

Toward a Holistic View: Analysis of Pre-Service Teachers' Professional Vision in Field Experiences and Its Implications

Ji-Eun Lee
Oakland University

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This study investigated the aspects of learning and teaching that pre-service teachers examined at distinct time periods while taking on different roles. Participants reported on what they noticed from their past learning experiences as students, as well as their current field experiences as student teachers. Their reflective critique was created within loosely structured themes. Results showed that participants mainly focused on the *teacher* factor while their attention to the *student* factor was weak. In addition, the participants tended to avoid making critical reflections when they were in the field compared to their reflections on previous learning experiences. It would be appropriate to consider more structured observation/reflection activities to support pre-service teachers' development of the full range of teaching/learning mathematics.

Keywords • pre-service teachers • teacher knowledge • noticing • instructional activities and practices • reflection

Introduction

A common feature of teacher preparation programs around the world is the field experience component. This aims to provide pre-service teachers with firsthand classroom experience so that they may transition smoothly into classroom teaching. An abundance of literature supports the importance of pre-service teachers' field experiences (Hammerness, Darling-Hammond, Grossman, Rust & Shulman, 2005). While the specifics of field experiences vary depending on the individual programs' requirements, one common characteristic is that pre-service teachers spend considerable time in the field setting *observing* and *reflecting upon* their co-operating teachers' teaching methods and other events happening in the field. Recent research in mathematics education has drawn attention to effective professional development that highlights the importance of understanding what and how teachers are attending to their classrooms (e.g., Jacobs, Lamb, Philipp, Schappelle, & Burke, 2007; Mason, 2002; Sherin, Jacobs, & Philipp, 2011). While the main body of research that addresses the importance of *noticing* or *learning through teaching* has focused on in-service teachers' professional growth, little has been reported on how these ideas can be incorporated into teacher preparation programs. Since pre-service teachers are in the process of transitioning from students to teachers, what they think and do in the teacher education program as well as in the field setting is certainly the result of their combined perspectives as both students and teachers. Understanding the different aspects of learning versus teaching can be a difficult transition, depending on the individuals' current role. To understand these transitional changes in perspective, this exploratory study shares the aspects of learning and teaching that a group of pre-service teachers perceived while taking on distinct roles (e.g., as a student in past experiences, as a teacher candidate observer in field settings, and as a student teacher in field settings).

Related Issues in the Literature

This study was designed to explore the patterns in the noticing and reflecting of a group of teacher candidates regarding classroom events at distinct time periods as they took on distinct roles. As a way of contextualising these exploratory efforts, this study traced four interrelated threads of research studies: (a) noticing, (b) noticing of pre-service teachers, (c) what to notice and how to reflect, and (d) apprenticeship of observation.

Noticing

Teaching practice is a comprehensive entity where various components are dynamically intertwined with each other (Ball & Cohen, 1999). The broad view of teaching practice includes, but is not limited to, planning for teaching, the implementation of lessons, analysis of curriculum materials, and reflection on teaching. Researchers have probed the noticing of teachers in order to understand teachers' thought processes regarding complex classroom events. Goodwin's (1994) concept of professional vision, described as, "socially organised ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group" (p. 606), emphasises the importance of examining the nature of a teacher's professional vision. Mason (2002, 2009) frames this professional vision as developing the sensitivity to *notice* things in the beliefs of "teaching as disciplined" inquiry. Further, Mason (2002) defines the idea of noticing as "a collection of practices both for living in, and hence learning from, experience, and for informing future practice" (p. 30). It is the role of teacher educators to consider ways to engage teachers and teacher candidates in authentic aspects of practice so that they can both learn to utilise teaching practice as a source of inquiry and develop a professional vision through intentional noticing.

Many previous studies reported on a variety of aspects of teachers' noticing through observing live or videotaped instruction. For example, some studies highlighted the teachers'/teacher candidates' ability to identify important aspects of classroom events (e.g., Star, Lynch, & Perova, 2011; Star & Strickland, 2008) or the ability to specifically analyse classroom lessons (e.g., Santagata, 2011; Santagata, Zannoni, & Stigler, 2007), and others offered a framework covering what teachers notice, how they reason, and how they make connections between the noticed classroom events and broader principles of teaching and learning (e.g., van Es & Sherin, 2002, 2008). Cultural differences were also shown to identify differences in teacher noticing (e.g., Miller & Zhou, 2007). Miller and Zhou (2007) reported that there were striking differences between a teacher's view of two cultures, Chinese and American, in that the American teachers were more attentive to pedagogical issues or teachers' personalities while their Chinese counterparts were more focused on the content of the lessons. As summarised in Jacobs, Lamb, and Philipp's (2010) overview of the literature on the noticing of mathematics teachers, the findings from the previous studies have underscored "the idea that teachers see classrooms through different lenses depending on their experiences, educational philosophies, cultural backgrounds, and so on," and that "particular kinds of experiences can scaffold teachers' abilities to notice in particular ways" (p. 171).

One of the key considerations provided by the previous research is the continuous, cyclical sequence, which emphasises the component of reflective practice. Mason (2011) described the discipline of noticing as a collection of techniques for (a) *pre-paring* to notice in the moment, and (b) *post-paring* by reflecting on the recent past to select what to notice in order to act freshly rather than habitually. Similarly, Endsley (2000) defined situation awareness, which is the term that embodies a theory of noticing, as involving three factors: (a) perception of meaningful elements in an environment, (b) comprehension of their meaning, and (c) projection of their status in the near future. Most of the other studies also generally characterised teacher noticing as consisting of three aspects: (a) attending to noteworthy events, (b) reasoning about such events, and (c) making informed teaching decisions on the basis of the analysis of these observations (van Es, 2011).

Given the existing framework of researching teachers' noticing, this study aimed to probe how pre-service teachers saw classroom events through the different lenses of students, student teachers, and teachers. This study hypothesises that pre-service teachers' noticing and reflecting

patterns via recalling, observing, and teaching with distinct roles at distinct time periods will be different because each context will provide a different perspective on classroom events.

Noticing of Pre-service Teachers

Previous research on noticing has suggested that improving teachers' ability to notice should be an explicit focus of teacher professional development by providing appropriate opportunities and a deliberative framework for participants to develop their ability to notice, and further develop their professional vision (Jacobs, Lamb, & Philipp, 2010; Santagata, Zannoni, & Stigler, 2007; Sherin & van Es, 2005, 2009; Star, Lynch, & Perova, 2011; Star & Strickland, 2008;). Although in-service and pre-service teachers both participated in the previous studies, studies that focus mainly on the noticing of pre-service teachers with a bigger sample size are scarce. Star and his colleagues' studies (2008, 2011) investigated types of pre-service teachers' (N=28, 30) noticing and measured the improvement of their observation skills after a methods course that had an explicit goal of improving observation skills. Other studies often include pre-service teachers and novice teachers as participants to compare their differences in noticing. Expectedly, expert in-service teachers recognised more meaningful events, making sense of multiple events, and were better able to notice subtle differences in instructional strategies (e.g., Borko & Livingston, 1989; Leinhardt, 1989; Sabers, Cushing, & Berliner, 1991). Considering pre-service teacher education as the beginning of a professional career, and acknowledging the scarce focus on the noticing of pre-service teachers, this study examines the noticing of 76 pre-service teachers, focusing on their patterns of noticing and accompanying reflective dispositions.

What to Notice and How to Reflect

The concept of reflection is considered an essential part of teaching (Ross, Bondy, & Kyle, 1993). Although complicated meanings of reflection that get played out in intricate and, often, contradictory ways (Fendler, 2003; Valli, 1997; Zeichner, 1994), the attention to reflective practice has been of increasing interest and the component of reflection has become a common practice in many courses in teacher education programs.

Generally speaking, reflection or critical reflection involves the process in which an event is recalled or noticed, contemplated, and appraised for planning and follow-up actions by responding to "what" and "why" questions. In relation to the notion of noticing, if the reflection is a natural process of professionals' work, reflection is more likely to happen upon the most frequently noticed things. Further, teacher thinking can be promoted when teachers give attention to what is important in making the theory-practice connection and deeply reasoning about given classroom situations (van Es & Sherin, 2002).

It has been noted that many different types of reflections are possible depending on the focus of reflection, such as academic (focusing on subject matter), technical (focusing on scientific theories of teaching), reflection-in-action (focusing on practice and experience), developmental or personal (focusing on the students), or critical (focusing on the socio-cultural context) (Valli, 1997; Zeichner, 1994). When analysing teachers' noticing, researchers sought to identify their foci during the observation of live or videotaped instruction. For example, Colestock and Sherin's (2009) data, from 15 middle and high school mathematics teachers who watched videotaped instruction, found that the majority of the descriptions of what the participants had viewed were related to issues of pedagogy, climate, and management. On the other hand, mathematical thinking, students, or classroom characteristics were a focus of the participants' noticing to a lesser degree. Star and Strickland (2008) used five observation categories for pre-service teachers' noticing from the videotaped instruction employing pre-post assessment design: classroom environment, classroom management, tasks, mathematical content, and communication. Their results showed that the largest improvements were seen in pre-service teachers' abilities to notice features of the classroom environment and tasks, while modest gains were seen in teachers' abilities to notice the mathematical content of a lesson, classroom management, and teacher and student communication during a lesson. Other research studies also suggest that, when watching videotaped instruction, mathematics teachers

initially focused on classroom organisation and general instructional practices rather than on the substantive mathematical content (Frederiksen, Sipusic, Sherin, & Wolfe, 1998; Sherin & Han, 2004). The many identified categories in the previous studies can be ultimately framed as the instructional core, which is composed of the teacher and the student in the presence of content, and their relationship with each other (City, Elmore, Fiarman, & Teital, 2009). All of this emphasises the notion that, "teaching is what teachers do, say, and think with learners, concerning content, in particular organizations and other environments, in time" (Cohen, Raudenbush, & Ball, 2003, p. 124).

With respect to the process of reflection, some teacher educators employ a naturalistic approach by letting their thoughts flow without imposing a restrictive structure on the concept of reflection. On the other hand, some educators have proposed a need for pre-service teachers to be equipped with more direct guidance such as an organizational structure to scaffold reflective activities (e.g., Genor, 2005; Goodwin, 2002). Noting the various foci of noticing and the benefits and limitations of structured or unstructured organization of reflection, this study took a mixed approach by initially allowing the participants to choose their foci of noticing so that their thoughts run freely, and later by providing a loosely structured organization of reflection.

Apprenticeship of Observation

Each pre-service teacher brings varied levels of mathematical understanding and diverse beliefs on teaching and learning to teacher education programs. In fact, many researchers have shown that teacher candidates' beliefs that were naturally developed without formal instruction are often hard to change or 'un-do' (Ball, 1990; Holt-Reynolds, 2011; Knowles & Holt-Reynolds, 1991). Those beliefs developed over many years of schooling through classroom observation are called "apprenticeship of observation" (Lortie, 1975/2002). It is frequently referred to as the important source for teacher candidates' beliefs about how to teach. Some teacher educators claim that the apprenticeship of observation has a skewed vision of teaching because pre-service teachers always observe teaching from a student's perspective without fully engaging in the work of teachers (e.g., Kosnik & Beck, 2011). However, Mewborn and Tyminski (2006) were cautious about the situation where the phrase "apprenticeship of observation" is used synonymously with the claim that "teachers teach the way they were taught." Instead of using this phrase as a one-size-fits-all explanation for the source of unchanging, skewed views that teacher candidates bring to teacher education programs, Mewborn and Tyminski (2006) asserted that some teacher candidates were capable of "being analytical about their goals for their teaching practices in light of their prior experiences" (p.32). Other research studies also suggested that teacher candidates' prior experiences during their apprenticeship of observation can be utilised in productive ways, if teacher educators provide opportunities to critically analyse the previous experiences and to newly craft their beliefs about teaching practices (Feimen-Nemser, 2001; Ross, 1987; Zeichner & Gore, 1990). Recognizing different views on apprenticeship of observation, this study will attempt to address the patterns of noticing and reflection pre-service teachers show. It will also contemplate on the ways pre-service teachers can use their prior experiences as students as a source to develop their professional vision.

Situating the Study

The previous research studies reviewed above have informed this study that it is important for teacher educators to know what aspects of classroom events pre-service teachers give particular attention to and how to effectively utilise reflection as a way to facilitate their development of professional vision. This study considers that the different roles pre-service teachers occupy over the course of their training can provide a unique lens for their noticing and critical reflection. It aims to compare pre-service teachers' patterns of noticing and reflection shown in different contexts while eliciting the implications. Specifically, this study examines the following questions:

1. What are the foci of noticing of pre-service teachers when they recall their past mathematics learning experience as students?

2. What are the foci of noticing of pre-service teachers as teacher candidate observers in their current field settings?
3. What are the foci of noticing of pre-service teachers when teaching in the field as a lead teacher?

Method

Participants

During the fall 2010, winter 2011, and summer 2011 semesters, 76 teacher candidates participated in this study while enrolled in one of four sections of a required four-credit K-8 mathematics methods course at a Midwestern university in the United States. All of the participants had successfully completed mathematics content courses prior to this methods course. This four-credit course is required for elementary education majors and is usually taken prior to student teaching. The instructor for all sections was the author of this study. Participants consisted of 71 female and 5 male teacher candidates. During the semester, participants were required to complete field experience components at assigned local schools. The field experience consisted of 30 flexible hours to be used for all methods course assignments. For the mathematics methods course, teacher candidates were required to observe their co-operating teachers' teaching and students' learning, to develop and implement at least one full-length whole group math lesson that incorporated what they learned in the methods course, and to reflect upon the field experiences. Teacher candidates usually made no fewer than 8 visits over 8 weeks in the fall and winter semesters and no less than 6 visits over 6 weeks during the summer semester. The visits to the field placement were to be planned with the co-operating teacher.

Context of Tasks and Data Source

The researcher designed a series of course activities that had three distinct phases throughout the semester: (a) reflection on participants' past mathematics learning experiences by reporting episodic events noticed and reflective disposition about what they noticed, (b) reflection on participants' observation experiences in the current field setting by reporting the event they noticed and reflective disposition about what they noticed, and (c) development/implementation of a mathematics lesson in the field and reflection on the results of their own teaching by reporting the event they noticed and reflective disposition about what they noticed.

To help encourage participants' engagement, a loosely structured format of observation and reflection was provided. Participants were asked to report on their experience around four themes (LEAD): (a) what should be *lessened*, (b) what should be *expanded*, (c) what should be *altered*, and (d) what should be *dropped*. The *lessen* category referred to the teaching and learning events that had educational merits but would have been better if it had not been overused. Observed events belonged to the *expand* category if the participants believed that what they observed were very effective ways of teaching and learning and that more implementation of those strategies would be desirable. The *alter* category was used for the observed events that would be more effective if the teacher or student chose different approaches. The last category, *drop*, was used to indicate the events that the participants thought were non-effective or when negative teaching and learning experiences took place. Thus, the format of writing in the LEAD report was open-ended, allowing participants to express their unique observations and experiences while ensuring that they could reflect upon their events within a loosely structured frame.

In each phase, participants submitted written episodic memories, called LEAD reports, to the course website (Moodle, Discussion Forum). In the LEAD report, participants documented the date of episode observed or experienced, provided brief description of the context, and indicated their reflective disposition (e.g., Lessened, Expanded, Altered, Dropped) along with their personal justifications. Groups of 4-5 participants were also formed to share their reports.

Group members were allowed to comment on each other's reports. There was no prescribed format for group discussion, but participants usually tended to respond to the reports that described similar experiences as theirs. In order to encourage students to respond honestly, it was promised that the quality of writing or the content of the reports would not be assessed and students would earn full credit by submitting their work. The LEAD report assignment was worth about 5 percent of the total course assignment points. Table 1 below shows a more detailed context of each phase.

Table 1
Description of Phases

Phase	Phase 1	Phase 2	Phase 3
What is the teaching/learning context involved?	Past learning experiences	Current learning experience	Lesson planning/ Post teaching reflection for future teaching
Whose teaching is the LEAD report based on?	Past mathematics teachers	Current field co-operating teacher	Self
What perspectives are elicited?	Observer-perspective as students	Observer-perspective as pre-service teachers	Field-perspective as lead teachers of lessons
What is the rationale of each LEAD phase?	Identifying/noticing the satisfaction/dissatisfaction with others' teaching practices that potentially produce the motivation to move toward the ideal state (Higgins, 1987) Getting a more profound level of reflection under the frame of LEAD Learning to see important features of classroom practice		Changing perspective from an information receiver/ observer to a more active leading role Finding important results that influence future teaching

The LEAD reports in Phase 1 were collected during the first two weeks of the course. Participants were asked to submit a minimum of four LEAD reports. The reports in Phase 2 were collected mostly between the fifth and tenth weeks of the course. A minimum of four (for summer semester) and six (for fall and winter semesters) LEAD reports were required, preferably one report per week. The reports from Phase 3 were collected during the last two weeks of course work. Participants were asked to submit at least one report along with the lesson plan they implemented in the field setting.

Major data sources were participants' personal narratives (LEAD reports) that had been documented via an online depository (Moodle). Although Moodle also facilitated group forums on issues encountered and provided opportunities for participants to rewrite/retell new stories (Connelly & Clandinin, 1994), the scope of the analysis of this study is focused on the original individual participants' narratives.

Data Analysis

LEAD reports were analysed with the procedures of content analysis for evaluating written text suggested by Johnson and LaMontagne (1993): (a) prepare the data for analysis, (b) become familiar with the analysis by noting emerging themes, (c) identify units of analysis, (d) define tentative categories for coding the responses, (e) refine categories, and (f) establish category integrity. Multiple research assistants participated in this process of developing coding scheme

as well as actual coding. For each stage of analysis, two independent raters coded LEAD report entries. The first rater was the author of this study, a mathematics teacher educator, and the second rater was a graduate research assistant whose background was elementary mathematics education. The unit of analysis is a meaning unit, which is comprised of "words, sentences or paragraphs containing aspects related to each other through their content and context" (Graneheim & Lundman, 2004, p.106). Thus, each report was reviewed and coded for whether it referenced the categories identified. Once the themes for coding were identified, the two raters independently coded a random sample of 10 participants' data. The inter-rater reliability, about 85%, was calculated during the process of content analysis as the number of agreements divided by the number of items coded. For the rest of the data, the two authors jointly coded so that the discussion on coding discrepancies could be resolved immediately. Descriptive analysis was conducted to explore the frequencies with which each category identified by the content analysis occurred, as well as which categories of reflective dispositions manifested (*lessen, expand, alter, and drop*). In the following section, the content analysis of LEAD reports and the results of descriptive analyses will be reported.

Findings and Discussion

In this section, the content analysis results of identified categories from participants' LEAD reports, the descriptive analysis results of frequencies of categories exhibited in LEAD reports, and frequencies of reflective dispositions (*lessen, expand, alter, drop*) exhibited in LEAD reports are presented.

Foci of Noticing: Identified Categories from Participants' LEAD Reports

From the analysis of all three phases of LEAD reports, categories of noted class events by participants were developed. Table 2 shows the categories and the descriptions of categories that were developed through the content analysis process. Below are some examples of excerpts taken from participants' reports to show how they were coded:

When I was a student, I can remember learning math by sitting in our seats and listening to the teacher drill us with fact... I think teachers should have expanded their math lessons into group work and a group setting. (This entry from a Phase 1 report is categorised as B6: Grouping Strategies.)

My co-operating teacher does a great lesson involving the students choosing a job with a certain salary, paying bills for one year, and seeing if they come out in debt at the end of the year, or with savings. [detailed lesson description provided]... With many small details that made it a strong lesson, one thing I would expand would be taxes and interest to really open the eyes of the students about what life will be like in the real world. (This entry from a Phase 2 report is categorised as B4: Modes of representation.)

I did a "human number line" using fraction bars, an assessment activity [detailed lesson description provided]... I found that I ended up doing a lot of teaching during the assessment activity; the students had not quite got it yet. I should have spent more time explaining before rushing into assessment. (This part of a Phase 3 report is categorised as B7: Flexibility/Pacing.)

Table 2
Categories of Noticing

Category	Description and Examples
A. Class environment/set-up	General (not lesson-specific) materials/equipment available to students focusing on their existence or absence (e.g., poster, bulletin board, computer, math manipulatives, textbooks being used).
B. Teacher	
B1. <i>Teacher preparation</i>	Teachers' preparation for specific lessons (e.g., prepare necessary materials, plan for class time, procedures for students to follow for efficient use of class time)
B2. <i>Classroom management</i>	Teachers' handling of students' behavioural problems and physical movement that are not directly related to the content of the instruction (e.g., handling of spontaneous/unexpected disorder, transition from one mode of activity to another)
B3. <i>Communication</i>	Written and verbal communication between teacher and students or facilitation of discussion among students (e.g., allowing time for student discussion, taking students' feedback, giving feedback on homework/tests, differentiated questions/prompts for diverse students, etc.)
B4. <i>Modes of representation used</i>	Teachers' use of various modes of representation (e.g., visual aids, real-life connections, physical models, etc.)
B5. <i>Teacher knowledge</i>	Teachers' demonstration of mathematical knowledge (e.g., appropriate application of mathematics)
B6. <i>Grouping strategies</i>	Various grouping strategies used by teachers (e.g., co-operative group, small group, partner work, individual work)
B7. <i>Flexibility/pacing</i>	Teacher's flexibility of modifying lessons as needed based on students' understanding (e.g., modifications of the planned lessons during the instruction)
C. Students	
C1. <i>Knowledge/Understanding/Skills</i>	Overall commentary of students' ability as a class and specific individual students' performance (e.g., prior knowledge/skills, understanding of concepts taught, mastery of new skills)
C2. <i>Emotions/Attitude</i>	Students' feelings (e.g., embarrassment, frustration, excitement, boredom)
C3. <i>Engagement</i>	The level of students' engagement in the lesson (e.g., frequencies or amount of time of students' active participation)
D. Tasks	
D1. <i>Types and quality of tasks</i>	Types of tasks (e.g., worksheets, practice problems, games, tasks for concept development, purely entertaining tasks, drill-driven tasks)
D2. <i>Delivery/facilitation of task</i>	Types of delivery or facilitation of tasks (e.g., inquiry-based tasks, differentiated tasks, tasks via direct instruction, activity-oriented tasks, project-based tasks)
D3. <i>Content of the tasks</i>	Mathematical contents/concepts covered by the tasks (e.g., specific comments on the mathematical content of the task)

used in the instruction)	
E. Assessment	
<i>E1. Types of assessments</i>	Types of assessments (e.g., timed tests, quizzes, standardised tests, formative vs. summative assessments)
<i>E2. Grading/Purpose of assessment</i>	Assessment routine (e.g., the ways of grading assignments and use of the results of assessment)

The categories emerging from participants' LEAD reports revealed the variety of aspects of classroom events, including class environment/set-up, teacher, students, tasks, and assessment. These categories of noticing were found in all three phases of LEAD reports, whether the report was based on their past experiences, the recent observations of field co-operating teachers, or their own teaching experiences. The results from the participants of this study are not much different from the frequently noted features of the live or video-recorded instruction by teachers [e.g., pedagogy, climate, management, mathematical thinking, classroom characteristics, student characteristics in Colestock and Sherin's (2009) study]. These categories were also similar to those used by researchers to evaluate pre-service teachers' ability to notice or to appraise in-service teachers' video portfolios [e.g., classroom environment, classroom management, mathematical content, tasks, and communication in Star and Strickland's (2008) study and pedagogy, climate, mathematical thinking, and management in Frederiksen et al.'s (1998) study]. Although Star and Strickland (2008) clarified that these categories are merely used as an illustrative framework rather than an optimal one, it is evident that they used this structure to include various observable features of teaching and learning in the classroom. In this regard, the foci of participants' event descriptions reported in their LEAD reports seem to naturally cover various observable features of teaching and learning in the classroom.

It was also found that, across all three phases, the *teacher* category resulted in more subcategories compared to others, implying the participants' perceptions of the importance of this category. The commonality in all phases also implies that it is possible that participants might have a pre-set mind about the essential elements of teaching and may have previously placed them into their own hierarchy. The teacher is viewed as the main actor, responsible for many of the instructional activities. The next section will review the frequencies in categories to see the participants' hierarchy of important elements in detail and any patterns of change in different phases.

Frequencies of categories exhibited in LEAD reports

It was noted that, even within one LEAD report, participants frequently referred to several categories, identifying multiple dimensions of their thoughts on the different aspects of teaching and learning they experienced as students, observed as student teachers, and implemented as teachers. Thus, one report often contained multiple entries of categories. In the process of descriptive analysis to calculate frequencies, the coding process focused on whether the specific category was present or absent in each participant's LEAD report.

A total of 518 entries for Phase 1, 1252 entries for Phase 2, and 135 entries for Phase 3 were identified for the descriptive analysis. Frequencies were calculated based on the total number of meaningful entries. Table 3 shows the frequencies of categories exhibited in each phase of LEAD reflection.

Table 3
Frequencies of categories exhibited in LEAD reports

Category	Phase 1 (total 518 entries of noticing from past learning experiences as students)	Phase 2 (total 1252 entries of noticing from current field setting as observers)	Phase 3 (total 135 entries of noticing during lesson planning/teaching as lead teachers)
A. Class environment/set-up	19.3%	14.2%	20.7%
B. Teacher	24.2%	41.2%	45.3%
B1. Teacher preparation	0.6%	1.6%	5.9%
B2. Classroom management	0.2%	2.8%	7.6%
B3. Communication	1.2%	5.1%	5.1%
B4. Modes of representation used	10.0%	22.2%	15.1%
B5. Teacher knowledge	3.3%	0.8%	1.5%
B5. Grouping strategies	6.2%	4.2%	6.4%
B6. Flexibility/pacing	2.7%	4.4%	3.7%
C. Students	10.3%	2.5%	4.4%
C1. Knowledge/Understanding/Skills	1.4%	1.5%	2.2%
C2. Emotions/ Attitude	5.5%	0.6%	0%
C3. Engagement	3.4%	0.4%	2.2%
D. Tasks	36.5%	34.5%	28.1%
D1. Types and quality of tasks	24.3%	30.3%	14.8%
D2. Delivery/ facilitation of instruction	12.2%	4.2%	13.3%
E. Assessment	9.7%	7.7%	1.5%
E1. Types of assessment	7.0%	2.6%	0%
E2. Grading/Purpose of assessment	2.7%	5.1%	1.5%

City et al. (2009) noted that the nature of the instructional practice is determined by the interactions of three elements of the instructional core (i.e., teacher, student, and content), not the qualities of any one element of it. Participants did not give balanced attention to each element of the instructional core. In all three phases, participants mostly attended to the theme related to *teacher* (24.2%, 41.2%, and 45.3% of LEAD reports respectively in each phase). In contrast, participants demonstrated weak attention to the theme of *student* (10.3%, 2.5%, and 4.4% of LEAD reports respectively in each phase). Although the theme of *tasks* was frequently mentioned (36.5%, 34.5%, and 28.1% of LEAD reports respectively in each phase), as noted above, the entries in this theme mostly referred to the types of tasks or the ways tasks were facilitated by teachers rather than the *content* of tasks, per se. In terms of the interactions of the elements of instructional core, the subcategories in the *teacher* and *task* categories somewhat illustrate teachers' interaction with *students* and *content* (e.g., how to communicate with students or to encourage students' discussion, how to represent the math concepts, and how to facilitate the tasks). However, participants' noticing of the interactions between *student* and *teacher* or *student* and *task* as reflected in their LEAD reports was quite weak. Figure 1 represents the strength of participants' attention to the elements of the instructional core across all three phases.

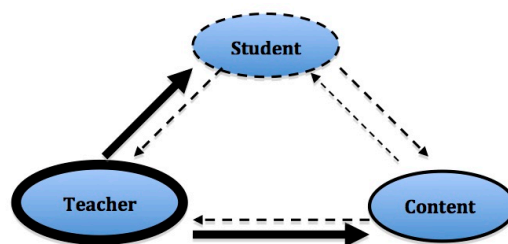


Figure 1. Strength of participants' attention to the elements of the instructional core

It was also notable that there were patterns of change through each phase. Participants gave increased attention to the theme of *teacher* in Phases 2 (41.2%) and 3 (45.3%), when they observed their co-operating teachers' teaching and they implemented their own lessons, compared to Phase 1 (24.2%). In contrast, the attention to the theme of *student* became much weaker in Phase 2 (2.5%) and Phase 3 (4.4%) than Phase 1 (10.3%).

There are some plausible explanations for these patterns of change. The constantly high frequencies in the *teacher* category might be an indication of the participants' emergent and immediate needs as new teachers who were about to embark on their professional career. As the participants became more sensitive to what teachers do, they often saw the majority of interactions occurring in class using a teacher-centred filter. This study does not claim that this pattern of noticing is unproductive, but this skewed pattern of noticing misses other important elements in the instructional process. For example, Dolye (1983) claimed that the term *task* focuses attention on three aspects of students' work including the products students are to formulate, the operations used to generate the product, and the resources available to students while they are generating a product. In contrast to this student-centred view, the participants of this study saw the classroom activities/interactions primarily as how teachers operate and what they provide. Attention to what students were doing with the given task was particularly weak.

The relatively high frequency in the *student* category and relatively low frequency in the *teacher* category in Phase 1 are understandable as Phase 1 LEAD reports were based on the participants' past learning experiences. They could relate more to what they did and how they felt as students instead of what teachers did. In particular, it was likely hard to notice the extensive decision-making role of the teacher in Phase 1. In Phases 2 and 3, the participants became more aware of the responsibilities that comprise the work of the teacher. Also, the unbalanced frequencies in Phase 3 might be an indication of the participants' difficulties in simultaneously handling multiple aspects of class events while they were teaching. The next section will review the frequencies in reflective dispositions to see the patterns of participants' critical views in different phases and discuss some probable explanations.

Frequencies of reflective dispositions exhibited in LEAD reports

The frequencies of participants' reflective disposition on their learning/teaching experiences in the LEAD report (i.e., Lessened/Expanded/Altered/Dropped) along with personal justifications are shown in Table 4. It was noted that the participants described multiple aspects of what they experienced or observed but did not provide separate reflective dispositions for each event they noted in the description part. For these cases, a separate coding category was used (noted 'N' in the following table).

Table 4
Frequencies of participants' reflective dispositions exhibited in LEAD reports

	Phase 1 (total 518 entries of noticing from past learning experiences)					Phase 2 (total 1252 entries of noticing from current field teachers)					Phase 3 (total 135 entries of noticing from own lesson planning/teaching)				
	L	E	A	D	N	L	E	A	D	N	L	E	A	D	N
A. Class environment/setup	3.5%	7.3%	5.6%	1.7%	1.2%	0.3%	5.4%	2.1%	0.5%	5.8%	0.7%	13.3%	6.7%	0%	0%
B. Teacher	2.1%	8.7%	11.2%	4.2%	1.1%	1.6%	9.4%	10.7%	1.2%	18.3%	0.7%	25.2%	19.3%	0%	0%
C. Students	0.8%	2.3%	1.2%	1.9%	1.2%	0.1%	0.6%	0.4%	0.1%	1.6%	0%	1.5%	3.0%	0%	0%
D. Tasks	11.4%	10.0%	7.5%	5.8%	1.7%	1.2%	9.3%	5.4%	1.2%	17.2%	2.2%	13.3%	11.9%	0.7%	0%
E. Assessment	2.5%	0.4%	1.7%	4.4%	0.6%	0.2%	1.4%	1.4%	0.2%	4.4%	0%	0%	1.5%	0%	0%
Total	20.3%	28.7%	27.2%	18.0%	5.8%	3.4%	26.1%	20.0%	3.2%	47.3%	3.6%	53.3%	42.4%	0.7%	0%

1) L – Lessen, E – Expand, A – Alter, D – Drop

2) N – Reports that described specific themes, but did not provide clear dispositions/justifications

Although two dispositions, *expand* and *alter*, were dominant across the three phases, there are some distinguishable features in the patterns of reflective disposition within each phase. In Phase 1, there were a relatively high number of reports related to *lessen* and *drop*, representing negative past learning experiences. Participants were more critical when describing their previous teachers' teaching and their learning experiences. These results are somewhat contradictory to the way of using the notion "apprenticeship of observation" (Lortie, 1975/2002) to illustrate the difficulties for pre-service teachers to consider alternative visions of teaching and learning. The participants' critical disposition implies the unlikelihood that they are going to blindly teach the way they were taught. As Mewborn and Tyminski (2006) asserts, this group of pre-service teachers demonstrated their ability to analytically examine the teaching practice in light of their prior experiences.

There are a couple of notable features in Phase 2 to be discussed. First, the frequencies in the *lessen* and *drop* categories were significantly lower compared to the results in Phase 1. Second, participants tended to report multiple aspects of teaching and learning through observations, but did not indicate specific dispositions/judgments for all the aspects they addressed. This tendency showed as a high frequency in category "N" (47.3%). This study can speculate a couple of plausible reasons for this situation. On one hand, this may imply that pre-service teachers considered field experiences a context to learn solely from those in authority (e.g., co-operating teachers) rather than an opportunity to actively generate their own ideas and thoughts. In other words, with the presence of expert co-operating teachers, they may have felt there was less room for improvement and change, defining their role as mentees or apprentices. On the other hand, this situation might be just an indication that pre-service teachers' ability to see the classroom events was developing. They were not just detached spectators in this phase any more. They actively noted what was happening in the scene just like a reporter. However, their ability as a critic was still developing.

It was interesting to see that the highest frequency was noted in the *expand* category in Phase 3. Many of the participants' LEAD report entries in this phase focused on "what went well." On one hand, it was good to see the positive, self-perceived teaching competence among these pre-service teachers. However, considering the fact that each of them prepared and taught only one showcase lesson, it would be insufficient to use this result as an evidence of their instructional competence. Also, some of the studies on student teachers' self-evaluations of their performance showed that their supervisors' evaluations were not always consistent with their own (e.g., Briggs, Richardson, Sezik, 1986; Wheeler & Knoop, 1982). These studies suggest that

student teachers may not be accurate in self-evaluating their teaching performance. Thus, care should be taken when interpreting this result as the evidence of their instructional competence.

Implications for Teacher Education

It is believed that researching on teacher noticing is important since it can lead to changed practice (Schoenfeld, 2011). This study focused on what pre-service teachers noticed in their past learning experiences and in current field experience settings because what they especially noticed and how they reflected on what they noticed could be a glimpsed blueprint for their future. It was found that the participants, as a group, generated quite constant categories of noticing across different phases, although the participants' foci of noticing showed some shifting as it went through different phases taking different roles. By asking the pre-service teachers to try to capture moments that occurred in different contexts with distinct roles, this study was hoping to probe transformational changes to the participants' thinking and noticing and contemplate its implications to teacher educators. Findings from this study have several implications for the preparation of pre-service teachers.

Many researchers cited Lortie's (1975/2002) study to conclude that the apprenticeship is formed from the perspective of a student and provides a skewed vision of teaching. However, the results from this study showed the participants' inclination to incorporate the shifting concerns encountered as they entered the occupation of a professional teacher. What they observed from their past learning experience is not a completely static entity. As shown in the participants' reflective dispositions, they demonstrated some of the classroom events in a critical perspective. Thus, this past experience can be utilised to offer some reflective opportunities including re-thinking what has been done and inquiring possibilities for alternative ideas.

Being in different roles surely sparked eliciting pre-service teachers' perspectives on teaching and learning. It shows that the participants' patterns of noticing and their reflective disposition are not completely determined based on their predisposition. Rather, it seems that the things they notice and reflect on are also continuously changing based on the situation and expected roles in which they find themselves.

This study showed that what participants attended to in the field setting is somewhat unbalanced, missing many important aspects in classroom teaching (e.g., weak noticing on students and their interactions with other elements of instruction). It may be that they narrowly define their effectiveness as teachers within what they can physically demonstrate. This informs teacher educators of the need to provide more detailed guidance in these areas in order to promote reflective thought across all areas of interactions.

This study provided teacher educators with opportunities to devise ways to enhance pre-service students' learning in field experiences and other associated experiences. It would be ideal to closely connect what is happening in the field setting with the pre-service teachers' past experiences and future plans instead of designing it as an isolated experience. In order to support important transformations it is needed to develop proper vehicles such as activities or assignments that will invite pre-service teachers to critically explore and reflect the meaning of what they noticed in their past experiences and field settings. This will offer teacher educators opportunities to redesign their course activities to better bridge university coursework and actual classroom settings.

If teacher education programs continue to provide field experiences as a context to help pre-service teachers have holistic views and critically reflect on teaching and learning in the classroom, it would be important to know what pre-service teachers observe, think, and do in the field setting. To do so, it would be desirable to consider more structured observation and reflection activities in collaboration between the teacher education program and the field setting. It is hoped that this study brings teacher educators' attention to the creative ways to support pre-service teachers' appreciation and development of the full range of teaching and learning of mathematics.

The findings from this study should be interpreted limitations of the stated setting and design. This study investigated what pre-service elementary teachers notice when asked to

reflect on past learning experiences (phase 1), current classroom observations in the field (phase 2), and current brief teaching experiences (phase 3). For Phase 3, although the majority of participants taught multiple small group or whole group lessons in addition to the one required full-length whole group lesson, they only had very limited teaching experiences. Reflections on their lessons with limited teaching experiences are likely to be quite different from reflections on teaching as they become familiar with students and content, and have begun to feel more at ease with teaching responsibilities. Likewise, their reflections on past learning experiences and field observations (phases 1 and 2) could become more reliable over time. Future research can investigate how pre-service teachers' reflections on these three phases have changed during the teacher education program (e.g., Year 1, Year 2, or Year 3 of the teacher education program) to identify the changing nature of their noticing.

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Authors

Ji-Eun Lee
 485F Pawley Hall
 Oakland University
 Rochester, MI, USA, 48309-4401
 email: lee2345@oakland.edu