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Rethinking the Use of Classroom Cases: Leveraging Generative and Multimedia Principles for Meaningful Preservice Teacher Learning

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Abstract

Preservice teachers only have a short time of classroom observation, micro-teaching, and field experience. This little opportunity for classroom practice poses a significant challenge to adequate teacher preparation. To address these concerns, scholars have turned to instructional strategies such as classroom cases to support preservice teachers and give them a hands-on opportunity to experience authentic teaching situations. However, many educators using cases in teacher education have yet to take maximum advantage of the evidence available to make case-based instruction more meaningful and beneficial to preservice teachers. Hence, we present a generative and interactive use of multimedia cases in preservice teacher education to maximize the benefits of cases and address the enormous gaps created by preservice teachers' limited access to the actual classroom.

Keywords

Videocases, CBI, Generative Learning, Multimedia Principles, Collaborative Learning

1. Introduction

Teachers, like other professionals, need opportunities to practice and cultivate professional skills when in training (Ball & Forzani, 2009). They need to demonstrate requisite skills such as adequate professional vision and the ability to notice and attend to critical problems of practice using their theoretical understanding and discretion in professional practice (Van Es & Sherin, 2002; Darl-

ing-Hammond, 2014; Berliner, 1988, 2002; Ball & Forzani, 2009). For instance, in medicine, doctors and nurses in training learn with both cadavers and patients. However, in teaching, the opportunity for classroom practice is limited during preservice education (Darling-Hammond & Hammerness, 2002; Ormrod, 2005).

Preservice teachers only have a short time of classroom observation, microteaching, and field experience. This little opportunity for classroom practice poses a significant challenge to adequate teacher preparation (Benedict-Chambers & Aram, 2017; Davis, 2006; Kazemi et al., 2016; Lampert et al., 2013). In addition, it can increase the shock and anxiety that beginning teachers have when they encounter the realities of actual classroom teaching, with its rough edges and complexities (Chubbuck & Zembylas, 2008; Lampert et al., 2013; Ball & Forzani, 2009; Howard, 2016). To address these concerns, scholars have turned to instructional strategies such as classroom cases to support preservice teachers and give them a hands-on opportunity to experience realistic teaching situations. Case-based instruction (CBI) is an instructional strategy that provides an avenue for preservice teachers to learn from actual classroom events and practice (Merseth, 1990; Shulman, 1992; Darling-Hammond & Hammerness, 2002). Research has documented the potential of classroom cases to support teacher learning and practice; however, its benefits are yet to be optimally harnessed for preservice education. Hence, we discuss evidence-based principles and strategies for maximizing the advantages of cases to enhance preservice teacher learning and professional knowledge of practice. Additionally, we identify gaps in knowledge that need to be empirically filled.

2. Case-Based Instruction

CBI is an instructional strategy that uses cases to simulate or represent real-life situations. It requires learners to analyze and make sense of the case events based on their understanding of theories and the evidence presented in the given cases (Malone et al., 2019; Merseth, 1990; Jonassen, 2006). CBI has been used extensively in preservice and in-service teacher education to provide a safe opportunity for practice and situate theoretical teaching knowledge in a classroom context similar to what practicing teachers experience (Merseth, 1990; Shulman & Colbert, 1989).

A case is a written or multimedia narrative of an actual or fictitious classroom scenario imbued with educationally valuable problems of practice to be solved or analyzed by professionals in training (Derry et al., 2002; Moreno & Ortegano-Layne, 2008; Jonassen, 2006). Cases enable learners to practice using knowledge in authentic situations; it immerses learners in the facts and uncertainties of the complex world of teaching, with all its rough edges (Darling-Hammond & Hammerness, 2002). A good case must have a significant educational issue, provide information to enable learners' conclusions and decision-making, and allow multiple interpretations (Ellet, 2007, 2018; Jonassen, 2006; Shulman, 1992).

3. Classroom Cases in Teacher Education

In teacher education, cases are classroom artifacts that include video, written, or animated cases. Specifically, classroom video cases offer preservice teachers the opportunity to engage with video recordings of actual classroom events or written cases of actual or composed classroom events. They facilitate preservice teachers' development of noticing and other germane instructional skills (Beck et al., 2002; Moreno & Ortegano-Layne, 2008). Teachers, both in-service and preservice, learn professionally from video cases when they notice and make meaning of important classroom events that are essential to their daily work as teachers (Star et al., 2011; Star & Strickland, 2008; McDuffie et al., 2014; Sherin & van Es, 2005; Sherin & van Es, 2009).

In specific, classroom cases have been used to facilitate teachers' development of instructional skills needed for implementing high-leverage classroom practices, effectively impacting their student learning, creating equitable learning opportunities for all learners, and ensuring all students have the support they need to succeed (Sherin & van Es, 2005; Ball, 2017; Ball et al., 2014; Arbaugh et al., 2015). Classroom cases, particularly video cases, have been used to develop teacher noticing skills (Kleinknecht & Gröschner, 2016; Van Es & Sherin, 2008; Weber et al., 2018), stimulate knowledge-based reasoning (Stürmer et al., 2013; Santagata & Angelici, 2010), foster the application of professional knowledge to a new context (Beck et al., 2002; Roth et al., 2011, 2019), facilitate change in practice (Roth et al., 2011, 2019, 2017; Borko et al., 2008) and influence student learning outcomes (Roth et al., 2019; Taylor et al., 2017, 2016). It has also been used to develop teachers' ability to elicit, identify and interpret student thinking (Sherin & van Es, 2005; Santagata & Taylor, 2018); identify, interpret, and analyze evidence of powerful classroom (Schoenfeld, 2017, 2014); demonstrate how knowledge about teaching and learning can be applied to actual classroom situations and provide opportunities for student teachers to discuss and elaborate events in the cases (Beck et al., 2002; Moreno & Ortegano-Layne, 2008; Moreno & Valdez, 2007; Nagro et al., 2017). For instance, in two studies by Mayo (2002) and Mayo (2004), students in the case narrative condition outperformed those in the lecture condition in their comprehension and application of introductory psychology concepts and course principles, respectively.

This article examines three instructional considerations and implications for optimizing the benefits of classroom video cases for preservice teacher education. First, we explore the application of multimedia learning principles for optimizing the benefits of cases to facilitate preservice teacher learning and practice. Classroom cases come in different media formats, such as written, animated, or video. These media formats have implications for the cognitive processing of classroom events, and relevant multimedia learning principles can optimize their benefits for learning (Derry et al., 2014; Mayer, 2002, 2014; Aina & Aina, 2023). Second, we examine the capacity of classroom cases for generative learning. Cases situate learning and instruction in the real-world context of teaching and

engage preservice teachers in generative and meaningful learning. Classroom cases problematize teacher education and provide preservice teachers the opportunity to apply theories to actual classroom events (Hatch et al., 2016; Csanadi et al., 2021; Syring et al., 2015; Gravett et al., 2017; Stark et al., 2011). In other words, it serves as a generative prompt and fosters the transfer of learning for contextual application (Stark et al., 2011; Syring et al., 2015; Hatch et al., 2016; Fiorella & Mayer, 2015). Third, we discuss the potential of collaborative learning for harnessing the instructional effectiveness and benefits of classroom cases. Research suggests that the generative capability of cases is more pronounced when preservice teachers analyze cases in social contexts, such as cooperative learning environments, collaborative environs, or within communities of practice (Csanadi et al., 2021; Gravett et al., 2017; Derry et al., 2002; Chi & Wylie, 2014; Chi et al., 2018; Aina & Aina, 2023).

4. Classroom Cases and Multimedia Learning

Generally, classroom cases can be in various media formats, such as written, animated, or video cases (Moreno & Ortegano-Layne, 2008; Moreno & Valdez, 2007). These media formats have implications for the cognitive processing of classroom events, and relevant multimedia learning principles can optimize their benefits for learning (Mayer, 2002, 2019; Moreno & Valdez, 2007; Derry et al., 2014). Early studies in multimedia learning research focused on the media effect, examining how one medium helped students learn the information better than another. Over time the focus shifted to the multimedia effect, the impact of learning from words and pictures relative to words alone (Mayer, 1997; Clark, 1994, 2001; Mayer, 2020a, 2020b; Kozma, 1994; Jonassen et al., 1994). Some studies have examined multimedia affordances, while others focused on the value-added benefits of one instructional method over the other (Mayer, 2020a, 2020b).

According to multimedia learning theories, people process words, spoken or written, and pictures differently, which has implications for learning (Mayer, 2020b). Theories like Dual coding (Clark & Paivio, 1991; Paivio, 2006), Working memory (Baddeley et al., 2015), Cognitive load (Sweller et al., 2011; Sweller, 2011), and the Cognitive Theory of Multimedia Learning (CTML, Mayer, 2005; Mayer, 2022) have evolved to explain how people learn from multimedia. The dual-coding theory makes clear that people have different information processing channels for words (auditory) and pictures (visual) (Clark & Paivio, 1991; Baddeley, 1997, 1992). The theory of working memory, cognitive load, and CTML describe learners' limited cognitive capacity in consciousness and for learning (Sweller, 2016; Sweller, 2011; Mayer, 2022). CTML specifically describes how learners engage in three kinds of cognitive processing that compete for their limited cognitive capacity: 1) extraneous processing, 2) essential processing, and 3) generative processing (Mayer, 2022). In line with CTML, when preservice teachers study classroom cases or view videocases, they engage in a mix of these

pieces of cognitive processing. Therefore, instruction should aim to minimize extraneous load and processing, manage intrinsic and essential processing, and facilitate generative learning experiences.

Extraneous processing or load does not support instructional goals, instead it impedes learning; essential processing or intrinsic load involves selecting relevant information from complex material represented in the working memory, while generative processing or germane load engages prior knowledge and motivation to make sense of presented information (DeLeeuw & Mayer, 2008; Mayer, 2020a; Sweller et al., 2011; Paas & Sweller, 2014). By implication, if learners engage in extraneous processing, learning is impaired; if they engage in essential processing, that might result in rote learning, strong retention, but weak transfer performance, while generative learning results in meaningful learning, improved retention, recall, and transfer performance.

4.1. Multimedia Principles for Optimizing Classroom Cases

Scholars have developed different principles for minimizing extraneous processing or load, optimizing essential or intrinsic load, and strengthening generative processing or germane load (Mayer, 2020b, 2020c). Studies have shown that extraneous processing is minimized when irrelevant information is excluded (coherence principle); cues are used to make vital information visible (signaling); the printed text is not added to graphics and narration (redundancy principle); when related words and graphics are close rather than apart or presented at the same time rather than in succession (contiguity principle) (Mayer, 2019, 2020c; Adesope & Nesbit, 2012). Past studies have also shown that intrinsic cognitive load can be optimized for learning by giving learners control over the instructional pace (segmenting principle), providing prerequisite information for learning new material (pretraining principle), and combining graphics with narration rather than graphics and onscreen text (modality principle) (Mayer, 2019, 2020c; Paas & Sweller, 2014). Likewise, generative processing or germane cognitive load can be reinforced when both auditory and visual channels are engaged rather than words alone (multimedia principle); conversation rather than formal language is used (personalization principle); human voice rather than machine voice is used for narration (voice principle); gestures such as eye contact, meaningful facial expressions, and body movements are engaged (embodiment principle); and learners have the opportunities to construct new knowledge (generative learning) (Mayer, 2019, 2020c; Wong & Adesope, 2021).

In case-based instruction, little is known about how the multimedia principles play out when learning from cases. However, there is ample evidence from multimedia learning research that can provide instructional design guidance for optimizing case-based instruction. For instance, earlier studies have shown that, in addition to enabling better learning transfer, classroom video cases might be more emotionally and motivationally appealing to preservice teachers than written cases (Derry et al., 2002, 2014; Moreno & Ortegano-Layne, 2008). In a study

by Moreno and Ortegano-Layne, video and animated cases were compared to written cases and a control group. Preservice teachers in the video and animation case conditions outperformed the control group on both learning performance and attitude toward learning (Moreno & Ortegano-Layne, 2008). In another study, Moreno & Valdez (2007) found that video cases were more effective for learning transfer and affect, than written cases and the control condition.

To harness the benefits of classroom cases, it is crucial to use effective pedagogical approaches that can mitigate cognitive load and preservice teachers' preconceptions about teaching with which they view and make sense of the complexities of teaching. For instance, teacher educators can help their students learn from video cases by leveraging multimedia learning principles and the science of instruction in their use of video cases (Mayer & Moreno, 2003; Derry et al., 2014).

According to Derry et al. (2014), since video cases have both pictures and words, preservice teachers might experience dual-channel cognitive loads, coupled with the complexities of teaching and its multiple events happening simultaneously. They might find cases designed to align with the coherence and signaling principles helpful for reducing extraneous loads and paying attention to critical classroom events important to student learning (Mayer & Moreno, 2003; Derry et al., 2014; Palincsar et al., 2007). They also recommended using the segmenting principle to design video cases in bites or mini cases, each focusing on a specific classroom event and accessible for student teachers to start, stop and rewind (Derry et al., 2010; Derry et al., 2014; Mayer & Moreno, 2003).

4.2. Application of Pretraining in Classroom Cases

The pretraining principle is a multimedia principle that is very valuable for case-based instruction; providing prior training to preservice teachers before engaging with cases might enhance their ability to pay attention to critical classroom events important to student learning. Pretraining has been used in online teacher education courses to help preservice teachers develop the conceptual understanding needed to notice and make better sense of the videocases they viewed (Derry et al., 2014; Hmelo-Silver et al., 2009). Another study also found that preservice teachers who read pretraining material before viewing a video case outperformed those who watched the case before reading on both retention and transfer of learning (Beitzel & Derry, 2009).

According to the pretraining principle, one way to help preservice teachers manage essential processing when learning from classroom cases, such as viewing video cases, is to equip the learner with the knowledge that would make it easier to process the events in the case they are viewing. Such knowledge is usually provided before exposure to the classroom cases and provides preliminary knowledge for processing the case event deeply. For instance, in viewing video cases relating classroom events to relevant prior knowledge, pretraining can help pro-

vide and activate the prior knowledge preservice teachers need to process and notice important case events effectively. Furthermore, stock video cases can be introduced to preservice teachers before they begin analyzing their own teaching videos to activate the level of interest they need to engage productively with case analysis (Aina & Aina, 2023). However, the pretraining principle is more likely to be effective when the video cases are long, advanced, feature problematic and complex classroom events, or when the video is not self-paced, and preservice teachers have limited knowledge about the core topics of interest (Derry et al., 2014; Mayer, 2022, 2020c; Blomberg et al., 2013).

4.3. Future Research on Multimedia Principles in Case-Based Environments

Overall, there is a need to examine how different multimedia principles apply to learning from cases, including written, video, and animated (Derry et al., 2014; Blomberg et al., 2013). There is also a need for more experimentally designed studies examining boundary conditions for learning effectively from cases. For instance, it is unclear how different media and instructional methods for learning from cases constitute cognitive load. That will also be a crucial line of research. Additionally, more intersectional studies are needed to examine interaction effects, contexts, cognition, and design elements of different types of cases.

5. Maximizing the Benefits of Cases with Generative Learning

Learning can take different forms, such as rote, association, or generation (Fiorella & Mayer, 2015). Rote learning entails memorizing information, associative learning involves building association, while generative learning demands that the learner draw meaning from and make sense of the information they are learning (Fiorella & Mayer, 2015; National Research Council, 2012; National Research Council, 2004).

Preservice teachers must develop a sound understanding of content knowledge, pedagogical knowledge, pedagogical content knowledge, child development, classroom management, and technology integration; however, it is more important that they can use the acquired knowledge in the context of practice to address critical classroom events (Darling-Hammond & Hammerness, 2005; Darling-Hammond, 2014). This practice-focused goal of teacher preparation necessitates the need to engage preservice teachers in generative learning experiences, which require them to actively make sense of the teaching cases they engage in during their learning and apply what they learn in new situations (Ball & Forzani, 2009; Santagata & Guarino, 2011; Shulman, 1992).

Generative activities are learning or instructional strategies that help learners deeply process and make productive sense of the information they learn (Fiorella & Mayer, 2015; National Research Council, 2012). Meaningful learning occurs when learners are engaged in generative activities; they help learners engage in appropriate cognitive processing during learning. Learners attend to relevant

information, mentally organize incoming information into a well-aligned and easily retrievable cognitive structure and integrate or establish meaningful relationships among the cognitive structures of information being stored and a productive path to relevant prior knowledge (Fiorella & Mayer, 2015, 2016). Learners' cognitive structures are the layers of knowledge constructed as they process the information they learn in their working memory. These layers of knowledge do not become learning until integrated and aligned with what the learner already knows and stored in their long-term memory.

5.1. Generative Activities for Supporting Classroom Cases

Scholars have examined different activities that enable meaningful learning and reinforce the transfer and application of theoretical understanding of concepts to authentic case scenarios and problems of practice, such as explaining material to oneself, teaching others, constructing a concept map, or representing knowledge through drawing (Chi et al., 1994; Fiorella & Pilegard, 2021; Fiorella & Mayer, 2016). In preservice and in-service teacher education, case-based instruction has been used to develop teachers' domain knowledge and pedagogical competencies. In particular, researchers and teacher educators have used CBI to reinforce teachers' professional vision, their ability to notice germane classroom events, use appropriate theories to conceptually make meaning of their observation, and decide on a strategical and empirically appropriate course of action (Derry et al., 2014; Santagata & Taylor, 2018; Santagata et al., 2021).

Studies have shown that CBI is an effective strategy for engaging preservice teachers in meaningful learning; it fosters their ability to apply theoretical knowledge to situated problems of practice (Santagata & Taylor, 2018; Darling-Hammond & Hammerness, 2002; Sherin & van Es, 2009; Van Es & Sherin, 2002). Though not all cases are used generatively to foster learning transfer, case activities that engage preservice teachers in generative tasks can reinforce all aspects of preservice teachers' professional vision, including noticing authentic classroom events (selecting), using appropriate theories to make meaning of their observation conceptually (organizing), and deciding on a strategical and empirically appropriate course of action (integrating) (Derry et al., 2014; Fiorella & Mayer, 2015).

According to Jonassen (2006), cases serve different functions, which have varying implications for students' roles and activities when they learn from cases. For instance, cases can be used as exemplars for illustrating models of excellent practice, as analogs for making recommendations, as prompts for analysis of practice, as problems to solve, and as tasks for students to develop to demonstrate theoretical understanding (Merseth, 1994, 1990). Each of these case activities demands and activates different cognitive processing, engenders different forms of learning and motivational outcomes, and fosters different aspects of teachers' professional vision (Santagata et al., 2021; Jonassen, 2006; Mayer, 2002, 2014; Sherin & Jacobs, 2011).

5.2. Strengthening Preservice Teacher Noticing with Generative Case Activities

Earlier studies used video cases as a prompt to facilitate preservice teachers' noticing and recall of different features of the classroom video vignette they viewed. Student teachers were asked to remember features of the classroom environment, classroom management, tasks, mathematical content, and communication they observed in the video case (Star et al., 2011; Star & Strickland, 2008). Although recall represents rote or associative learning, the skill of noticing it engenders is the foundation upon which other generative-related aspects of a teacher's professional vision lay (Star et al., 2011). Improving preservice teachers' abilities to notice classroom events is critical to strengthening their ability to interpret and make sense of essential classroom features. Syring et al. (2015) found that although direct instructional cases were equally motivating as problem-based cases, PBL was more effective than direct instructional cases for supporting preservice teachers' immersion in case activities, their perceived pleasure, and the practical relevance of teacher preparation courses.

Typology for using cases: Following Jonassen (2006)'s typology, generative learning is more likely to be fostered when preservice teachers analyze cases, solve a problem of practice represented in a case, or construct a case by themselves to represent a given problem of practice or depict a pedagogical principle (Aina et al., 2022). When learners analyze a case, they identify pedagogical principles as criteria for evaluating the case and search for evidence to support their analysis and conclusions (Jonassen, 2006; Merseth, 1994; Ellet, 2018). Their primary task is to associate case events with appropriate theoretical and pedagogical principles of teaching and learning. Likewise, when they learn with cases as problems to solve, they use theories in novel ways to generate and iteratively test their ideas and solutions (Jonassen, 2006; Merseth, 1994). Additionally, student teachers can construct new cases representing essential theoretical and pedagogical principles (Beck et al., 2002; Darling-Hammond & Hammerness, 2002).

Using a web-based environment, Stark et al. (2011) combined example-based learning with problem-based cases to examine the effects of cases as examples on the diagnostic competence of students in training. They examined the effects of example format (erroneous examples vs. correct examples) and feedback format (elaborated feedback vs. corrective feedback) on domain-specific conceptual and application knowledge. Erroneous examples with elaborate feedback improved the students' transfer of learning. In particular, they found that giving detailed feedback effectively facilitates conceptual and application knowledge.

Prior knowledge in cases: In line with the generative learning principles, Stark et al. (2011) noted that prior knowledge is the strongest predictor of students' diagnostic competence when learning from cases with complex examples, stronger in effect than the duration of time students spend on the task, the format of example, or the feedback type they receive. A deep conceptual understanding is critical for students to effectively process cases with complex exam-

ples and domains. Their study also indicated the essential role of detailed but optional expert feedback for enhancing conditional knowledge for both beginning and advanced students when studying complex materials.

In testing the hypothesis about preservice teachers' professional vision for noticing, reasoning, and deciding about problematic student beliefs about mathematical abilities, Rieche et al. (2019) found that only a few preservice teachers noticed dysfunctional mathematical beliefs, described them using theoretical concepts or generated evidence-based and valuable strategies for addressing the beliefs. The authors linked the noticing problems to insufficient conceptual understanding (low prior knowledge) and difficulty putting knowledge into practice. They called for intervention to strengthen preservice teachers' conceptual knowledge and integrate concepts into practice through generative prompts.

Fostering creative thinking and reflective practice: In a mixed factorial study where instructional approaches (example-based learning and generative tasks) were crossed with text-rich multimedia classroom cases as independent factors. Aina et al. (2022) reported that preservice teachers that learned with cases, either as an example-based or generative task, did not differ significantly in their learning theories or text interpretation scores. However, the authors discovered that participants' learning theories and text interpretation scores consistently increased under the generative condition over time. They did not find that progressive growth trend in the modeling condition. They concluded that generative tasks have the potential to unlock preservice teachers' creative and reflective minds.

Segmentation in cases: More recently, Martin et al. (2022) investigated how segmenting a videocase and eliciting reflection through either open or focused self-explanation might foster preservice teachers' professional vision. Being a generative learning strategy, self-explanation was expected to facilitate students' professional vision. The authors did not find evidence for increased professional vision and learning gains across groups in the posttest; however, they reported that students who received segmented videos performed better than those who received whole videos during study implementation. This is in line with the recommendation by Derry et al. (2014) that teacher educators employ the segmenting principle to design video cases that are broken up into bite-sized or mini cases, each of which focuses on a particular classroom event and can be started, stopped, and rewound by preservice teachers (Derry et al., 2010, 2014; Mayer & Moreno, 2003). Additionally, Martin et al. (2022) recommended that segmenting be used in a way that does not deplete working memory resources by including longer breaks in the videos to make the number of segments manageable and the flow of the video events meaningful for the preservice teachers.

Self-explanation in cases: Similarly, Martin et al. (2022) found that students in the focused self-explanation noticed more instructional strategies during training than those in open self-explanation. They also observed a significant increase in performance from the pretest to the posttest across groups that they at-

tributed to the intervention. Likewise, they suggested that self-explanation be used to minimize students' chances of focusing on less relevant events, perhaps by providing clear objectives and prompts appropriate for students' level of prior knowledge. Their study revealed that students might find it hard to transfer scaffolds from cases with focused explanation prompts to cases with an open explanation prompt if those scaffolds were removed too early rather than gradually, especially for low prior knowledge students. It is, therefore, essential to know that preservice teachers with high prior knowledge of the videocase might not benefit as much as those with low prior knowledge from either segmenting or focused prompts. Suppose the prompts are too focused, and the preservice teachers have higher prior knowledge; in that case, they might experience an expert-reversal effect, a condition in which instructional strategies that work well with novices may lose their potency or even backfire when applied with more seasoned students (Mayer, 2022, 2020c; Fiorella & Mayer, 2015).

While it might look simple to implement at first, implementing CBI as a generative activity requires deliberate attention to instructional design. No doubt, generative tasks are powerful for helping preservice teachers develop practice-based knowledge; however, teacher educators must provide appropriate guidance that should be clear and cognitively activating. It is clear to the extent that it reduces the risks of students generating explanations on irrelevant instructional events and is rich in cognitive activation in that it prompts preservice teachers to leverage their prior knowledge of theories and experiences.

6. Leveraging Collaborative Activities for Meaningful Case-Based Learning

The cognitive perspective of learning constrains meaningful learning to what happens in an individual's mind (Vosniadou, 2007; NASEM, 2018). The learner processes the information they learn in their cognitive architecture; they engage in appropriate cognitive processing of the information, elaborate and represent the information in ways that make it easy to retrieve and use in a new context (Mayer, 2002; Fiorella & Mayer, 2015). However, this view of learning fails to capture other people's role in developing the cognitive, intrapersonal, and interpersonal abilities needed to make generative learning attainable. The sociocultural learning perspective fills this void; it posits that meaningful learning occurs best in group contexts when people interact with others during their learning process (NASEM, 2018; Putnam & Borko, 1997, 2000).

The sociocultural perspective of learning takes into account social activities that foster appropriate cognitive processing during learning. In this sense, meaningful learning takes place as people participate in the practices of a community, and learning is both situated and emerges from the practices of such communities of practice and collaborative effort (National Research Council, 2012; Putnam & Borko, 1997, 2000). People learn a lot from birth to adulthood through discourse and interactions with others; they build communities of prac-

tice and leverage the learning of others during collaborative work and interactions with others. Therefore, active group participation and social interaction serve as a germane mechanism through which individuals internalize knowledge and develop the confidence to use it in new contexts to solve problems (National Research Council, 2012; Enyedy & Stevens, 2014; Miyake & Kirschner, 2014; Nokes-Malach et al., 2019).

Engagement in communities of practice occurs in two ways; people develop knowledge and skills and also apply them in communities of practice (Enyedy & Stevens, 2014; Nokes-Malach et al., 2019). Individuals' meaningful experience from active participation in social interaction motivates them to learn and seek mastery goals (Aina & Aina, 2023). When people engage with others in a community, they observe and adopt the criteria that others employ to evaluate their competence and use those criteria to improve their learning and performance. They imbibe the community's culture of continuous improvement and development. As a generative process, social interaction also provides the context for critical cross-examination of an individual's thinking, misconception, and beliefs (National Research Council, 2012; Nokes-Malach et al., 2019). This refinement of knowledge provides opportunities for the learning and growth of the participants in the community of practice.

Studies that examined collaborative learning in case-based instruction showed mixed findings. Csanadi et al. (2021) examined whether preservice teachers would learn better from cases in a collaborative setting than in an individual setting; they found that students who collaborated made significantly less reference to scientific theories and evidence than individuals. However, collaboration effects were observed for problem explanation, evidence evaluation, solution generation, and communication. In essence, collaboration is beneficial for engaging preservice teachers in analyzing problems of practice, evaluating cases using evidence, and generating solutions to authentic problems. However, collaboration can also be constrained by social loafing, social anxiety, and production blocking.

Comparing collaborative and independent uses of cases to lecture only, Arrastia-Chisholm et al. (2021) did not find a significant difference in conceptual learning among the three conditions. Additionally, collaborative case analysis resulted in significantly lower scores on the summative application-based multiple-choice questions compared to individuals. Caution must be taken in interpreting these findings, considering the internal weaknesses and limitations of the study design. For instance, the study did not account for prior knowledge and learner experience, implemented no random assignment, and assessed outcome variables using multiple-choice questions rather than alternative transfer measures.

Mayo (2004) randomly assigned preservice teachers to receive either CBI involving a collaborative activity or lectures only. The author found that students in the CBI condition performed better than those who received traditional in-

struction on comprehension and application of course principles. Specifically, the author found benefits for engaging students in collaborative discussion. However, it is unclear how collaboration contributes to the learning outcomes. It could have been helpful if an additional group was added to the study to learn with CBI without the collaborative component; that would help disentangle the collaborative effect when learning with cases. However, students in the CBI condition found their case-based learning experience productive, enjoyable, realistic, and helpful.

Using multiple sources of qualitative observational data, Gravett et al. (2017) reported that engaging preservice teachers in a collaborative discussion of cases resulted in actively engaged learning, immersed and caused students to value the complexities and uncertainties of teaching, fostered their relation of theories to dilemmas of practice, identification with the dilemmas of practice and relive the intricacies of classroom teaching vicariously. Gravett and colleagues made several empirical claims that would need to be subject to experimental examination. For instance, there is a need to examine how preservice teachers' identification with case dilemmas mediate the relationship between case type and their value of the intricacies of teaching.

It is also essential to examine how identifying with case dilemma (case immersion) influences their values for the complexities of teaching through the development of interest and value for conceptual knowledge and theories. Also, they claimed that the effect of learning from cases on preservice teachers' development of teaching concepts would be moderated by their preconceptions and personal experience of teaching as a learner. In line with the generative learning premise, Gravett et al. (2017) acknowledge the vital role of sufficient prior knowledge in preservice teachers' ability to relate case problems to relevant theoretical knowledge during collaborative discussion. More studies are needed to further examine some of the findings from Gravett et al. (2017).

Engaging preservice teachers in videocases with a collaboration component is valuable, especially when there are clear guidelines and well-established culture for collaboration. Interdependence should be built into the activities, be it whole class or small groups, to make the working relationship productive and meaningful for the students.

7. Conclusion

In conclusion, we have advocated for a more active and interactive use of multimedia cases in preservice teacher education as a means to address the huge gaps created by limited access to the actual classroom by teachers in training. Cases have the potential to help preservice teachers gain hands-on experience in teaching and learning, coupled with the opportunity to apply theory to practice. However, educators using cases in teacher education have yet to take maximum advantage of the abundance of evidence available for making case-based instruction more meaningful, from the science of instruction in multimedia learning to

the vast body of knowledge about collaborative and generative activities that are capable of helping learners integrate knowledge in powerful ways and transfer their learning to new situations. We have also called specific attention to notable areas where there are gaps in empirical knowledge about CBI regarding multimedia and generative learning. We hope that as scholars fill these gaps in knowledge, more teacher educators will also take advantage of the enormous opportunities in generative case activities to enrich their preservice teachers' experience and equip them to face the challenges of teaching in a diverse, multicultural, multilinguistic, and technologically advanced twenty-first century. Teacher educators should become deliberate designers of classroom case activities using known and evidence-based multimedia learning principles and engaging students in meaningful case-based instruction enriched with collaborative learning opportunities.

Authors' Contributions

Conceptualization, S.A.; literature reviews, S.A.; writing—original draft preparation, S.A.; writing—review and editing, S.A. and M.A.; supervision, S.A.; project administration, S.A.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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