to place as much emphasis in this area.

Perhaps participants in the PO section did not see the value of considering learner characteristics or missed considering the relationship among environmental characteristics (Gobet, 2005), while participants in the IF section were required to examine these aspects of each case. This suggests that asking novices to consider these factors on their own is not enough; rather, it is important to intentionally design opportunities that guarantee productive reflection on this key aspect of the problem-solving process. Finally, several more groups in the IF section relied on video resources, academic articles, and state standards for inspiration compared to groups in the PO section. The IF groups' willingness to explore broader resources is a promising finding and suggests that CBI discussions with an active facilitator can increase learners' awareness of potential resources for problem finding.

Reported Discussion Topics

Both sections discussed similar topics: 1) lesson plan development, 2) learner, environmental, and content characteristics, 3) previous learning experiences and preferences for learning, and 4) helpful informational sources. Table 5 provides a summary of counts across topics for each section. Each topic is discussed in more detail in the following paragraphs, and subcategories for each topic are identified and compared across course sections.

Lesson Plan Development

Not surprisingly, most groups' discussions focused on developing lesson plans—the task learners were asked to complete. These discussions included brainstorming topics for lessons, selecting instructional methods and resources, integrating technology, deciding how to implement the lesson, adapting existing instructional materials, and envisioning engaging methods for learners. For the first two cases, more IF than PO groups reported discussing ways to make the lesson motivational or engaging for learners. Additionally, for Case 3, PO groups reported discussions at a very macro-level of lesson planning—getting the task finished. Conversely, IF groups discussed more specific details of their lesson plans (e.g., how the lesson would be implemented). While discussion prompts focused on these specific topics and were addressed during the whole group discussion in the IF section, these topics did not appear central to the planning completed by PO groups.

Learner, Environmental, and Content Characteristics

The second most frequently discussed topic focused on learner, environmental, and content characteristics. For instance, groups sometimes discussed learners' current levels of knowledge, classroom setups, and appropriate standards. In the IF section, students started each case by discussing these topics as part of the instructor-facilitated discussion. While students in the PO section also received prompts covering these topics, across all four cases, most PO groups did not report considering learner characteristics, the learning environment, or content requirements or standards.

Previous Learning Experiences and Preferences for Learning

As groups discussed the cases, they often reflected on previous learning experiences and personal preferences for learning and teaching. Additionally, as the semester progressed, groups sometimes considered their experiences with previous cases. During Case 1, fourteen IF groups, compared to five PO groups, discussed previous learning experiences. This difference was likely related, at least in part, to the fact that during the whole-class discussions in the IF group, students were asked to consider where they could get ideas for lessons and what were the strengths and weaknesses of the different lesson sources. Previous learning experiences was one of the topics that surfaced during this discussion. While students in the PO section were asked to consider the same prompt, they did not report actually discussing it.

Informational Sources

The least discussed topic centered on gaining additional information to understand the case issues. For example, groups discussed empathizing with learners, considering the needs of case stakeholders, exploring content taken from academic articles, utilizing personal expertise, and analyzing aspects of field experiences. No differences were apparent between sections.

Discussion and Implications of Findings Related to Discussion Topics

As groups discussed learner, environmental, and content characteristics and informational sources, they engaged in exploring and understanding aspects of the case problems (i.e., problem finding). Moreover, as groups reflected on previous learning experiences and developed their lessons, they articulated solutions to the case problems. Most case discussions focused on lesson development. IF groups reported more instances of discussing problem-finding topics than PO groups. Often, topics discussed by the IF groups were linked to questions asked during the whole-class discussion. For instance, during the third case, the IF discussion focused on how to implement the lesson. As such, all students in this section heard ideas about how best to implement a lesson for 270 teachers with busy schedules. In the PO section, only one group reported discussing lesson implementation. As this was a key aspect of the case, the fact that only one PO group reported considering implementation is problematic.

Students in the PO section did not appear to utilize the suggested discussion prompts or were uncertain how to best discuss case components. Students in the IF section often discussed more topics and reached a finer level of detail than PO groups. That is, students in the IF section commonly reported discussing multiple topics, shared reasons for focusing on specific areas, and often indicated connections between what they discussed and the goals of their instructional design. This is illustrated in one IF group's reported discussion topics:

> The topics we discussed ranged from what type of lesson we wanted to teach, and how we were going to teach it. We discussed the classroom environment and the levels of the learners, so that we planned a lesson plan that the students could understand and learn from. From the beginning we pictured what it was like to learn a new language, and took many ideas from our own previous experiences.

Although both sections received similar prompts, these prompts were used differently by preservice teachers to complete the design process. Without a facilitator and left to their own devices, PO preservice teachers in this study focused on getting the task done and failed to attend to all aspects of the design decision-making process—an important aspect of effective problem solving (Tawfik et al., 2017). By considering possible reasons for the limited use of prompts in the PO section, we gain a better understanding of how specific CBI discussion facilitation strategies might influence how preservice teachers approach the ID process.

In the group discussions in this study, the initial prompts were designed to encourage students to start the PF process, to make connections among case issues, and to develop a complete understanding of key issues. In many ways, these prompts appeared to work in intended ways: Students reported discussing learner and learning environment characteristics and content requirements. These results echo what other researchers have found regarding the importance of developing sound prompts to shape the discourse that takes place during a learning experience (Ertmer & Stepich, 2002; Dolmans et al., 2002). While these discussions appeared to activate prior knowledge and prompt students to share personal expertise (Schmidt et al., 2007), the prompts did not promote meaningful discussion equally or spark similar

sources of inspiration across sections. For example, students in the IF section reported addressing more diverse discussion topics, gave more consideration to PF topics, and considered case issues at a more detailed level than students in the PO section. Therefore, not only did the prompts appear important for shaping the conversation, but how they were implemented also appeared related to their overall usefulness—especially the depth of consideration given to problem-solving elements during case discussion (Ertmer & Koehler, 2015; Ng & Tan, 2006).

The different discussion facilitation methods appeared to relate to how the students in the two groups approached the design process. As students in the IF section developed their lessons, they drew their inspiration from more sources and more often reported considering learner and environmental characteristics. In other words, compared to students in the PO section, they spent more time with PF or developing a more complete understanding of the case problems. When considering design problems, working with an incomplete representation of a problem can negatively impact the potential solutions generated (Svihla & Reeve, 2016). Additionally, students in the PO section often struggled getting started on their analyses of the case (Jones et al., 2011; Schmidt, 2005) and consistently relied only on previous learning experiences (Feiman-Nemser, 2001; Joram & Gabriele, 1998; Lortie, 1975)—both typical of novice teachers. In short, as learners were being prompted to engage with complex instructional problems, their abilities to start the process, make sense of case content, and manage the problem-solving process was likely related to the type and timing of support they received (Hmelo-Silver et al., 2007).

Problem-centered learning can be challenging for learners, and thus, instructional scaffolding (e.g., support given to learners while problem solving that is gradually removed to encourage independent problem solving; Puntambekar & Hübscher, 2005) is often used to support learners in such environments. Although scaffolding has been utilized for many years in education, defining what scaffolding actually involves and understanding the best methods for applying it in educational situations still varies widely (Bliss & Askew, 1996; Davis & Miyake, 2004).

Regarding the prompts and facilitator support offered in each discussion format as a form of scaffolding suggests the discussion prompts alone did not offer enough support for students to effectively manage the complexity involved. Thus, this strategy likely did not reduce cognitive load, which left students in the PO section feeling overwhelmed, resulting in case problems being out of range for the novice designers (Hmelo-Silver et al., 2007). Evaluating the PO discussion facilitation strategies using a scaffolding lens suggests that the missing element was a facilitator providing "appropriate support based on an ongoing diagnosis" of the students' current levels of understanding (Puntambekar & Hübscher, 2005, p. 3). Without this type of guidance, coverage of the key topics was left to chance, and even if these topics were considered, any misconceptions were left unchecked (Ertmer & Koehler, 2015; Ng & Tan, 2006). At the same time, preservice teachers in both sections of the course were possibly working with underdeveloped socially shared regulation skills (e.g., "processes by which group members regulate their collective activity," Häkkinena et al., 2017, p. 30), and differences between the two groups suggest that the facilitator roles not only includes focusing and guiding the discussion, but supporting socially shared regulation.

The differences in discussion topics' frequencies across sections suggests that the IF and PO groups engaged with discussions in different ways. An alternative interpretation is that groups in the IF section of the course were more comprehensive when reporting their discussion topics. However, in terms of length, responses across cases resulted in similar average word counts: IF = 82.8 and PO = 81.1. With similar average word counts, the difference between sections appears related to the way IF groups described their discussions versus their willingness to share more.

End-of-the-Course Evaluations

Just less than 50% of the students completed the end-of-the-course evaluation (nIF=28, nPO=33). Using a five-point Likert scale, students were asked to rate their perceptions of participating in the CBI experience. Across both sections, most respondents agreed the cases allowed them to learn (nIF=68%, nPO=59%) and felt they could apply what they learned in their future profession (nIF=79%, nPO=70%). When asked about the discussions, respondents were less positive, as most students did not agree that the discussions were helpful to their learning (nIF=43%, nPO=48%). However, most students indicated that the discussions helped them make connections among ID topics (nIF=50%, nPO=64%). Interestingly, while students enrolled in the IF section were more positive about the overall case-learning process, students in the PO section were more positive about the discussion aspect of the process. Overall, Mann-Whitney analysis revealed that students' perceptions of the usefulness of the case method and discussion did not differ significantly across sections. Specific results for each section are provided in Tables 6 and 7.

As part of the evaluation, students were asked to describe ways in which the case study assignments and discussions helped them develop skills designing instruction. Students in both sections shared many promising perceptions including increased skills in developing lesson plans (e.g., "I learned the fundamentals of designing a lesson plan"); understanding

how to design lessons for different students, environments, circumstances (e.g., "It helped me look at different situations and evaluate them to understand how I can design a lesson in the given situation"); increasing abilities to work in groups (e.g., "I now know how to collaborate with others in designing instruction and they helped me become more creative with each different type of case"); and preparing for their future teaching endeavors (e.g., "They gave us multiple situations in which we would build our lesson plans on. This will help prepare us for many types of situations that we may face in our future").

However, a small group of students in each section described the case analysis process as a negative experience (nIF=3, nPO=5), although the negativity appeared different across sections. Negative comments from the PO section focused on uncertainty with the process: "Because of lack of direction, I felt the case study assignments prohibited me from learning and were more of a hindrance than a learning tool." On the other hand, IF students' dissatisfaction was more general: "I felt as it was more of a waste of time."

When evaluating the discussions specifically, many students in both sections believed that these helped them generate ideas for lesson plans. In addition, several students in the IF section shared that the discussions helped them consider barriers and how to overcome them. While some students in both sections were displeased with the discussions (nIF=5, nIS=8), the reasons for dissatisfaction varied. For instance, many PO students shared that not much discussion occurred during class time. In contrast, some students in the IF section felt discussions focused on topics that were too basic: "They seemed to be a little redundant and common sense."

In the PO section, many students felt overwhelmed with the open-endedness of the case assignments, which may have kept them from incurring all the possible benefits. Furthermore, many PO students did not make effective use of their time in class for discussions. As discussions are considered a central component of CBI, this is problematic. Additionally, some students in the IF section felt discussion topics were too simplistic to be helpful. Perhaps, while some topics might have appeared to be obvious to students, novices still often overlook these issues and quickly skip ahead to generating solutions. While negative views existed in both, IF students more commonly pointed to in-depth instructional design processes: "There are several critical things that affect lesson planning that I had not considered before. After taking this course I am confident in my ability to deal with these obstacles."

Discussion and Implications of Findings Related to End-of-the-Course Evaluations

Although students in the IF section perceived the overall case-learning process as a more productive experience than students in the PO section, students in the PO section perceived the case discussions as more beneficial to their learning. These perceptions contradict other data. That is, although most IF students who responded to the survey did not view the case discussions as helpful, reported discussion topics and shared sources of inspiration suggest that with a facilitator, these students were able to consider ID topics more deeply. This finding suggests that some students did not see the connections emphasized during the discussion, and perhaps, viewed discussion time as a "time consumer," as one student shared. However, based on the discussion and inspiration sources reported by the PO group, without a facilitator, these topics likely would not have been addressed and/or thoroughly considered.

Similar to other research dealing with learners' participation in discussions for educational purposes (see Beaudoin, 2002; Xie & Huang, 2014; Xie et al., 2011), perhaps the preservice teachers in this study failed to see the value of discussions and were not motivated to participate. Additionally, preservice teachers' descriptions of discussions as a waste of time underscores other research related to the tendency of novice problem solvers to move directly to developing solutions without fully considering key problem elements (Hmelo-Silver, Nagarajan, & Day, 2002; LeMaistre, 1998), especially in instances when learners are working with limited instructional support (Ng & Tan, 2006). Possibly, students in the IF section believed that getting to work immediately on a solution to each case would have been more productive and effective than using time to participate in a discussion on topics they viewed as "redundant and common sense."

CBI facilitators are in a challenging position of balancing the amount and type of support offered to students (Ertmer & Koehler, 2014; Leary, Walker, Shelton, & Fitt, 2013; Mitchem et al., 2008). On one hand, they must provide enough support so that the problem-solving process does not seem beyond learners' current abilities (Hmelo-Silver et al., 2007). On the other hand, they do not want to provide too much guidance so that the problem under investigation loses authenticity and effectiveness, shifting too much of the sense-making process from the student to the instructor (Svihla & Reeve, 2016). Although providing pre-constructed prompts might present an easier method for supporting problem solving during CBI, instructors should be prepared to embrace the challenge of facilitating a dynamic discussion that addresses students' current understandings and helps move them forward.

Conclusion

To prepare for the professional realities of teaching, preservice teachers could benefit from approaching instructional design as a problem-solving process (Goeze et al., 2014). CBI has the potential for developing such problem-solving skills in learners (Tawfik & Jonassen, 2013; Tawfik & Kolodner, 2016; Wirkala & Kuhn, 2011). In this study, two CBI discussion facilitation strategies were compared—discussions guided by pre-constructed prompts and a facilitator, and discussions guided solely by pre-constructed prompts. On the surface, preservice teachers participating in either discussion format appeared to work in similar ways—that is, they relied heavily on previous learning experiences, focused primarily on completing the task at hand, and discussed similar topics. However, students in the IF section reported using more diverse sources of inspiration and reported considering learner and environmental characteristics more frequently as they made design decisions. Additionally, students in the PO section did not appear to fully utilize the case prompts. Overall, the data collected and analyzed in this study indicate that IF students spent more time than PO students attempting to fully understand the case problems and more frequently reported being concerned with designing lessons that met the learners' needs and engaged them.

CBI appears to be a promising approach for preparing preservice teachers for the complex realities they will face in the profession (Goeze et al., 2014). While previous research has emphasized the importance of CBI discussion in supporting and developing learners' understanding (Ertmer & Koehler, 2014, 2015; Ertmer & Stepich, 2002; Goeze et al., 2014; Gravett et al., 2017; Levin, 1995), limited research has considered how specific discussion facilitation strategies relate to the development of the targeted problem-solving skills. Results from this investigation suggest that preservice teachers who participate in discussions facilitated by pre-constructed prompts and a facilitator are more likely to consider more factors during the instructional design process than those who participate in discussions facilitated by pre-constructed prompts alone.

These results underscore the power of an intentional discussion. Productive discussions do not happen automatically; a skillful facilitator must not only develop effective prompts to focus learners' efforts, but also help learners use those prompts to engage in a productive discussion and collaboration. While this certainly places responsibility on CBI facilitators to create a meaningful learning experience for their learners (Ertmer & Koehler, 2014, 2015; Heckman & Annabi, 2006; Hmelo-Silver & Barrows, 2006), the results can be worth the effort. As in this case, facilitated discussions more fully addressed many common design challenges facing preservice teachers (e.g., preconceived ideas about lesson development, underestimation of the complexity of teaching, where to start the ID process) than discussions guided by prompts alone. However, even preservice teachers participating in CBI without a facilitator appeared to benefit from engaging with the problems present in the cases while working in a collaborative environment. Although a skilled CBI facilitator likely could have improved the effectiveness of the method, it is also possible that an ineffective CBI facilitator would not have added more value than what students could have accomplished on their own.

With additional research, the role of a CBI facilitator can be more fully understood, including the specific strategies that are implemented and how they shape subsequent learning. Similar to previous research, the results of this investigation suggest that for learners to fully benefit from CBI, effective discussion must be a part of the process (Austin et al., 2015; Goeze et al., 2014; Koehler et al., 2019)—that is, a discussion that is designed to support case objectives and course goals, facilitates coverage of the targeted problem space, and engages learners with the content. The key then is to develop a discussion that supports, challenges, and enables learners' understanding of important problems of practice.

References

An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. Computers & Education, 53(3), 749–760. doi:10.1016/j.compedu.2009.04.015

Austin, J., Heskett, J., & Bartlett, C. (2015). Key elements for excellence in classroom cases and teaching notes. Harvard Business School Publishing. Ref #9-915-417

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. The Qualitative Report, 13(4), 544–559.

Beaudoin, M. F. (2002). Learning or lurking? Tracking the "invisible" online student. The Internet and Higher Education, 5(2), 147–155. doi: 10.1016/S1096-7516(02)00086-6

Berliner, D. C. (1988, February). The development of expertise in pedagogy. Charles W. Hunt Memorial Lecture, American Association of Colleges for Teacher Education Annual Meeting, New Orleans, LA, United States.

Bliss, J., & Askew, M. (1996). Effective teaching and learning: Scaffolding revisited. Oxford Review of Education, 22(1), 37. doi:10.1017/cbo9781316285596.008

Block, C. C., Oakar, M., & Hurt, N. (2002). The expertise of literacy teachers: A continuum from preschool to grade 5. Reading Research Quarterly, 37(2), 178–206. doi:10.1598/

rrq.37.2.4

Capon, N., & Kuhn, D. (2004). What's so good about problem-based learning? Cognition & Instruction, 22(1), 61–79. doi:10.1037/e617962012-552

Chi, M. T. H., & Glaser, R. (1985). Problem-solving ability. In R. J. Sternberg (Ed.), Human abilities: An information processing approach (pp. 227–250). W. H. Freeman and Company.

Choi, I., & Lee, K. (2009). Designing and implementing a case-based learning environment for enhancing ill-structured problem solving: Classroom management problems for prospective teachers. Educational Technology Research & Development, 57(1), 99–129.

Darling-Hammond, L. (2003). Keeping good teachers: Why it matters, what leaders can do. Educational Leadership, 60(8), 6–13. doi:10.1007/s11423-008-9089-2

Darling-Hammond, L., & Baratz-Snowden, J. (2007). A good teacher in every classroom: Preparing the highly qualified teachers our children deserve. Educational Horizons, 85(2), 111–132. doi:10.2307/j.ctvpr7rd1.5

Davis, E. A., & Miyake, N. (2004). Explorations of scaffolding in complex classroom systems. Journal of the Learning Sciences, 13(3), 265–272. doi: 10.1207/s15327809jls1303_1

Dolmans, D. H. J. M., Gijselaers, W. H., Moust, J. H. C., De Grave, W. S. D., Wolfhagen, I. H. A. P., & Van Der Vleuten, C. P. M. (2002). Trends in research on the tutor in problem-based learning: Conclusions and implications for educational practice and research. Medical Teacher, 24(2), 173. doi:10.1080/01421590220125277

Ertmer, P. A., & Koehler, A. A. (2018). How context affordances shape facilitation strategies and problem-space coverage: Comparing face-to-face and online case-based discussions. Educational Technology Research and Development, 66(3), 639-670. doi:10.1007/s11423-017-9563-9

Ertmer, P. A., & Koehler, A. A. (2015). Facilitated versus non-facilitated online case discussions: Comparing differences in problem space coverage. Journal of Computing in Higher Education, 27, 69–93. doi:10.1007/s12528-015-9094-5

Ertmer, P. A., & Koehler, A. A. (2014). Online case-based discussions: Examining coverage of the afforded problem space. Educational Technology Research & Development, 62(5), 617–636. doi:10.1007/s11423-014-9350-9

Ertmer, P. A., & Stepich, D. A. (2005). Instructional design expertise: How will we know it when we see it? Educational Technology, 45(6), 38–43.

Ertmer, P. A., & Stepich, D. A. (2002). Initiating and maintaining meaningful case discussions: Maximizing potential of case-based instruction. Journal on Excellence in College Teaching, 13(2/3), 5–18.

Ertmer, P. A., Stepich, D. A., Flanagan, S., Kocaman-Karoglu, A., Reiner, C., Reyes, L., Santone, A., & Ushigusa, S. (2008). Impact of guidance on the problem-solving efforts of instructional design novices. Performance Improvement Quarterly, 21(4), 117–132. doi: 10.1002/piq.20041

Eseryel, D., Ge, X., Ifenthaler, D., & Law, V. (2011). Dynamic modeling as a cognitive regulation scaffold for developing complex problem-solving skills in an educational massively multiplayer online game environment. Journal of Educational Computing Research, 45(3), 265–286. doi:10.2190/ec.45.3.a

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. Teachers College Record, 103(6), 1013–1055. doi:10.1111/0161-4681.00141

Flynn, A. E., & Klein, J. D. (2001). The influence of discussion groups in a case-based learning environment. Educational Technology Research & Development, 49(3), 71–86. doi:10.1007/bf02504916

Ge, X., Planas, L. G., & Er, N. (2010). A cognitive support system to scaffold students' problem-based learning in a Web-based learning environment. Interdisciplinary Journal of Problem-based Learning, 4(1), 30–56. doi:10.7771/1541-5015.1093

Goeze, A., Zottmann, J. M., Vogel, F., Fischer, F., & Schrader, J. (2014). Getting immersed in teacher and student perspectives: Facilitating analytical competence using video cases in teacher education. Instructional Science, 42(1), 91–114. doi:10.1007/s11251-013-9304-3

Gravett, S., de Beer, J., Odendaal-Kroon, R., & Merseth, K. K. (2017). The affordances of case-based teaching for the professional learning of student-teachers. Journal of Curriculum Studies, 49(3), 369–390.

Häkkinen, P., Järvelä, S., Mäkitalo-Siegl, K., Ahonen, A., Näykki, P., & Valtonen, T. (2017). Preparing teacher-students for twenty-first-century learning practices (PREP 21): a framework for enhancing collaborative problem-solving and strategic learning skills. Teachers and Teaching, 23(1), 25–41. doi:10.1080/13540602.2016.1203772

Hammerness, K., Darling-Hammond, L., Bransford, J., Berliner, D., Cochran-Smith, M., McDonald, M., & Zeichner, K. (2005). How teachers learn and develop. In L. B. Darling-Hammond, J. (Ed.), Preparing teachers for a changing world: What teachers should learn and be able to do (pp. 358–389). Jossey-Bass.

Harwell, M. R. (2011). Research design in qualitative/quantitative/mixed methods. In C. F. Conrad & R. C. Serlin (Eds.), The SAGE handbook for research in education: Pursuing ideas as the keystone of exemplary inquiry (2nd ed) (pp. 147–163). SAGE Publications.

Herreid, C., & Schiller, N. (2013). Case studies and the

flipped classroom. Journal of College Science Teaching, 42(5), 62–66.

Hmelo-Silver, C. (2013). Creating a learning space in problem-based learning. Interdisciplinary Journal of Problem-based Learning, 7(1). doi:10.7771/1541-5015.1334

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning faciliatator. Interdisciplinary Journal of Problem-Based Learning, 1(1), 21–39. doi:10.7771/1541-5015.1004

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). Educational Psychologist, 42(2), 99–107. doi:10.1080/00461520701263368

Hmelo-Silver, C. E., Nagarajan, A., & Day, R. S. (2002). "It's harder than we thought it would be": A comparative case study of expert-novice experimentation strategies. Science Education, 86, 219–243. Doi: 10.1002/sce.10002

John, P. D. (2006). Lesson planning and the student teacher: Re-thinking the dominant model. Journal of Curriculum Studies, 38(4), 483–498. doi: 10.1080/00220270500363620

Jonassen, D. H. (2011). Learning to solve problems: A handbook for designing problem-solving learning environments. Routledge.

Jones, K. A., Jones, J., & Vermette, P. J. (2011). Six common lesson planning pitfalls: Recommendations for novice educators. Education, 131(4), 845–864.

Joram, E., & Gabriele, A. J. (1998). Preservice teachers' prior beliefs: Transforming obstacles into opportunities. Teaching & Teacher Education, 14(2), 175–191. doi: 10.1016/s0742-051x(97)00035-8

Koehler, A. A., & Ertmer, P.A. (2016). Using Web 2.0 tools to facilitate case-based instruction: Considering the possibilities. Educational Technology, 56(1), 3–13.

Koehler, A. A., Ertmer, P. A., & Newby, T. J. (2019). Developing preservice teachers' instructional design skills through case-based instruction: Examining the impact of discussion format. Journal of Teacher Education, 70(4), 319–334. doi: 10.1177/0022487118755701

Lachner, A., Jarodzka, H., & Nückles, M. (2016). What makes an expert teacher? Investigating teachers' professional vision and discourse abilities. Instructional Science, 44(3), 197–203. doi:10.1007/s11251-016-9376-y

LeMaistre, C. (1998). What is an expert instructional designer? Evidence of expert performance during formative evaluation. Educational Technology Research and Development, 46(3), 21–36. doi:10.1007/bf02299759

Leary, H., Walker, A., Shelton, B. E., & Fitt, H. (2013). Exploring the relationships between tutor background, tutor training, and student learning: A problem-based learning meta-analysis. Interdisciplinary Journal of Problem-based Learning, 7(1), 40–66. doi:10.7771/1541-5015.1331

Lee, S. H., Lee, J., Liu, X., Bonk, C. J., & Magjuka, R. J. (2009). A review of case-based learning practices in an online MBA program: A program-level case study. Part of a special issue: Technology Support for Self-Organized Learners, 12(3), 178–190.

Levin, B. B. (1995). Using the case method in teacher education: The role of discussion and experience in teachers' thinking about cases. Teaching and Teacher Education, 11(1), 63–79. doi: 10.1016/0742-051x(94)00013-v

Lortie, D. C. (1975). Schoolteacher: A Sociological Study. University of Chicago Press.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). Qualitative data analysis: A methods sourcebook. Sage.

Mitchem, K., Fitzgerald, G., Hollingsead, C., Koury, K., Miller, K., & Tsai, H. H. (2008). Enhancing case-based learning in teacher education through online discussions: Structure and facilitation. Journal of Interactive Learning Research, 19(2), 331–349.

Ng, C. S. L., & Tan, C. (2006). Investigating Singapore preservice teachers' ill-structured problem-solving processes in an asynchronous online environment: Implications for reflective thinking. New Horizons in Education(54), 1–15.

Pease, M. A., & Kuhn, D. (2011). Experimental analysis of the effective components of problem-based learning. Science Education, 95(1), 57–86. doi: 10.1002/sce.20412

Puntambekar, S., & Hubscher, R. (2005). Tools for scaffolding students in a complex learning environment: What have we gained and what have we missed? Educational Psychologist, 40(1), 1–12. doi:10.1207/s15326985ep4001_1

Schmidt, M. (2005). Preservice string teachers' lesson-planning processes: An exploratory study. Journal of Research in Music Education, 53(1), 6–25. doi: 10.2307/3345603

Schmidt, H. G., Loyens, S. M. M., Van Gog, T., & Paas, F. (2007). Problem-based learning is compatible with human cognitive architecture: Commentary on Kirschner, Sweller, and Clark. Educational Psychologist, 42(2), 91–97. doi:10.1080/00461520701263350

Shulman, J. H. (1992). Case Methods in Teacher Education. Teacher College Press.

Smith, P. L., & Ragan, T. J. (2005). Instructional design (3rd ed.). John Wiley & Sons, Inc.

Soslau, E. (2012). Opportunities to develop adaptive teaching expertise during supervisory conferences. Teaching & Teacher Education, 28(5), 768–779. doi: 10.1016/j.tate.2012.02.009

Stepich, D. A., Ertmer, P. A., & Lane, M. M. (2001). Problem-solving in a case-based course: Strategies for facilitating coached expertise. Educational Technology Research & Development, 49(3), 53–69. doi:10.1007/bf02504915

Strangis, D. E., Pringle, R. M., & Knopf, H. T. (2006). Road

map or roadblock?: Science lesson planning and preservice teachers. Action in Teacher Education, 28(1), 73–84. doi:10.1080/01626620.2006.10463568

Svihla, V., & Reeve, R. (2016). Facilitating problem framing in project-based learning. Interdisciplinary Journal of Problem-Based Learning, 10(2). doi:10.7771/1541-5015.1603

Tawfik, A. A., Gill, A., Hogan, M., York, C. S., & Keene, C. W. (2017). How novices use expert case libraries for problem solving. Technology, Knowledge and Learning, 1–18. doi: 10.1007/s10758-017-9324-1

Tawfik, A., & Jonassen, D. (2013). The effects of successful versus failure-based cases on argumentation while solving decision-making problems. Educational Technology Research & Development, 61(3), 385–406. doi: 10.1007/s11423-013-9294-5

Tawfik, A. A., & Kolodner, J. L. (2016). Systematizing scaffolding for problem-based learning: A view from case-based reasoning. Interdisciplinary Journal of Problem-Based Learning, 10(1). doi:10.7771/1541-5015.1608

Teasley, S., & Roschelle, J. (1993). Constructing a joint problem space: The computer as a tool for sharing knowledge. In S. P. Lajoie & S. J. Derry (Eds.), Computers as cognitive tools (pp. 229–258). Erlbaum.

Terrell, S. R. (2012). Mixed-methods research methodologies. The Qualitative Report, 17(1), 254–280. doi:10.46743/2160-3715/2012.1819

Wirkala, C., & Kuhn, D. (2011). Problem-based learning in K-12 education: Is it effective and how does it achieve its effects? American Educational Research Journal, 48(5), 1157–1186. doi:10.3102/0002831211419491

Xie, K., & Huang, K. (2014). The role of beliefs and motivation in asynchronous online learning in college-level classes. Journal of Educational Computing Research, 50(3), 315–341. https://doi.org/10.2190/EC.50.3.b.

Xie, K., Durrington, V., & Yen, L. L. (2011). Relationship between students' motivation and their participation in asynchronous online discussions. MERLOT Journal of Online Learning and Teaching, 7(1), 17–29.

Yadav, A., & Koehler, M. (2007). The role of epistemological beliefs in preservice teachers' interpretation of video cases of early-grade literacy instruction. Journal of Technology and Teacher Education, 15(3), 335–361.

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APPENDIX 1

Table 1. Discussion Prompts.

Prompt Sequence	Prompt Purpose	Course Section	
		Instructor-Facilitated	Prompt-Only
Prompt 1	As a part of problem finding during ill-structure problem solving, individuals need a clear understanding of the problem context, with consideration given to diverse perspectives (Koehler & Ertmer, 2016; Choi & Lee, 2009). In the first two prompts, participants are being guided to construct a solid understanding of the problem as they consider their audience and potential barriers to implementation with this group.	• Instructor will say, "I would like you to consider the key characteristics of teachers. In other words, they are your learners—what's important to note? At the same time, what is important to note about the realities of their jobs and their schedules? Take some time to discuss this within your groups." • Instructor will ask student groups to report ideas. The instructor will type responses on the computer so all participants can see the ideas being shared. After all ideas have been shared, instructor will ask students to identify common themes among the different reported ideas.	• Consider the key characteristics of teachers (your learners) and the realities of their jobs and schedules.
Prompt 2		• Instructor will say, "Now that we have a lot of different characteristics of teachers and realities of their job listed, let's think about actually implementing the lesson with the teachers. What are potential barriers that would prevent the lesson from being successful? What might get in the way of a smooth lesson? Take some time to discuss this within your group." • Instructor will ask student groups to report ideas. The instructor will type responses on the computer so all participants can see the ideas being shared. After all ideas have been shared, instructor will ask students to identify common themes among the different reported ideas.	• Consider potential barriers that would prevent your lesson from being successful and prevent a smooth lesson.

Prompt 3	During ill-structured problem solving, as individuals generate solutions, they should consider multiple potential ways that the problems initially identified might be addressed (Koehler & Ertmer, 2016; Choi & Lee, 2009). In the third and fourth prompts, participants are being asked to suggest multiple solutions that would address problem elements.	• Instructor will say, "Within the case, it gives you eight different potential lesson plan topics. Within your group, decide which topic you will choose. Begin to plan out a basic outline of what your lesson might look like. Think about specific activities and methods that will be used. Also, be sure to consider how you can overcome the barriers that we just discussed." • Instructor will say, "What are some of the ideas that you had?" Instructor will choose one of the barriers that were previously identified. Then, the instructor will ask how the groups planned to overcome that barrier.	• After deciding on which topic you will be focusing on, consider what methods will best help you teach the content and how you will overcome any barriers that might occur.
Prompt 4		• Instructor will say, "Now, think about the lesson you're planning. How could you potentially use technology as you implement this lesson? How will technology help you meet the goals of your lesson and overcome some of the barriers that you mentioned earlier? In your groups, decide on three potential ways for using technology in the lesson." • Instructor will ask student groups to report ideas. The instructor will type responses on the computer so all participants can see the ideas being shared. After all ideas have been shared, instructor will ask students to identify common themes among the different reported ideas.	• Consider several ways how technology can be used to implement the lesson activities and to achieve the lesson goals.

Prompt 5	After individuals suggest solutions during ill-structured problem solving, they should evaluate the strength of their ideas (Koehler & Ertmer, 2016; Choi & Lee, 2009). In the final prompt, participants are asked to determine strengths and weaknesses of their proposed solutions.	• Instructor will say, "Revisit your original ideas for using technology. What are the pros and cons for each method?" • Instructor will ask student groups to report ideas. The instructor will type responses on the computer so all participants can see the ideas being shared.	• Consider what the strengths and weaknesses are for the various ways you have identified for using technology and opportunities for improvement.

Note. These specific prompts focused on the implementation of a teacher training on cyber-security.

APPENDIX 2

Table 2. Sample Group Responses.

Prompt	Reported Group Response
Please provide an overview of what topics your group discussed as you planned your lesson.	We tried to apply our own experiences to taking a foreign language. We tried to remember what our teachers emphasized and encouraged. We brainstormed interactive activities in which we participated and discussed how we could incorporate technology given the learning environment and scenario. We had trouble figuring out the specific area around which we wanted to formulate our lesson plan. We discussed using media, such as a song or movie, followed by some form of interaction with students. We finalized our plan with a PowerPoint because we felt that would allow for the most communication. We also decided to play BINGO with students and incorporate vocabulary discussed in the PowerPoint.
How did you decide what topics to discuss as you planned your lesson?	We decided to focus on a lesson that is fairly introductory and emphasizes farming and land. Katie and Brandon are Agriculture Education majors and Steve is an Earth and Space Science education major which led us to a logical area of interest. We also consulted many resources (stated in lesson plan) that focused on not overwhelming students with information, having interactive lesson plans, and allowing for communication and collaboration. All of these strategies can enhance the experience to learn a foreign language.
Please include a full description of what inspired your lesson including where you found information about the lesson content, technology, and teaching method.	We decided that our lesson needed to involve a brief teaching segment by the instructor followed by an interactive activity and a group discussion. After consulting someone who had experience teaching English as a second language, we determined that students can often learn from each other through group interactions. Based on the majors of our group, we decided a focus on land and agriculture would be very appropriate. We also read an article (see below) about incorporating other subjects into ESL to provide practice for applications of the English language in all areas of conversation. The BINGO activity is a fun and interactive way to review and practice the new terminology to which the students have just been exposed. We feel that, overall our lesson plan is quite competent to teach them the fundamentals of vocabulary in regards to land and agriculture and encourages students to learn how to apply these concepts in everyday communication.

APPENDIX 3

Table 3. Counts for Sources of Inspiration for Lesson Plans.

	Instructor-Facilitated					Prompts-Only				
Theme	C1	C2	C3	C4	Total	C1	C2	C3	C4	Total
Previous Learning Experiences	57	11	1	7	76	9	11	4	9	33
Learner and Environmental Aspects	19	27	20	12	78	6	9	11	6	32
Research and Investigation	9	14	8	7	38	5	7	7	1	20
Personal Knowledge and Interests	1	2	0	0	3	3	3	2	1	9

APPENDIX 4

Table 4. Number of Groups Reporting Using Each Inspirational Source by Case.

Theme	**Case 1**		**Case 2**		**Case 3**		**Case 4**	
	IF	PO	IF	PO	IF	PO	IF	PO
Previous Learning Experiences	10	6	10	10	3	5	5	6
Learner and Environmental Aspects	12	6	13	7	13	9	11	6
Research and Investigation	8	4	11	6	6	4	12	9
Personal Knowledge and Interests	1	3	2	3	0	2	0	0

APPENDIX 5

Table 5. Counts for Topics by Case and Course Section.

	Case 1		Case 2		Case 3		Case 4		Total	
Topic	IF	PO	IF	PO	IF	PO	IF	PO	IF	PO
Lesson Plan Development	25	22	34	27	26	26	21	28	106	103
Learner, Environmental, and Content Characteristics	18	12	19	11	12	6	8	4	57	33
Previous Learning Experiences and Preferences for Learning	15	6	8	8	1	1	4	6	28	21
Informational Sources	3	0	8	4	2	1	4	0	17	5

APPENDIX 6

Table 6. Overview of Student Responses to End-of-the-Course Evaluation Questions.

	Instructor-Facilitated						Prompts-Only					
Question	**SA**	**A**	**U**	**D**	**SD**	**n**	**SA**	**A**	**U**	**D**	**SD**	**n**
The case study assignments used in this course enabled me to learn.	4	15	3	3	3	28	7	12	5	4	4	32
I can apply the learning from the case study assignments to work in my future profession.	7	15	3	2	1	28	9	14	4	2	4	33
The class discussions during the case assignments were helpful to my learning.	2	10	6	6	4	28	6	10	7	7	3	33
The class discussions during the case assignments help me make connections between and among topics related to designing instruction.	5	9	6	5	3	28	7	14	5	5	2	33

Note. SA = Strongly Agree, A = Agree, U = Undecided, D = Disagree, SD = Strongly Disagree

APPENDIX 7

Table 7. Mann-Whitney Comparison of Course Evaluation Responses.

Question	**U**	**p**
The case study assignments used in this course enabled me to learn.	441.5	.919
I can apply the learning from the case study assignments to work in my future profession.	433.5	.659
The class discussions during the case assignments were helpful to my learning.	406.0	.404
The class discussions during the case assignments help me make connections between and among topics related to designing instruction.	401.0	.359