Vol. 22, No. 1, August, 2019, pp. 55–71

Social Discourse Influencing Elementary Teachers' Cognition and Metacognition for Problem Solving in Open-ended Professional Development

Hui-Chen K. Durley, Ph.D.
Oklahoma City Public Schools

Xun Ge
University of Oklahoma

Abstract

This study explored teachers' problem solving during technology-mediated professional development (PD) in the topic related to teaching English Learners (ELs, i.e. students whose home languages are not English). Open-ended PD provided authentic, situated contexts using videos of scenario to engage six elementary teachers to participate in small group, social discourse and collaboration for problem solving. Group social discourse was video recorded to observe participants' cognitive and metacognitive development during PD. Post-PD interviews were also conducted to explore the influence of social discourse upon individual thinking for problem solving. PD artifacts for problem solving were also collected. Data analysis revealed three themes characterizing teachers' cognition and metacognition including conceptual understanding of PD content, application of professional learning for classroom practice, and authentic discernment of activities in classroom situations. The findings suggested that when teachers developed group thinking that helped them to generalize their own classroom experience to explain problem scenarios social discourse facilitated the development of collective intelligence and enabled peers to scaffold thinking for problem solving. Lacking cohesiveness as a group, teachers' thoughts manifested individualistic interpretations and unrealistic suggestions to deal with classroom issues. Study implications include incorporating open, interactive, authentic problem-based activities that facilitate meaningful discussions and collaboration to elicit dialogical connections of minds.

Introduction

Recent advancement in technology plays a critical role in open, collaborative environments for professional development (PD) of PK-12 teachers (Carpenter, 2016; Goncalves & Osório, 2018; Hennessy, Haßler & Hofmann, 2015). Technology-mediated environments utilize technology as a support mechanism and allow learners to assume an active role in their learning experience (Jonassen, Peck, & Wilson, 1999). Some studies (Herro & Quigley, 2017; Liu, Tsai & Huang 2015) revealed that technology-mediated PD facilitated communication and collaboration and improved teachers' content, pedagogical, and technological knowledge and skills. However, Crompton, Burke, and Gregory's (2017) review of research regarding technology integration conducted from 2010 to 2015 indicated that the focus on student rather than teacher learning dominated scholarly research. In addition, Grant, Tamim, Brown, Sweeney, Ferguson, and Jones (2015) found that teachers were still in need of relevant and effective PD to help them successfully integrate technology into classroom practice. Andrei (2017) found that teachers needed more targeted PD, such as utilizing technology to address learning needs of diverse backgrounds of

students. Furthermore, researchers (Kafyulilo, Fisser, & Voogt, 2016; Van Praag & Sanchez, 2015) investigated PD outcomes and found limited transformative effect on teachers' classroom practice due to contextual factors such as technology adoption, administrators' support, teacher resistance to new technology, and etc. Thus, technology-mediated PD literature can benefit from research that attempts to understand teacher learning and development and identify critical approaches that address diverse learning needs and elicit transformative impact upon practice. These endeavors are critical for decision making for PD researchers, practitioners, and policy makers.

Technology-mediated environments designed according to constructivist perspective engage learners in mindful activities of social, dialogical, and reflective discourse and collaboration for knowledge construction (Duffy & Cunningham, 1996; Jonassen, Peck, & Wilson, 1999). Such a design is what Hannafin, Land and Oliver (1999) termed the Open-ended Learning Environment (OELE). The OELE is a pedagogical framework that intergrates technology to provide enabling contexts, resources, tools, and scaffolding for problem solving and affords learners with the autonomy, control, and pacing over the structure and sequence of learning tasks. As a learner-centered approach, the OELE allows "individual responsibility for establishing learning goals and /or determining learning means" (Hannafin, Hannafin & Gabbitas, 2009, p. 768). Problem solving in the OELE requires a high level of cognitive and metacognitive functioning (Land, 2000). Therefore, the OELE approach to teacher professional development may have the potential to promote higher order thinking and learning for authentic problem solving in real-world classroom practice. This research focuses on investigating Open-ended PD, particularly the mindful activities of social discourse and collaboration, in influencing teachers' cognition and metacognition for problem solving.

In this research, we created a professional development model, Open-ended PD, which was aligned with the OELE framework. This model, according to Hannafin, Land & Oliver (1999), values learners' divergent thinking and multiple perspectives in dealing with authentic, real-world problems. As a problem-solving process, Open-ended PD engaged a group of teachers in social-cultural activities for knowledge construction, such as social discourse involving dialogical negotiation of thinking and perspectives and collaboration involving the use of interactive resources and tools (Daniels, 2001). In this PD environment, scenario videos of authentic classroom problems teachers dealt with in routine practice were presented to support the development of situated cognition. Scenario videos also served as enabling contexts allowing teachers to develop a personal connection to learning. Online resources included various discussion topics such as recent educational trends, effective strategies, field practice, and expertise. Interactive tools, for example, webbing and notetaking online graphic organizers enabled teachers to work collaboratively to brainstorm ideas, identify possible causes to classroom problems, and consider solutions to address the issue. Scaffolding support via blogs provided an avenue for teachers to participate in asynchronized discussion with PD instructors and peers. These four components were essential in facilitating social discourse and collaboration and support teachers' cognitive and metacognitive efforts for problem solving.

Cognition refers to one's knowledge as to what one can recall, understand, or explain about his or her own cognitive phenomena (Flavell, 1979). Metacognition is the purposeful and conscious control one exerts over his or her own cognition (Brown, 1980). Cognition deals with what one knows, and metacognition entails how one goes about knowing (pathways to cognitive understanding and development). Flavell argued that monitoring one's cognition is critical for problem solving, which can be achieved through the action and interaction among one's own

metacognitive knowledge, experiences, tasks, and strategies. In addition, Ge and Land (2003; 2004) argued that problem solving requires four processes of actions including identifying problem representation, developing possible solutions, constructing arguments for proposed strategies and solutions, and monitoring problem-solving processes and evaluating final solutions. Thus, problem solving involved in classroom practice requires teachers to identify the root of problems and possible causes to problems, develop instructional strategies and classroom management tactics for solutions, construct logical reasoning for proposed instructional activities, justify changes made in classroom practice, and plan and design lessons to address the problems.

Thus, this research explored teachers' experiences in Open-ended PD and specifically focused on social discourse and collaboration influencing cognition and metacognition for problem solving. Research questions included:

1. What are the characteristics of teachers' cognition and metacognition developed as a result of social discourse and collaboration for problem solving in Open-ended PD?
2. How are teachers' cognition and metacognition influenced by social discourse and collaboration for problem solving in Open-ended PD?

Theoretical Framework of Open-ended PD

Hannafin, Land, and Oliver's (1999) OELE theorectical foundations including pedagogy, psychology, technology, culture, and pragmatics served as core principles in designing Open-ended PD. The PD environment provided an online platform for teachers to develop problem-based, situated cognition in dealing with authentic classroom issues. Supporting teachers' zone of proximal development [ZPD] (Vygotsky, 1978) with scaffolding of PD instructors and peer learners, Open-ended PD facilitates cognitive and metacognitive processing through social discourse and collaboration. Developing situated cognition is to navigate knowledge about problem contexts through individual local, socio-cultural communication (Duffy & Cunningham, 1996). Thus, teachers' understanding about problem situations associated with various contextual factors such as diverse student needs, instructional programs, and grade-level focus involves divergent thinking and multiple perspectives. In addition, prior knowledge, professional skills, and classroom experiences also play a role in generating personal theories for problem solving (Hannafin, Land, Oliver, 1999).

Problem solving involves constructing a mental representation in a given problem situation named problem space and undertaking an "activity-based manipulation of problem space" (Jonassen, 2000, p. 65). In examining problem contexts, learners identify possible causes to the problem and develop intuitive theory that generalizes "prior or everyday experience to explain system concepts" (Land & Hannafin, 1996, p. 45). Cognitive activities involved in social discourse such as articulating concepts, meanings, and propositions and interpreting and explaining individual conceptualizations to peers promote conceptual understanding (Hannafin, Land, & Oliver, 1999). Metacognition engenders when learners monitor their own thinking, reflect upon personal experiences, and ask "provoking questions" (Jonassen, 1999, p. 233) to challenge, justify, and integrate one another's thinking for problem solving. Metacognitive activities draw individual attention to incrementally and holistically examine personal intuitive theory.

Open-ended PD facilitates the development of cognitive and metacognitive abilities allowing for integration of prior and new knowledge, application of strategic thinking to challenge existing assumptions (Jonassen, Peck, & Wilson, 1999), the development of logical reasoning (Land, 2000) and pragmatic plans to include "events of instruction" (Gagné, Briggs, & Wager, 1998, p. 28). In

addition, social discourse enabling co-constructed knowledge and expertise facilitates the development of collective intuitive theory (Land & Hannafin, 2000). Collaboration helps individuals become more efficient and effective problem solvers than they are able to achieve independently, which engenders collective intelligence, the term coined by Smith (1994). Even so, collective intelligence must be contextually and authentically guided, supported, and scaffolded in order to develop discernment for real-world problem solving (Brown, Collins, & Duguid, 1989).

Teacher PD Literature Related to Technology-mediated, Open Environments

Research specifically investigating teachers' PD experiences in technology-mediated environments was found to focus on observing the change in pedagogical beliefs (Tondeur, van Braak, Ertmer & Ottenbreit-Leftwich, 2017), perspectives (Gaudin & Chaliès, 2015), reflections (Morales, 2016), and classroom practice (Whitwort & Chiu, 2015). Much of the research emphasized individual rather than group experiences. In a few studies related to social discourse, some (Kiemer, Gröschner, Pehmer, & Seidel, 2015; Pehmer, Gröschner, & Seidel, 2015; Sedova, Sedlacek, & Svaricek, 2016) investigated teachers' classroom practice in promoting student dialogues. Ab Rashid, Rahman, and Rahman (2016) studied social exchanges and interactions via social networking sites and found teachers developed strategic use of social media to construct professional identity. In addition, Kohli, Picower, Martinez, and Ortiz (2015) researched teachers' participation and discussion in informal, grassroot groups and synthesized their findings in topics related to political influence on educational policy, contextual factors in school environments, and increasingly diverse student population. These studies provide some insight into the content of discussion in social discourse.

Some researchers investigated teachers' experiences in open learning environments (Woodcock, Sisco, & Eady, 2015) for the instruction of diverse student contexts (Egbert, Herman, & Lee, 2015; Mouza, C. & Barrett-Greenly, 2015) from a design-based perspective emphasizing technological and pedagogical features. On the other hand, researchers (Baker, 2014; Kang & Cheng, 2014; Golombek & Doran, 2014) investigated teachers' cognitive development and found a close connection to instructional practice and classroom experience. To explore further, the majority of studies (Garrison & Akyol, 2015; Khosa & Volet, 2014; Szeto, 2015) researching PD impact on cognition and metacognition were found related to teachers in higher education contexts. Therefore, this research, which explored the impact of Open-ended PD upon elementary teachers' cognition and metacognition in the EL contexts, provided a significant and meaningful scholarly contribution to current PD literature.

Method

This study employed qualitative research to explore teachers' experiences in Open-ended PD. The study received approvals of both internal review boards at the researchers' university and the school district located in a southwestern state. Using the technique of convenient sampling, six teachers were selected as research participants due to work relationships with the researchers (Creswell, 1998). Informed consent of each participant was sought and obtained.

Participants and Study Contexts

Participants were elementary teachers including four females and two males. Five were Caucasian and only one Hispanic male. Pseudonyms were used to protect participants' identity. Andrew, Debra, and Rose were assigned to Group A and Angel, Cassandra, and Travis to Group

B. Group composition was based on participants' years of experience in the profession for the purpose of creating a heterogeneous group. Participants' acquaintance with one another due to their work relationships was also a considering factor to promote peer collaboration in a small group.

Open-ended PD, an online program, aimed to promote teachers' awareness and understanding of English Learners (ELs). PD activities included analyzing enabling contexts (watching a problem scenario video, discussing the classroom situations, and identifying problem space), examining resources (viewing and discussing learning content), utilizing tools (applying online graphic organizers to record group discussion, brainstorming strategies, and proposing solutions), and accessing scaffolding support from instructors and peers (posting questions and answers, providing social and emotional support for one another, and submitting learning artifacts). The scenario video featured a third grade teacher, Mrs. Marshall, teaching a science lesson. The video showed some students acting inattentively to the teacher's instruction and talking among themselves (see Figure 1 for more details). The end of the video showed the teacher reflecting upon the situation during her planning period and asking the question, "How do you improve the academic success of ELs?" Resources included online links to video lessons, articles regarding effective instruction, and district reports of student performance data; and tools such as online notetaker and webbing application were also embedded for social discourse and collaboration (see Figure 2 for more details). Scaffolding support was provided via a link to a PD blog.

Figure 1. The Screenshot Shows a Problem Scenario Video in Open-ended PD that Prompts Participants to Solve Real Classroom Problems

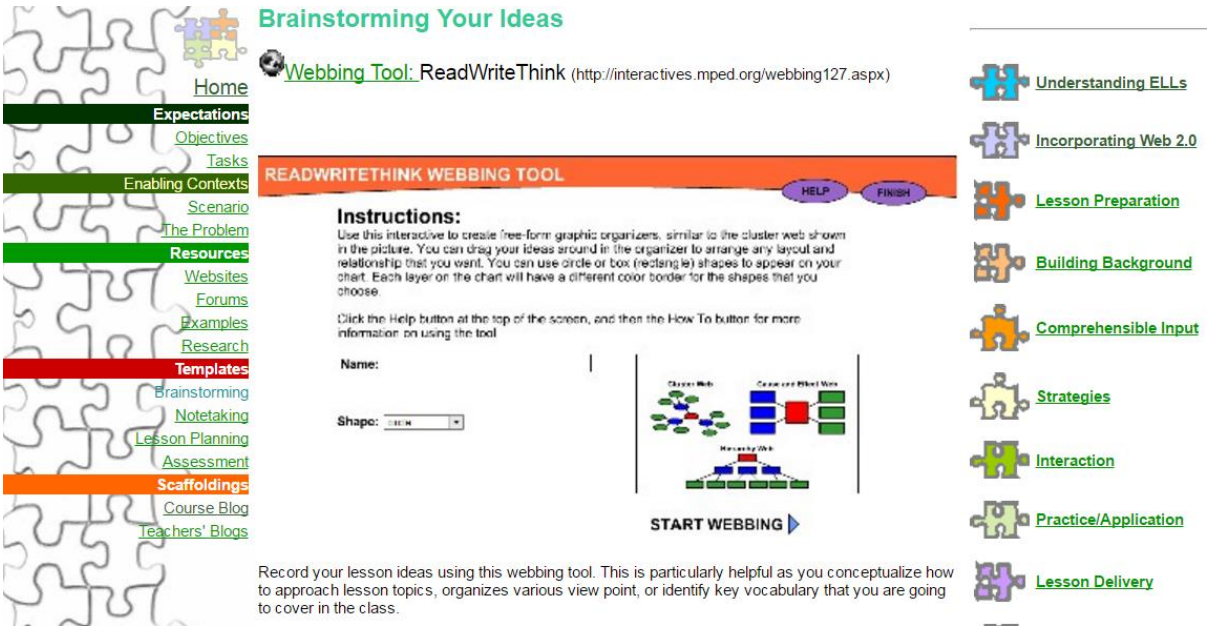

Figure 2. The Screenshot Shows a Webbing Tool in Open-ended PD for Participants to Record their Discussions and Brainstorm Ideas for Problem Solving

Data Sources

Three major sources of data helped us to understand teachers' PD experiences through social discourse and collaboration in this study. Entired group activities were video recorded in order to capture participants' real-time social discourse duing collaboration. To probe about social discourse influencing individual thinking, we interviewed each of the participants and obtained audio recordings of interview data. All the collaborative activities generated from Open-ended PD online tools and reports were also collected as PD artifacts.

Data Collection

Participants met in small groups of three with the first author who served as the PD instructor at her work location. Group A met first in one afternoon session, and Group B met the following week. Each participant had access to a desktop or a laptop computer. Participants were asked to access Open-ended PD, participate in social discourse, and work collaboratively to solve problems identified by the group. The instructor served as a facilitator to coach, scaffold, and pace PD activities and also participated in social discourse.

Each group session took approximately 90 minutes and was video recorded to observe participants' social discourse. Problem-solving artifacts including printouts of notes and graphic organizers generated in the platform were also collected. Social discourse videos were later analyzed in reference to problem solving processes, thus six excerpts were identified and selected as visual reminders for individual interviews. These excerpts served as a triggering event to further probe participants' PD experience. Individual interviews lasted about 30 minutes and were audio recorded. As a result, data collected included two social discourse videos, six individual interviews, and PD artifacts for the purpose of data triangulation in order to establish trustworthiness critical in qualitative research (Creswell, 1998).

Data Analysis

Both researchers conducted theme-based content analysis to examine social discourse video and interview data. Data analysis procedures involved transcribing, segmenting, and encoding as required in qualitative research (Van Someren, Barnard, & Sandberg, 1994). Both video and audio data were initially transcribed into text. Segmenting was done by listening to the original form of data for boundaries of phrases in speech that were marked by pauses in order to divide the text into segments. Segments were then combined into episodes to form categories and themes. The criteria in determining and assigning a particular episode to a specific category within a theme were based on our understanding of study constructs regarding cognitive and metacognitive development in Open-ended PD. Our contextual knowledge and professional experience as ELs and teaching students from diverse backgrounds also provided a strong support in our coding process. When disagreement arose, both researchers discussed the reasoning process, compared the difference in perspective, and sought consensus.

Findings

The data analysis provided answers to the two research questions: (1) understanding characteristics of participants' cognition and metacognition in Open-ended PD, and (2) the influence of social discourse and collaboration for problem solving. The analysis of interview data revealed three themes including conceptual understanding of PD content, application-focused thinking, and authentic discernment for real-world practice. Evidence of episodes supporting each theme are discussed.

Understanding Characteristics of Participants' Cognition and Metacognition in Open-ended PD

Conceptual Understanding

Interview data revealed evidence of participants recalling several key concepts introduced in the PD. The meaning of content concepts, such as weekly progress monitoring of students with urgent needs, was also explained and supported with examples of participants' own classroom practice. Propositional statements about the importance of developing cultural connections and building upon students' background knowledge showed evidence of participants developing contextual understanding of EL students. Table 1 listed detailed examples of interpretative and explanatory statements extracted from interview data. Evidence of conceptual and contextual understanding of various concepts, meaning, and propositions found in the data showed that participants not only developed declarative knowledge about the PD content but also were able to transfer it into practical knowledge reflected in their daily practice.

Table 1. *Detailed Examples of Episodes in the Theme of Conceptual Understanding*

Theme	**Category**	**Descriptor**	**Example of Episode**
Conceptual understanding	Interpretative	concepts	Andrew thought that progress monitoring showed specific area students were good at and struggled with.
		meanings	Cassandra said that the best way to learn a language was to immerse in that language environment.
		propositions	Travis said, "It was wrong, the toothpaste [brands] ...especially for English Learners. I think it needed to be more cultural...it would get them to think better. They would know it. They could associate with it better. And you can probably teach the

			subject better because it's something they already know. Whereas if I was to teach what your favorite brand of hot dog is, they probably just like I don't know. Therefore, they don't care about the subject because we've automatically gone outside of their box so they don't know how to think and they don't care about it."
	Explanatory statement to	define	Rose defined, "[Progress] monitoring…which is something that we do like DIBELS."
		clarify	Cassandra clarified a key point and understood that an inclusive classroom was a better setup for ELs to learn content subject and build language competency simultaneously.
		summarize	Debra summarized from the information presented in a PD resource video and said, "I remember in the beginning. One guy was saying that they [ELs] should be learning English first and once they understand English and they can speak it, then they can read. And then another teacher said, I disagree. I think that even though they have limited English, they can still start learning to read, instead of putting it off."
		restate	Angel restated what she remembered, "They [ELs] didn't need to be able to speak the language before they could learn to read."
		realize	Andrew realized that ELs could start learning to read English text even if they could not pronounce the words correctly.
		question	Travis asked, "What strategies were they talking about? graphic organizers or web-based programs?"
		specify	Travis specified that students' low academic performance was closely related to their family socio-economic status so even native speakers struggled academically.

Application-focused Thinking

Interview data also suggested that participants' cognitive abilities developed through social discourse involved strategic thinking, logical reasoning, and pragmatic planning. Table 2 presented examples of episodes identified in this category of application-focused thinking. Using comprehension strategies, generating rationales to support their reasoning process, and devising lesson plans to build background knowledge, illustrate concepts, and develop school-home connections showed evidence of participants' thoughts focusing on immediate application of newly learned techniques to address unique instructional needs in their own classroom practice.

Table 2. *Detailed Examples of Episodes in the Theme of Application-Focused Thinking*

Theme	**Category**	**Descriptor**	**Example of Episode**
Application-Focused Thinking	Strategies	cause/effect	Angel thought that weekly progress monitoring provided critical information, "If nobody's.. making progress... We probably need to change our approach or introduce new skills so that it's helping them [students] to be successful each week. (Angel)
		compare/ contrast	Andrew thought about using the compare/contrast strategy to identify similarities and differences of Independence Day between America and Mexico.
		classification	Rose thought to introduce classification strategies that teaching students how to organize objects in different groups.
		cluster	Debra planned to incorporate graphic organizers such as thinking bubbles to model and record students' thought processes during reading instruction.

		brainstorming	Rose brainstormed different ways including oral, visual, and tactile representations to introduce vocabulary concept.
	Logical Reasoning	argument	Angel argued for the importance of parental involvement in helping ELs practice vocabulary at home.
		inference	Debra reasoned that simply providing a word and its definition were not effective in teaching ELs new vocabulary. She made an inference of using concrete examples or demonstration.
		prediction	Travis predicted that effective progress monitoring would work well with ELs in helping teachers identifying an area of focus in small group intervention.
		consideration	Cassandra considered engaging students in pre-reading preparations including read-aloud and picture walk as a logical step to build students' background knowledge.
	Pragmatic planning	Goal and outcome	Travis thought that reading goals required biweekly adjustment to reflect students' reading abilities based on the outcomes of progress monitoring.
		problem/ solution	Travis devised a plan to direct students' attention to identify problems, critical events, and final solutions in reading passages.
		beginning/ middle/ end	Angel thought about a collaborative writing idea using video to record students' thoughts and discussion and develop storyline to include beginning, middle, and end.
		timeline	Andrew thought to introduce sequence of events in timeline and give students a visual of background information in reading passages.

Authentic Discernment

The interview data revealed that participants gained some perspectives about EL students and were able to identify themselves with their students. Travis shared his personal experience as a classroom teacher encountering language and cultural barriers in the profession. Being a Caucasian teacher reflecting upon past experiences of working with two distinct groups of African American, high school students and Hispanic elementary students, he felt the weight of confronting double language barriers. He spoke about having to make some adjustments, "I usually draw it and then do movement if it's something involves movement… I drew everything on the board even flowcharts… we'll do color and we'll do linear progression… I taught political science last year… an AP political science… And I didn't color code or anything."

These remarks showed evidence of Travis developing an awareness of the academic struggles that ELs experienced in mainstream classrooms. He recognized that language and cultural barriers also existed in his own learning to teach students different from the culture he grew up and was familiar with. Aligning perspectives gained from work experiences to instructional activities, Travis demonstrated discernment that classroom practice ought to authentically reflect the reality of ethnic and cultural differences in school communities. Authentic discernment brought about empathy and understanding of the culture of learning that empowered participants to become more conscious about student needs and more thoughtful about ways to relate instructional activities to them. Table 3 presented examples of episodes of authentic discernment that revealed participants' thinking and learning as a result of social discourse and collaboration in Open-ended PD.

Table 3. *Detailed Examples of Episodes in Theme of Authentic Discernment*

Theme	Category	Descriptor	Example of Episode
Authentic Discernment Connected to the Real World	Perspectives	self	Angel talked about her students knowing her being a candy fan and brought her Mexican brand suckers.
		peers	Cassandra wondered whether teachers at other schools shared the same views that ELs seemed confused and often felt lost in class.
		students	Debra thought ELs were particularly interested in sports so she often used the example to draw their attention.
		context	Travis thought that the district's core reading programs were insufficient to address teachers' instructional needs.
		approach	Rose thought that small group approaches were helpful, "because you can speak more of one on one with them, and it's easier for them to ask questions and get a direct answer."
	Experiences	self	Cassandra did a quick self-evaluation and admitted that she should have provided more opportunities for students to practice vocabulary.
		peers	Andrew talked about a Caucasian teacher not knowing how to comb the hair of an African American student.
		students	Angel talked about a special needs student in her class requiring a lot of repetition to learn sight words.
		context	Rose pointed out the inadequacy of the mainstream curriculum to address ELs' needs.
		approach	Travis talked about drawing pictures and graphics on the board to illustrate content concepts for his first graders.
	Activities	self	Travis talked about linear progression drawings he did on the board for first graders because of his engineer mindset.
		peers	Rose talked about gaining some insight from Andrew's sharing stories about himself growing up as an EL student.
		students	Angel talked about having students bringing the brands of toothpaste in Spanish they used at home for the lesson of graphing activities.
		context	Debra said, "Especially when we read a science lesson, I have to stop and ask them what kind of science, what kind of job is this gona prepare you for having this knowledge."
		approach	Cassandra thought that graphing foods students ate on a regular basis would be a fun activity for math.

The Influence of Social Discourse and Collaboration for Problem Solving

To answer the second research question regarding the influence of social discourse and collaboration upon participants' thinking for problem solving, both social discourse video and interview data were analyzed. The analysis revealed three themes: the development of collective intelligence, peer scaffolding support for problem solving, and hindrances to group collaboration. Evidence of episodes supporting each theme includes:

Collective Intelligence

The data analysis suggested that social discourse had a positive influence upon participants' reasoning for problem solving. The findings revealed that Andrew, Debra, and Rose in Group A developed group consciousness that arrived to consensus in explaining and interpreting the problem identified in the PD enabling context. In the interview, Andrew considered language barriers the main cause to EL students acting inattentive to instruction. He specified the teacher mishandling the situation also a contributing factor to EL students' disruptive behaviors in the

classroom. Debra also commented, "It was kind of hard just to look at the EL angle of it because you also have classroom management issues pop up." Rose's explained that ineffective instruction that failed to focus EL students' attention on learning content might have been the reason that students acted inattentively and later it became an issue of classroom management. These explanations showed a common thread of thoughts, which not only described underlying causes in interpreting the problem but also provided detailed explanations.

Evidence of the group developing group thinking manifested in their conceptualizations of problem space. Social discourse data also revealed that group thinking guided individual cognitive and metacognitive processing for problem solving. Andrew proposed several strategies including video lessons, model demonstrations, visual aids, and concrete examples to teach new vocabulary concepts. He said, "Maybe have a little model of it, showing and demonstrating how it works or what it is used for, and that would capture their attention more and they would know what an anemometer is." In the interview, Rose said, "You think about it [effective instruction for ELs], but you don't think about as many ways as you can do it." In reviewing the social discourse video, she realized that some classroom issues such as student chit chatting and playing she constantly dealt with might have been related to a lack of language proficiency in understanding instruction and insufficient background knowledge to the mainstream curriculum that was insensitive to students' unique cultural needs. Evidently, Andrew's remarks in the video modeled a logical reasoning process for Rose to reexamine student behavior in a new light. Social discourse triggered recognition and metacognition enabling the group to generate cohesive, collective intuitive theory to frame the problem in more depth, develop better instructional strategies, and consider changing classroom practice to reflect more closely to student learning needs. Group A demonstrated complexity in contextual knowledge, strength in pedagogical application, and keen discernment in dealing with challenges in the profession, which helped them solve problems more intelligently than they would have accomplished independently. Collective intelligence characterized the group's social discourse and collaboration and promoted cognition and metacognition of each member's problem-solving practice in the profession.

Scaffolding Support

The analysis of social discourse video data also suggested that Group A developed a mutual understanding in support of one another's thinking. In reviewing student performance data in PD resources, Debra argued that EL students should experience fewer language barriers in the subject of math than other subjects including language arts, social studies, and science. In the interview, Andrew responded, "I know what she's talking about... Math was something that was more of a universal thing [language]." Both were in agreement of each other's perspectives considering math a more leveled field for ELs' academic growth.

However, previous year's state testing data in the PD resources showed a trend of ELs' underperformance in math. As a fourth-grade teacher, Debra reflected upon her own practice and provided an observation regarding the trend.

> In those higher grades or overall, there's a lot of reading that's involved in those math questions. So I would consider if it was just math [in terms of number and operation]. Yes, it would be higher [performance of ELs shown in the state testing data] because they could do the work. It could be the way we are teaching the math vocabulary. I mean there are a lot of vocabulary not just in reading but math too, academic vocabulary. And it could be the way that math's presented on CRT [the state standardized test]. They're all story problems. Maybe the kids aren't getting the help

> on that. It could be that we're all just putting so much focus on reading so math is suffering. It could be any of those factors.

In the interview, Andrew responded to Debra's remarks and commented that her reasoning process with step-by-step explanations and sharing experiences related to teaching upper grades provided scaffolding to help him understand school academic performance reports and also develop an awareness of critical practice varied in grade levels. He said that Debra pointed out a new direction that he should strengthen his focus on math vocabulary and reading comprehension of story problems in his first grade class. Evidently, the data suggested that social discourse provided scaffolding support for reflective practice benefiting group members in developing authentic discernment and keen insight into critical practice in their profession.

Hindrances to Group Collaboration

The analysis of Group B social discourse video revealed that each member had individualistic thinking different from one another. Angel, Cassandra, and Travis had their own theory in interpreting the classroom problem in the PD enabling context. Cassandra thought the teacher lacked a clear lesson focus. Angel thought language barriers was the problem that hindered EL students from understanding instruction. Travis felt that the teacher had a negative attitude toward the students being targeted. The video data showed evidence of the group expressing personal views about the problem situation and uttering opinions about the teacher featured in the scenario video. Intuitive theories generated in the group's problem solving appeared individualistic and incohesive, and none of the viewpoints were taken into consideration by their peers.

Guided by personal theory, the interview data also revealed divergent thinking patterns in the group's proposed strategies and solutions for problem solving. Cassandra suggested to have a warm-up activity to introduce the lesson purpose and focus students' attention on vocabulary. Angel said that a new seating arrangement to isolate inattentive students from one another and also move them in close proximity to the teacher should resolve the issue. These action plans, whether to restructure instructional events or implement a classroom management technique, might only have a temporary effect upon improving the teacher's lesson delivery or modifying student behaviors, however did not address the problem of language barriers.

When probed about bridging the gap of language barriers in the interview, Angel, a first year novice, reasoned that EL students' parents and family should offer some support. She suggested, "That [introducing language] should be something the parents have to help ...because we don't have enough hours in a day to completely teach them everything in our core reading but also build the vocabulary as well." However, in the video data, Travis already told the group, "With EL households, homework, anything dealing with home just becomes too difficult… I don't think you can really have an expectation on it." He later explained in the interview that most of the parents in the low socioeconomic neighborhood lacked the education and proficiency in English and were not capable of helping students with school work. Despite her 25 years of teaching experience, Cassandra said in the interview, "I don't know. That's my problem, I don't know where to go for help for them [ELs]. I don't know what that wall is." These remarks suggested that social discourse provided little benefit for the group to reexamine the underlying problems confronting them in the profession.

Furthermore, both video and interview data revealed some noteworthy patterns of interaction among members of the group. In the interview, Angel responded to the video showing her patting Travis's head for not knowing the term, graphic organizers, "I am glad that somebody has to keep him on track." Cassandra also commented Travis being stubborn and argumentative. Travis

responded and said, "This is where it's me versus the world." He often felt like a loner and not being understood by his teammates. Evidently, adherence to individualistic intuitive theory, unwillingness to listen and accept others' perspectives, and having presumptuous attitudes toward one another created hindrances to the group's thinking and development for problem solving.

Discussion and Conclusion

Results of this study suggested that Open-ended PD promoted teachers' situated cognition to develop contextual knowledge, strategic thinking, and real-world discernment to deal with students of diverse languages and cultures. Especially, when social discourse and collaboration engendered collective intelligence enabling participants to generate group thinking and scaffold peers' cognition and metacognition, they gained new perspectives to examine classroom problems encountered in their profession. This finding supported Land and Hannafin's (2000) literature emphasizing the critical importance of cognitive and metacognitive scaffolding in influencing individual thinking and decision making for problem solving. Similar results were also found in the empirical research (Pehmer, Gröschner & Seidel, 2015; Thomas, Bell, Spelman, & Briody, 2015; Xie, Yu, & Bradshaw, 2014) that constructive discussions, open to one another's viewpoints and carefully considering feedback of peers improved individual performance on learning tasks.

The outcomes of this study also suggested that authentic problem solving in Open-ended PD promoted professional dialogue, rich in breadth and depth, pointing to critical aspects that echoed educational trends found in empirical research of the K-12 contexts, for example, the challenge of increasingly diverse students in today's classrooms (Kohli, Picower, Martinez & Ortiz, 2015; Mouza & Barrett-Greenly, 2015; Silverman, Martin-Beltran, Peercy, Hartranft, McNeish, Artzi & Nunn, 2017) and state testing requirements and school accountability with regards to ELs (Thompson, 2017; Umansky, 2016; Wolf, Guzman-Orth, Lopez, Castellano, Himelfarb & Tsutagawa, 2016). We recognized that the findings of this study yielded from a small sample size of only six teachers (five Caucasians and one Hispanic) insufficient to reflect and represent today's teaching force and was also limited in research scope and generalizability inherent in qualitative inquiry. However, these individuals' real-time PD experiences were captured in videos and their thinking during the problem solving process were explored deeply through rich qualitative data, which provided a detailed portrait and empirical support for constructivist theory in optimizing a learners zone of proximal development.

Thus, this research provided significant and meaningful results that have a strong implication for researchers, practitioners, and policy makers in the teacher PD context. First, PD practitioners including trainers, school administrators, and district leaders should consider Open-ended PD approach to cultivate teachers' reflective thinking and problem-solving practice involving diverse student population in our school situations. Second, policy makers should adopt a bottom-up approach that pays special attention to teacher voice for decision making on curriculum, standards, and assessment that tailor to EL's developmental needs. Third, researchers interested in teacher PD should focus on identifying effective practice and approaches that transform the knowing, thinking and doing. Our future studies will also focus on replicating this research using social media to facilitate social discourse and collaboration in problem-based PD to explore learner engagement, social interaction, characteristics of social discourse through social media, and cognitive and metacognitive development in problem-based approaches.

References

Ab Rashid, R., Rahman, M. F. A., & Rahman, S. B. A. (2016). Teachers' engagement in social support process on a networking site. *Journal of Nusantara Studies (JONUS)*, *1*(1), 34–45.

Andrei, E. (2017). Technology in teaching English language learners: The case of three middle school teachers. *TESOL Journal*, *8*(2), 409–431.

Baker, A. (2014). Exploring teachers' knowledge of second language pronunciation techniques: Teacher cognitions, observed classroom practices, and student perceptions. *Tesol Quarterly*, *48*(1), 136–163.

Brown, A. L. (1980). Metacognitive development and reading. *Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence, and education*, 453–481.

Brown, J. S., Collins, A., and Duguid, P., (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32–42.

Carpenter, J. P. (2016). Unconference professional development: Edcamp participant perceptions and motivations for attendance. *Professional Development in Education*, *42*(1), 78–99.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage.

Crompton, H., Burke, D., & Gregory, K. H. (2017). The use of mobile learning in PK-12 education: A systematic review. *Computers & Education*, *110*, 51–63.

Daniels, H. (2001). *Vygotsky and pedagogy.* London, UK, and New York, NY: RoutledgeFalmer, Taylor & Francis Group.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology: A project of association for educational communications and technology* (pp. 170–198). New York, NY: Macmillan.

Egbert, J., Herman, D., & Lee, H. (2015). Flipped instruction in English language teacher education: A design-based study in a complex, open-ended learning environment. *Tesl-Ej*, *19*(2), n2.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American psychologist*, *34*(10), 906.

Gagne', R. M., & Glaser, R. (1998). *Instructional technology: Foundations*. Tallahassess, FL: Holt, Rinehart, and Winston.

Garrison, D. R., & Akyol, Z. (2015). Toward the development of a metacognition construct for communities of inquiry. *The Internet and Higher Education*, *24*, 66–71.

Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational Research Review*, *16*, 41–67.

Ge, X., & Land, S. M. (2003). Scaffolding students' problem-solving processes in an ill-structured task using question prompts and peer interactions. *Educational Technology Research and Development*, *51*(1), 21–38.

Ge. X., & Land, S. M. (2004). A conceptual framework for scaffolding III-structured problem-solving processes using question prompts and peer interactions. *Educational Technology Research and Development, 52*(2), 5–22.

Golombek, P., & Doran, M. (2014). Unifying cognition, emotion, and activity in language teacher professional development. *Teaching and Teacher Education*, *39*, 102–111.

Gonçalves, B., & Osório, A. (2018). Massive Open Online Courses (MOOC) to improve teachers' professional development. *RE@ D-Revista de Educação a Distância e Elearning*, *1*(1), 52–63.

Grant, M. M., Tamim, S., Brown, D. B., Sweeney, J. P., Ferguson, F. K., & Jones, L. B. (2015). Teaching and learning with mobile computing devices: Case study in K-12 classrooms. *TechTrends*, *59*(4), 32–45.

Hannafin, M., Hannafin, K., & Gabbitas, B. (2009). Re-examining cognition during student-centered, web-based learning. *Education Technology Research Development, 57*, 767–785.

Hannafin, M., Land, S., & Oliver, K. (1999). Open learning environments: Foundations, methods, and models. In C.M. Reigeluth, (ed.). *Instructional-design theories and models, Vol. 2: A new paradigm of instructional theory*, (pp. 115–140). Mahwah, NJ: Erlbaum.

Hennessy, S., Haßler, B., & Hofmann, R. (2015). Challenges and opportunities for teacher professional development in interactive use of technology in African schools. *Technology, Pedagogy and Education*, *24*(5), 1–28.

Herro, D., & Quigley, C. (2017). Exploring teachers' perceptions of STEAM teaching through professional development: implications for teacher educators. *Professional Development in Education*, *43*(3), 416–438.

Jonassen, D. H. (1999). Designing constructivist learning environment. In Reigetuth, C.M. (dd.), *Instructional design theories and models*. *Vol. 2: A new paradigm of instructional yheories*, (pp. 215–239). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Jonassen, D. H. (2000). Toward a design theory of problem solving. *Educational technology research and development*, *48*(4), 63–85.

Jonassen, D. H., Peck, K. L., and Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ and Columbus, Ohio: Prentice Hall Inc.

Kafyulilo, A., Fisser, P., & Voogt, J. (2016). Factors affecting teachers' continuation of technology use in teaching. *Education and Information Technologies*, *21*(6), 1535–1554.

Kang, Y., & Cheng, X. (2014). Teacher learning in the workplace: A study of the relationship between a novice EFL teacher's classroom practices and cognition development. *Language Teaching Research*, *18*(2), 169–186.

Kiemer, K., Gröschner, A., Pehmer, A. K., & Seidel, T. (2015). Effects of a classroom discourse intervention on teachers' practice and students' motivation to learn mathematics and science. *Learning and instruction*, *35*, 94–103.

Khosa, D. K., & Volet, S. E. (2014). Productive group engagement in cognitive activity and metacognitive regulation during collaborative learning: can it explain differences in students' conceptual understanding?. *Metacognition and Learning*, *9*(3), 287–307.

Kohli, R., Picower, B., Martinez, A. N., & Ortiz, N. (2015). Critical professional development: Centering the social justice needs of teachers. *The International Journal of Critical Pedagogy*, *6*(2).

Land, S. M. (2000). Cognitive requirements for learning with open-ended learning environments. *Educational Technology Research & Development, 48*(3), 61–79.

Land, S. M. & Hannafin, M. J, (2000). Student-centered learning environment. In Jonassen, D. H. & Land, S. M. (ed.), *Theoretical foundations of learning environments*, (pp. 1–23). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Land, S. M., & Hannafin, M. J. (1996). A conceptual framework for the development of theories-in-action with open-ended learning environments. *Educational Technology Research and Development*, *44*(3), 37–53.

Liu, S. H., Tsai, H. C., & Huang, Y. T. (2015). Collaborative Professional Development of Mentor Teachers and Pre-Service Teachers in Relation to Technology Integration. *Journal of Educational Technology & Society*, *18*(3).

Morales, M. P. E. (2016). Participatory Action Research (PAR) cum Action Research (AR) in Teacher Professional Development: A Literature Review. *International Journal of Research in Education and Science*, *2*(1), 156–165.

Mouza, C., & Barrett-Greenly, T. (2015). Bridging the app gap: An examination of a professional development initiative on mobile learning in urban schools. *Computers & Education*, *88*, 1–14.

Pehmer, A. K., Gröschner, A., & Seidel, T. (2015). How teacher professional development regarding classroom dialogue affects students' higher-order learning. *Teaching and Teacher Education, 47*, 108–119.

Pehmer, A. K., Gröschner, A., & Seidel, T. (2015). How teacher professional development regarding classroom dialogue affects students' higher-order learning. *Teaching and Teacher Education, 47*, 108–119.

Sedova, K., Sedlacek, M., & Svaricek, R. (2016). Teacher professional development as a means of transforming student classroom talk. *Teaching and Teacher Education*, *57*, 14–25.

Silverman, R. D., Martin-Beltran, M., Peercy, M. M., Hartranft, A. M., McNeish, D. M., Artzi, L., & Nunn, S. (2017). Effects of a cross-age peer learning program on the vocabulary and comprehension of English learners and non-English learners in elementary school. *The Elementary School Journal*, *117*(3), 485–512.

Smith, J. B. (1994). *Collective intelligence in computer-based collaboration*. CRC Press.

Sedova, K., Sedlacek, M., & Svaricek, R. (2016). Teacher professional development as a means of transforming student classroom talk. *Teaching and Teacher Education*, *57*, 14–25.

Szeto, E. (2015). Community of Inquiry as an instructional approach: What effects of teaching, social and cognitive presences are there in blended synchronous learning and teaching?. *Computers & Education, 81*, 191–201.

Thomas, E. E., Bell, D. L., Spelman, M., & Briody, J. (2015). The growth of instructional coaching partner conversations in a prek-3rd grade teacher professional development experience. *Journal of Adult Education*, *44*(2), 1.

Thompson, K. D. (2017). English learners' time to reclassification: An analysis. *Educational Policy*, *31*(3), 330–363.

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*(3), 555–575.

Whitworth, B. A., & Chiu, J. L. (2015). Professional development and teacher change: The missing leadership link. *Journal of Science Teacher Education*, *26*(2), 121–137.

Wolf, M. K., Guzman-Orth, D., Lopez, A., Castellano, K., Himelfarb, I., & Tsutagawa, F. S. (2016). Integrating scaffolding strategies into technology-enhanced assessments of English learners: Task types and measurement models. *Educational Assessment*, *21*(3), 157–175.

Woodcock, S., Sisco, A., & Eady, M. J. (2015). The learning experience: Training teachers using online synchronous environments.

Umansky, I. M. (2016). Leveled and exclusionary tracking: English learners' access to academic content in middle school. *American Educational Research Journal*, *53*(6), 1792–1833.

Van Praag, B., & Sanchez, H. S. (2015). Mobile technology in second language classrooms: Insights into its uses, pedagogical implications, and teacher beliefs. *ReCALL*, *27*(3), 288–303.

Van Someren, M. W., Barnard, Y. F., & Sandberg, J. A. C. (1994). *The think aloud method: a practical approach to modelling cognitive*. London: Academic Press.

Vygotsky, L. S. (1978). Mind in society: The development of higher mental process. Cambridge, Mass.: Harvard University Press.

Vygotsky, L. S. (1987). The problem of speech and thinking in Piaget's theory. In R. W. Riebert, & A. S. Carton (Ed.), *The collected works of L.S. Vygotsky, V. I*: *Problems of general psychology* (pp. 53–91). New York, NY: Plenum Press.

Xie, K., Yu, C., & Bradshaw, A. C. (2014). Impacts of role assignment and participation in asynchronous discussions in college-level online classes. *The Internet and Higher Education*, *20*, 10–19.