The Influence of Collaborative Reflection and Think-Aloud Protocols on Pre-Service Teachers' Reflection: A Mixed Methods Approach

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The purpose of this mixed methods study was to determine if there are differences in pre-service teachers' depth of reflection when using a written self-reflection form, a written self-reflection form and a think-aloud protocol, and collaborative reflection. Twenty-six pre-service teachers were randomly assigned to fourteen teaching teams. The teams taught a lesson that was videotaped and completed a written self-reflection form while viewing their lesson. The participants were randomly assigned to a control group or experimental group. The control group reflected individually using a written self-reflection form. Experimental Group #1 reflected collaboratively using a written self-reflection form, and Experimental Group #2 reflected individually using a think-aloud process while completing the written self-reflection form. The reflection forms were analyzed for depth of reflection, and a one-way ANOVA revealed significant differences in depth of reflection between the three groups. Participants also engaged in focus group interviews to describe their experiences. Two significant themes emerged: reflection on the teaching experience and reflection on the process used. We recommend that reflection should be used to help pre-service teachers learn from experience. In addition, the use of collaborative reflection and reflection using think-aloud protocols should be considered to promote deeper reflection and understanding.

Keywords: reflection; pre-service teacher reflection; collaborative reflection; think-aloud protocol

Introduction/Conceptual Framework

The challenges associated with preparing teachers for the 21st century are great. In fact, the National Council for Accreditation of Teacher Education (NCATE) recently reported that teacher education programs should be overhauled from subject-matter, theory-laden programs to programs rooted in experience and clinical practice (National Council for Accreditation of Teacher Education, 2010). The council reported that more emphasis should be placed on "giving teacher candidates their sea legs by helping them develop and study their practice," (NCATE, 2010, p. 3). Furthermore, in the National Research Agenda for the American Association for Agricultural Education, Doerfert

(2011) pointed out there is a disconnect between the science of learning and the practice of teaching. He explained that despite the solid research base associated with learning, "a gap exists between the science of meaningful learning and the practice of teaching for meaningful learning" (Doerfert, 2011, p. 22). With this in mind, it is necessary for teacher preparation programs to provide pre-service teachers with meaningful learning opportunities rooted in experience.

One method teacher preparation programs can utilize to help pre-service teachers examine their teaching practices is reflection. Reflection plays a central role in most teacher preparation programs and is a valuable component of professional development (The Association of

Teacher Educators, 2003). Reflection is identified as a method that helps practitioners better understand what they know and do through a consideration of what they learn in practice, and the process places an emphasis on learning from doing (Loughran, 2002). It is widely acknowledged that reflection is prerequisite for in-depth understanding and for furthering professional development (Tigelaar, Dolmans, Meijer, De Grave & Van Der Vleuten, 2008).

John Dewey, a key originator of the concept of reflection, described reflection as a problem solving process. The reflective process begins when a person encounters an experience that involves "(1) a state of doubt, hesitation, perplexity, mental difficulty, in which thinking originates, and (2) an act of searching, hunting, inquiring to find material that will resolve the doubt, settle and dispose of the perplexity," (Dewey, 1933, p. 12). Dewey's work supported the notion that reflection is a cognitive process and a special form of problem solving. This process resolves an issue through active chaining, careful ordering, and linking multiple ideas together (Hatton & Smith, 1995). Reflective thinking cannot be compared with simply "thinking things over," (Rodgers, 2002). Reflective thinking is a rigorous and disciplined way of thinking nested in scientific inquiry and it requires attitudes that value the personal and intellectual growth of the learner through the process. A more contemporary examination of reflection utilizes Schön's conceptualization that reflection is intimately bound with action (Schön, 1983). Schön emphasized that professionals should learn to frame the problems they are facing, test various hypotheses to solve the problem, and modify actions as a result (Hatton & Smith, 1995; Schön, 1983). Often described as "reflection-on-action," this requires implementation of solutions that stem from reflecting after an action is completed (Schön, 1983; Yost, Sentner, & Forlenza-Bailey, 2000). The process requires that individuals examine performed tasks in order to review what happened, and it provides an opportunity to examine the relationship and connection of one experience to another (Kim & Lee, 2002; Rodgers, 2002).

Using Dewey and Schön's notions of reflection as a guide, teacher educators continue to employ strategies that promote the reflection of pre-service teachers. Despite doing so, teacher preparation programs are often scrutinized for not adequately preparing future educators. The process of reflection, when integrated within teacher preparation programs, is a tool that will help prepare future teachers (Lee, 2005). The goal of reflection in teacher preparation is to develop a teachers' reasoning about why they used a certain instructional strategy and how they can improve their teaching to have a positive effect on students (Lee, 2005). Many teacher education programs claim to be reflective in their practice, but Rodgers (2002) pointed out this is often missing in a thorough exploration of teacher preparation programs. The experiences within teacher preparation programs should broaden the field of experience and knowledge, yet experiences alone are not enough. The addition of reflection to pre-service teachers' experience allows them to make meaning from experience. This enables pre-service teachers to make sense and draw conclusions from their experiences within a teacher preparation program. Reflection is necessary to help make meaning from experience (Rodgers, 2002). Even though the importance of reflection is documented, Greiman and Bedtke (2008) reported in their study of 31 agricultural education teacher education departments, only one department utilized reflection as an instructional planning component.

Authors of teacher preparation literature described several strategies that help pre-service teachers become more reflective. Those strategies include journaling, peer teaching demonstrations, case studies, and action research projects (Hatton & Smith, 1995; Yost, Sentner, Forlenza-Bailey, 2000). A common strategy utilized in teacher preparation programs is reflective teaching. Reflective teaching promotes growth through analysis and self-directed evaluation (Calderhead, 1987). In many of these teaching experiences, teachers reflect individually using a written self-reflection form to capture their thoughts. In fact, most reflective experiences utilize individual or intrapersonal reflection (Kim & Lee, 2002). In

individual reflection, the learners deliberate and think to themselves about the experience.

While individual reflection is certainly meaningful, in some cases, collaborative reflection can promote deeper reflection. In collaborative reflection, individuals reflect through group discussion and discourse. The experience is not purely an individual process, but it is a process in which learners construct meaning in a situated context (Kim & Lee, 2002). Discussing and comparing experiences with others deepens the learning experience. Collaborative reflection helps teachers refine their teaching skills and approaches to teaching and provides a means for improvement (Martin & Double, 1998). Essentially, working with a partner allows a deeper level of analysis that might be impossible to obtain otherwise. Previous researchers revealed the positive benefits of collaborative reflection and have concluded that collaborative reflection facilitates higher-order thinking when compared to individual reflection (as cited in Kim & Lee, 2002). Hawkey (1995) reported that pre-service teachers expressed a desire to share experiences and knowledge with their peers. They benefitted from the skills and support of their peers. Raywind (1993) concluded that collaborative reflection helps facilitate professional growth and development. By reflecting together, teachers can take their knowledge to the next level through deeper analysis, application, and evaluation (Nicholson & Bond, 2003).

Finally, a think-aloud protocol is a widely used technique that provides information about individuals' cognitive processes (Sasaki, 2008). In an attempt to better understand how professionals use knowledge to make decisions, researchers commonly used think-aloud protocols (Corcoran, Narayan, & Moreland, 1988). Think-aloud protocols are "retrospective reports," wherein an individual reports his or her thoughts about a task after it has been completed (Sasaki, 2008, p. 350). When thinking aloud, individuals must maintain focus on the completion of the task and merely verbalize their thoughts (Ericsson & Simon, 1998). This can be challenging because many specific tasks are often automatic (Corcoran, Narayan, & Moreland, 1988). A think-aloud report represents the information held in short-term

memory and is considered a direct representation of an individual's cognitive processes (Corcoran, Narayan, & Moreland, 1988; Sasaki, 2008). These reports allow an individual to search for meaning, theorize, or interpret his or her own behavior and actions. The process promotes deeper reflection as individuals use previously acquired mental representations to plan, evaluate, and reason between alternative solutions (Ericsson & Simon, 1998).

Finally, think-aloud protocols promote the strategic processing of information; therefore the process may lead to a deeper understanding of the cognitive and metacognitive processes one uses. Because learning to teach involves complex interactions between cognitive and metacognitive processes, the think-aloud process facilitates reflection as a valuable learning experience for teachers (Calderhead, 1987). Even so, there remains a lack of research to examine think-aloud protocols and their influence on teacher reflection. For example, the majority of research associated with think-aloud protocols is used to gain insight into individuals' reading processes in an attempt to help identify the differences between less able and more able readers (Berne, 2004). With this in mind, incorporating think-aloud protocols in reflective experiences should create a deeper and more meaningful learning experience.

Purpose and Objectives

Because reflection creates meaningful learning experiences within teacher preparation programs, the reflective experiences of pre-service teachers should be examined. Furthermore, teacher educators should create reflective experiences that maximize learning through reflection. Drawing upon Dewey's conceptualization of reflection and Schön's notion of reflection-on-action, several questions emerge related to the reflective experience of pre-service teachers. How can teacher educators create meaningful reflective experiences for pre-service teachers? Are the reflective experiences of pre-service teachers designed to maximize depth of thinking and promote advanced critical thinking skills? As collaboration and the use of think-aloud protocols promote greater cognitive

and metacognitive processing, will reflective experiences utilizing collaboration and think-aloud protocols lead to deeper reflection? The specific research questions that guided this study include:

1. What are the differences in depth of reflection for pre-service teachers when using individual reflection, individual reflection using a think-aloud protocol, and collaborative reflection?
2. How do pre-service teachers describe their experience when reflecting individually, collaboratively, and using a think-aloud protocol?

Methodology

To address the above research questions, We selected a convergent parallel mixed methods research approach (Creswell & Plano-Clark, 2011). The purpose of a convergent parallel design is to "obtain different but complementary data on the same topic" (Creswell & Plano-Clark, 2011, p. 77). This particular design is useful when the researcher wants to triangulate the methods by comparing and contrasting quantitative statistical results and qualitative findings. In the convergent parallel design, quantitative and qualitative data are collected and analyzed separately. The merging of the two sets of data typically occurs as discussion or as part of the conclusions based on data analysis (Creswell & Plano-Clark, 2011). The method is also particularly useful when the data are transformed from one type into the other type of data (i.e. transforming qualitative themes into quantitative counts).

The convenience sample included pre-service teachers enrolled in the Career and Technical Education teacher preparation program at a large university in the mid-Atlantic region. This teacher preparation program meets the requirements set forth by the state department of education and upon completion of the program, participants will have earned a Master's Degree in Career and Technical Education (CTE), with a specialization in Agricultural Education, Business and Information Technology, Marketing, or Family and Consumer Sciences. All participants hold a Bachelor's degree within their discipline specific to their intended certificate. There were twenty-six participants. Twelve participants were pursuing Agricultural Education certification, ten were pursuing Business and Information Technology/Marketing Education, and four participants were completing a concentration in Family and Consumer Science Education. Seventy-three percent of the participants were female (19 participants).

Upon receiving university Institutional Review Board approval and obtaining written consent from the participants, teaching teams (two participants per group) were randomly assigned to teach the same pre-written lesson. The teaching teams taught their lessons to their peers in a teaching demonstration which was videotaped. Following the peer teaching demonstration, the participants participated in a reflective experience where they completed a written self-reflection form while viewing their videotaped lesson. The written self-reflection form asked participants to reflect on three domains using three reflection prompts. The reflection prompts included: (1) What were my particular strengths in this area?, (2) What would I change in regards to this particular area?, and (3) How could I go about making that change?

The first domain asked the participants to analyze their ability to communicate with students. This domain included three sub-domains: (1) directions and procedures, (2) explanation of content, and (3) expectations for learning (Danielson, 2007). The second domain focused on the discussion techniques the participants used while teaching. This domain had three sub-domains: (1) quality of questions, (2) discussion techniques, and (3) student participation (Danielson, 2007). The final domain included an analysis of the ability of the pre-service teachers to demonstrate flexibility during their lesson. This domain included three sub-domains: (1) lesson adjustment, (2) response to students, and (3) persistence (Danielson, 2007).

Six participants were randomly assigned to the control group. The remaining participants were randomly assigned to two experimental groups. Experimental Group #1 included 14 participants (seven teaching teams), and Experimental Group #2 included six parti-

cipants. Experimental Group #1 participated in a collaborative reflective experience in which a written self-reflection form was utilized. The seven teaching teams watched their videotaped lesson and completed their written self-reflection form as a pair, and they were encouraged to discuss the experience while completing the written self-reflection form. Experimental Group #2 completed an individual reflective experience using written self-reflection form and a think-aloud protocol. In this group, the six participants were asked to verbalize their thoughts *before* completing the written self-reflection form. The control group included six participants who completed an individual reflective experience using only the written reflection form. The control group completed their written self-reflection form as they watched their videotaped lesson. To ensure consistency of the reflective experience and minimize distractions, the experimental groups and the control group watched their videotaped lesson in an assigned classroom on campus.

After the experimental groups and the control group completed the reflective experience, we analyzed the reflection forms using a researcher-developed categorization scheme that was created from previous research that analyzed depth of reflection (Facione, 1990; Kember et al., 1999; Lee, 2005; Mezirow, 1990; Wong, Kember, Chung, & Yan, 1995; Yost, Sentner, & Forlenza-Bailey, 2000). Each sub-domain of the reflection forms were analyzed independently for the control group and experimental groups. Scores were assigned ranging from one to three and half scores were assigned if responses included characteristics of two levels. Each researcher categorized the self-reflection forms for all groups using a categorization scheme synthesized from the literature. The categorization scheme allowed us to classify the depth of reflection based upon three levels identified through previous research: (1) recall level: R1, (2) rationalization level: R2, and (3) reflectivity level: R3 (Lee, 2005). Data were recorded in the written form by each researcher and converted to an Excel file. The data were analyzed using JMP 8.0 for Windows™ statistical package. We established *a priori* a minimum significance level of 0.05. According to Coolidge (2006), this is the conventional minimum level of significance. The researcher developed categorization scheme and a description of each level follows.

Recall Level (R1)

This level describes the characteristics of "non-reflectors" who indicate a simple awareness of the experience (Lee, 2005; Mezirow, 1991; Wong et al., 1995). Participants identified as non-reflectors and categorized within this level described what happened during the teaching experience, rather than providing a rationale for why the happenings occurred. In addition, the participants classified as R1 described their attempts at modeling teaching methods they observed or were taught, yet they focus on only recalling the experience of using those methods. At this level, the participants referred to their thoughts and feelings, but did not describe how or why those feelings were developed (Kember et al., 1999).

Rationalization Level (R2)

This level describes characteristics of "reflectors" who possess the ability to critique perception, thinking, and judgment while extracting meaning from an experience (Facione, 1990; Lee, 2005; Mezirow, 1991; Wong et al., 1995). In this experience, participants identified as reflectors interpreted their teaching experience with a rationale for why happenings might have occurred. In addition, the participants examined the intended and actual relationships between pieces of their experiences and described their search for why happenings occurred. Reflectors were able to generalize their experiences and create guiding principles for future lessons. At this level, the participants referenced their thoughts and feelings, described how and why their feelings were developed, and assessed the logical strength of their feelings (Facione, 1990; Kember et al., 1999).

Reflectivity Level (R3)

Participants classified within the R3 level – "critical reflectors" – approached the experience with the intention of changing/improving their

teaching in the future (Lee, 2005; Mezirow, 1991; Wong et al., 1995). As a result of the reflective experience, the critical reflectors were able to form strong hypotheses based upon the evidence at hand (Facione, 1990). Additionally, the participants provided justification for multiple perspectives as they examined the issues they faced while teaching. Critical reflectors appear amendable to change, and they described how their teaching might influence their students' behaviors and actions. Furthermore, critical reflectors framed their decisions within the broader ethical, moral, political, and historical decisions behind their actions (Yost, Sentner, Forlenza-Bailey, 2000).

Following the reflective experiences, focus groups were conducted. The focus groups allowed the participants to have time to reflect and recall experiences in a group setting where one response can trigger additional feedback from the rest of the group (Lofland, Snow, Anderson, & Lofland, 2006). We conducted three separate semi-structured focus group interviews, and each focus group interview had one facilitator. Homogeneous groups were selected by us to ensure participants within each focus group experienced either the control or treatment groups. The focus groups lasted 30 minutes. Data analysis for the focus group interviews began during the interviews with probing and follow-up questioning. All interviews were audio recorded and transcribed verbatim by us. Researchers employed the comparative analysis method to analyze the data (Corbin & Strauss, 2008). Investigator

triangulation enhanced the reliability and trustworthiness of the data (Patton, 2002). Each researcher completed initial thematic analysis to increase the reliability of the analysis. Following the initial thematic analysis, We discussed the preliminary coding scheme in order to reach consensus regarding inconsistencies among the codes.

Findings

The reflection forms were analyzed using a researcher developed categorization scheme based upon previous researchers' efforts to analyze depth of reflection. A one-way between subjects ANOVA compared the effect on type of reflective experience on the raters' overall mean scores. There was a significant difference on the type of reflective experience according to the raters' overall mean score at the $p<.05$ level for the three experiences [$F(2, 16) = 6.81$, $p = 0.007$]. Post-hoc comparisons using the Tukey-Kramer HSD test indicated that the raters' overall mean score for the control group (written reflection only) ($M = 1.65$, $SD = 0.31$) was significantly different than Experimental Group #1 (collaborative reflection) ($M = 1.22$, $SD = 0.16$). An effect size of 1.73 indicates a non-overlap of 75.4% in the two distributions (Cohen, 1988). Experimental Group #2 (think aloud) ($M = 1.47$, $SD = 0.10$) did not significantly differ from the collaborative and individual reflection groups. Table 1 provides the total mean score for the control group and experimental groups.

Table 1
Total Mean Scores of Control Group and Experimental Groups

	n	M	(SD)	*d*
Control	6	1.65*	(.31)	1.73
Experimental Group #1	14	1.22*	(.16)	
Experimental Group #2	6	1.47	(.10)	

Note. Control group completed an individual reflective experience using only the written reflection form. Experimental Group #1 participated in a collaborative reflective experience in which a written self-reflection form was utilized. Experimental Group #2 completed an individual reflective experience using written self-reflection form and a think-aloud protocol. Possible score range is 1-3. *$p < .05$.

Table 2
Mean Scores of Constructs for Control Group and Experimental Groups

	Communicating With Students			Discussion Techniques		Flexibility During Teaching		
	M	(SD)	d	M	(SD)	M	(SD)	d
Control (n = 6)	1.70*	(.11)	5.04	1.72	(.13)	1.53*	(.09)	4.46
Experimental Group #1 (n = 14)	1.17*	(.10)		1.31	(.12)	1.15*	(.08)	
Experimental Group #2 (N = 6)	1.47	(.11)		1.52	(.13)	1.41	(.09)	

Note. Control group completed an individual reflective experience using only the written reflection form. Experimental Group #1 participated in a collaborative reflective experience in which a written self-reflection form was utilized. Experimental Group #2 completed an individual reflective experience using written self-reflection form and a think-aloud protocol. Possible score range is 1-3. *p < .05.

As depicted in Table 2, a one-way between subjects ANOVA was conducted to compare the effect on type of reflective experience on the raters' domain mean scores. There was a significant difference in the type of reflective experience on raters' domain mean score of communicating with students at the p<.05 level for the three experiences [F(2, 16) = 6.36, p = 0.009]. Post-hoc comparisons using the Tukey-Kramer HSD test indicated that the raters' domain mean score for control group (written reflection only) (M = 1.70, SD = 0.11) was significantly different than Experimental group #1 (collaborative reflection) (M = 1.17, SD = 0.10). In addition, there was a significant difference in the impact of the type of reflective experience on raters' domain mean score of flexibility during teaching at the p<.05 level for the three experiences [F(2, 16) = 4.88, p = 0.02]. Post hoc comparisons using the Tukey-Kramer HSD test indicated that the raters' domain mean score for control group (written reflection only) (M = 1.53, SD = 0.09) was significantly different than experimental group #1 (collaborative reflection) (M = 1.15, SD = 0.08).

Finally, based on three focus groups, two major themes emerged from the analysis of the qualitative data. These categories are used as a framework for organizing the discussion. The themes will be discussed separately. However, they are not experienced independently of one another but holistically. The two major themes were reflection on the teaching experience and reflection on the process used. Content related

to the identified themes are described next with direct quotations.

Reflection on the Teaching Experience

Participants in the control group and both experimental groups described in detail their reflection on their teaching experience. Participants pointed out the value in reflecting on their peer teaching demonstration. "It helped me to see things that I did or didn't…did or didn't flow well" [9]. Another participant agreed that reflection provided an opportunity to examine the overall effectiveness of the lesson. "…it just allowed us to see how things – what aspects went well and what didn't go well…" [18:19]. The reflective experience helped the participants recall their teaching, and it helped them to validate the changes they felt they needed to make in future teaching. "After we taught, my partner and I had already seen what we really needed to change and started doing that. Then we watched the video – it reiterated and made me more confident about the changes we needed to make" [341:343]. Another participant expressed similar feelings. "I kind of noticed things that I hadn't even thought that I wasn't doing right. It showed me that I was doing things that I thought I was doing right the whole time" [440:442]. "…[the reflective experience] gives you a list of things you were working on…you could be consciously thinking 'Okay, I'm trying to do this. I'm trying to do this'"

[430:432]. Additionally, as a result of the reflective experience, participants indicated they would change how they taught this particular lesson. "…it allowed us to see how we could alleviate those problems when we taught again" [20]. Participants also described specific changes they would make in their lesson as a result of the reflective experience. "We took out one of the activities because we realized two of them were very similar and the students didn't really understand the different between the two during the practice teach. We just combined them into one" [44:46]. Another participant also described a potential change to their lesson plan. "…we had it broken up where one person did one activity and the next person did another activity. We found when that happened the other person was just standing in front of the room, so we modified it" [53:55].

Reflection on the Process Used

While the participants described the benefits of the reflective experience, there were notable differences in the experiences of the control group and the experimental groups. Specifically, control group participants described the benefits of completing only the written self-reflection form. "It just helped me to think about things in a way that I hadn't" stated one participant [82]. Another participant corroborated his or her colleague's feelings. "I think writing in general kind of makes you have to come full circle with your thoughts, so I think it just makes it more complete" [85:86]. Additionally, the written self-reflection process was described as beneficial. The form itself provided "structure," and it gave the experience "organization."

The use of a think-aloud process provided both benefits and challenges for the participants in Experimental Group #2. "I thought it was awkward at first," stated a participant [146]. Others in the think-aloud group described this same sentiment. "Well, I thought it was awkward, and I was a little self-conscious," one participant described [135]. They explained: "It was weird sitting there talking to the computer screen. You didn't want someone to talk by…they might say 'What's she doing in there? Who is she talking to? Wait a minute. That's just her in there taking to herself'" [240:243].

Even though participants expressed several challenges associated with thinking-aloud, they were able to express how the process helped them reflect. "…I didn't mind it at all. It was actually kind of neat because there were no distractions. I could think about exactly I wanted to say and say it" [146:148]. Another participant described how the think-aloud process helped her elaborate upon her thinking. "It's easy to elaborate upon yourself when you're talking aloud rather than just writing it down…if you're talking, you kinda come up with everything as you're speaking. You keep diverging into it – keep coming up with newer ideas" [187:190]. The think-aloud process helped the participants process the peer teaching demonstration and helped them identify ways to change or improve their teaching. "…having to talk to yourself about it, just made you think or look back on what you did and what you could do better. It was kinda cool"[177:178]. Another participant anticipated the differences between using only a written self-reflection form and using a think-aloud process. "When you're talking…it gives you more flow rather than just writing it down, which is what we normally do when we do reflection. Talking aloud and hearing yourself say something is different" [408:410].

The collaborative reflection experience participants (Experimental Group #1) also described the advantages of working with partner to reflect. Reflecting with a partner provided an opportunity for the participants to brainstorm how they could improve their teaching. "Me and my partner discussed all the things that we saw and all the things we can improve and change" [423:424]. Another participant described the same result of reflecting with a partner. "…we were able to, I guess, talk about it and come up with new ideas at the same time. I guess two heads are always better than one in coming up with new, creative ideas how to fix things" [584:586]. Additionally, the collaborative reflective experience provided an opportunity to gain another perspective on how the peer teaching demonstration went. "We could get both perspectives. 'To me, it looks like I did bad. What do you think?'" [572:573]. By reflecting with a partner, the pre-service teachers indicated the reflection process was "easier,"

and it created more opportunities to figure out "…what we were going to fix for the next time" [546]. Although the collaborative reflective experience had notable benefits, it presented some challenges for the participants. The process was described as "distracting" and some felt it was difficult to focus during the experience. "It was kind of distracting to work with someone else because at the same time, we were laughing at ourselves. So that was kind of distracting…" [591:592].

Conclusions

The objective of this study was to determine the differences in depth of reflection for pre-service teachers when using individual reflection, individual reflection using a think-aloud protocol, and collaborative reflection. The conclusions of this study are not generalizable beyond the population in this particular study. We made the following conclusions based on the data collected. The findings support the idea that reflection is a valuable experience for pre-service teachers. As a result of reflecting upon their teaching, participants in both the control and experimental groups indentified changes they would make to the lesson plan and their teaching methods. "I definitely reflected on what I could have done better," said one participant. "I really thought about the different things I did, and what I didn't do" [64:65]. In fact, one pre-service teacher went as far to say that that reflection, "improved my teaching" [423]. Furthermore, the reflection process itself provided the pre-service teachers with structure and organization, which promoted deeper reflection. "Because [the reflection forms] had different sections, it made you reflect on the whole. It made me think about things that I could do differently," described one participant [74:75]. Another pre-service teacher elaborated on how the structure of the process helped him/her reflect. "It gave me more ideas to reflect upon. I probably wouldn't have thought of some of those questions or reflected on certain aspects of the lesson. The form helped me think about things that I probably would have [without them]" [93:94]. It can be concluded that reflection facilitated a consideration of change in teaching practices for the pre-service teachers in both the control and experimental groups.

The analysis of the written self-reflection forms revealed that the participants' depth of reflection ranged from recall (R1) to the rationalization level (R2). The R1 level describes characteristics of "non-reflectors," while the R2 level describes characteristics of "reflectors." The mean scores for the written self-reflection forms ranged from 1.22 to 1.65. This indicates that the participants in this study merely described a simple awareness of what happened during their teaching. The participants referred to their thoughts and feelings, but they did not describe how or why those feelings developed. This was confirmed through the data generated from the focus group interviews. One participant described their awareness of their teaching. "I noticed that I'm not a very good describer of activities" [24]. Another pre-service teacher described a similar depth of reflection. "We had to change one of the games because we saw that it didn't work at all. So we completely made a new system for selecting groups" [492:493]. However, some participants indicated depth of reflection in their written self-reflection forms. While thinking about why things happened, some pre-service teachers were also actively looking at the relationships between the "why" and creating guiding principles for future lessons. This is a characteristic of R2 reflection. This depth of reflection was illustrated by the data. "So after [teaching the lesson] – this was almost a week later that we saw it, I'd already been working on my lesson, thinking to myself 'Well, I'm not gonna ask these questions anymore. I'm gonna do this – gonna ask these questions'" [333:334].

There was not a significant statistical difference between the mean scores of the written self-reflection forms of Experimental Group #1 (collaborative reflection) and Experimental Group #2 (reflection using think-aloud protocol). In fact, previous researchers have indicated that both methods promote deep processing (Corcoran, Narayan, & Moreland, 1988; Ericsson & Simon, 1998; Kim & Lee, 2002; Martin & Double, 1998; Nicholson & Bond, 2003; Sasaki, 2008). The qualitative data supported the conclusion that both methods enhanced the pre-service teachers' reflective

experience. For example, one participant described the benefit of using a think-aloud process. "It was a way to be really honest when you critiqued your teaching. You didn't have to say what somebody else wanted to hear. It was really way to be honest and really reflect" [184:185]. In addition, another participant discussed the benefit of reflecting collaboratively. "We could discuss what would be best for us. It was easier to collaborate and change the lesson since we did it together" [556].

The mean scores for the control group's written self-reflection forms (M = 1.65) were higher than the collaborative group (M = 1.22) and think-aloud group (M = 1.47), thus indicating the control group had the greatest depth of reflection. With this in mind, it was also noted that the participants in both experimental groups described collaborative reflection and reflection using a think-aloud as distracting and awkward. For example, one participant recounted being uncomfortable using a think-aloud process. "It occurred to me that people could be walking by, seeing me talking to myself. I felt that as inhibiting" [136]. Another participant described the distracting nature of the think-aloud process. "I kinda forgot at times to say what I was thinking. I had to go back and catch up on what I was thinking" [154]. One pre-service teacher that reflected collaboratively also indicated being distracted. "[My partner and I] were like 'Oh my gosh! I can't believe we sound that way! That's what we look like? That's what we sound like?' That was distracting" [593:594]. As a result, We concluded that the distractions and awkwardness of collaborative reflection and the think-aloud process played a role in the level at which participants reflected. This was supported by the qualitative data as participants described the distracting nature of the collaborative reflection process and the awkwardness experienced during the think-aloud process.

Recommendations

Pre-service teachers should be provided with opportunities to reflect on their teaching throughout their teacher preparation program. This will help them identify ways they can improve their teaching in order to help students succeed. In this particular study, the pre-service teachers articulated how the reflective experience helped them improve their teaching. Furthermore, the participants expressed that the reflective experience will influence how they approach teaching in the future. "After we teach a class, we can go back in our lesson plans and write notes of things that we could change, things we liked, or things that went really well. Reflecting like that would be beneficial," said one participant [516:518]. With that in mind, teacher educators should continue to embed reflective experiences into teacher preparation programs.

Working collaboratively and using a think-aloud process has been identified as a method that promotes greater cognitive and metacognitive processing (Corcoran, Narayan, & Moreland, 1988; Ericsson & Simon, 1998; Kim & Lee, 2002; Sasaki, 2008). With this in mind, pre-service teachers should be encouraged to utilize these methods when reflecting. However, as illustrated in this study, working collaboratively and using a think-aloud process can be distracting. Therefore, teacher educators should provide training for how to use both methods. The think-aloud process should be modeled, and pre-service teachers should be given the opportunity to practice the method before beginning the reflective experience. In addition, to fully understand the impact think-aloud protocols have on reflection, the think-aloud verbalizations can be recorded and transcribed. Analysis of the transcripts would help researchers understand which information the participants attended to, how they processed the information, and the manner in which they combined information to make decisions. Finally, in order to ensure the accuracy of the written self-reflection forms to what is actually experienced during collaborative reflection, the collaborative reflection experience should also be recorded and transcribed. This would help researchers determine if there was a discrepancy between what was verbalized and what was written on the reflection form. By doing so, the researcher would be able to determine if the depth of reflection (as indicated by the written self-reflection form) was influenced by working with a peer.

While this particular study was completed with pre-service teachers, we suggest future studies designed to examine the differences between pre-service and in-service teachers reflective experiences. Which would lead to greater depth of reflection for in-service teachers – individual reflection, individual reflection using a think-aloud protocol, or collaborative reflection? This particular line of inquiry could help maximize the reflective experiences of in-service teachers and continue to promote the idea of a *reflective practitioner* within classrooms.

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