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An investigation of noticing skills of pre-service and in-service teachers

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Abstract

The aim of the study was to investigate the noticing skills of prospective teachers and teachers at schools. The study adopted the case study design. The participants of the study were selected voluntary basis via criterion sampling method, and were composed of 12 student teachers of Mathematics at the Elementary Mathematics Teaching program of a state university, and 3 teachers of Mathematics in the practice school of participant student teachers. The student teachers analyzed mathematical thinking focused videos of students' problem solution activities in the course for 5 weeks with 3 hours each. In schools, a teacher's lesson was analyzed every week. The data collection tools consisted of the written opinion forms, observation notes, video recordings of classes, and follow-up meeting transcriptions. Written opinions of student teachers and teachers were analyzed week by week via theoretical framework (Van Es, 2011) in order to determine their level of noticing. The results revealed that after the sessions, the noticing levels of student teachers were improved. In addition, teachers did not make interpretations at extended level in the level of noticing.

Keywords: Teachers' noticing, in-service teachers, student teachers, mathematics teaching

1. Introduction

With the renewed mathematics curriculum, learning by understanding mathematics has become more important. In mathematics education, a learning approach in which teaching thinking is brought to the forefront as well as providing students with basic concepts and skills is adopted (National Council of Teachers of Mathematics [NCTM], 2000). Similarly, it is aimed to raise students who are actively involved in the learning process and have the skills of questioning, thinking, discussion and self-expression in the Secondary School Mathematics Course (Grades 5-8) (Ministry of National Education [MoNE], 2018). Along with the updated curriculum, the most important task of achieving

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the targeted skills in mathematics education falls on the teachers (NCTM, 2000). Along with the new approaches adopted in mathematics education, the roles expected from teachers have also changed (MoNE, 2017; NCTM, 2000). Although updated programs are student-centered, they are teachers who will implement these programs (Dede & Argün, 2003). Mathematics education requires teachers to make decisions in the middle of the lesson (NCTM, 2000). Because mathematics is an abstract course, and during the learning of mathematical concepts, every student may not build the concept correctly in his mind. It is a great opportunity for the teacher to recognize the difficulties experienced in the student mind during the teaching and to make sense of the reason of this difficulty. It is clear that the correct reactions and correct strategies to be applied by the teacher as a result of this interpretation will increase the quality of the learning environment. For this reason, it is very important for a mathematics teacher to recognize the events in the classroom and make sense of these events.

A teacher needs to be aware of and interpret the situations happening in the class (Berliner, 2001; Frederiksen, 1992). In other words, teachers realize what a student thinks and what is important in what he thinks, whether a particular task attracts the interest of a student, when a particular book fascinates the student, what makes an idea difficult, when students are busy or when they understand, all this and more they should (Ball, 2011). The ability to notice is a theoretical structure based on teachers' understanding and interpreting important events in the classroom (Goldsmith & Seago, 2011; Jacobs, Lamb & Philipp, 2010; Sherin & van Es, 2009; van Es, 2011). There are many events happening at once in the classroom, and a teacher needs to be able to review these stimuli and identify important moments that require attention (Sherin, Russ & Colestock, 2011). Van Es and Sherin (2002) emphasizes that the ability of teachers to notice is not only about paying attention to what is important in class situations, but also includes understanding and reasoning about what is observed based on relevant information. It consists of three categories: paying attention to the thinking of the students, interpreting them and offering solutions by focusing on student thinking (Jacobs, Lamb and Philipp, 2010; Jacobs, Lamb, Philipp and Schappelle, 2011). Mason (2002) defines the skill of noticing as a series of practices to develop teachers' sensitivity to act differently during teaching. In addition, Mason (2008) stated that teachers consider the important events in the class as well as their reflections, comments and decisions about these events. In their study, van Es and Sherin (2002) explained the learning to notice framework as follows: noticing, it includes identifying important situations that arise in teaching situations, using knowledge related to class context to make sense of emerging situations, establishing a relationship between special situations and general principles of learning-teaching (van Es & Sherin, 2002).

Professional noticing is at the core of teachers 'ability to respond to students' urgent needs (Gibson & Ross, 2016). Notice components require not only useful knowledge and skills, but also a high degree of coordination (Ball, 2011). Therefore, for a teacher to manage the teaching process well, it is very important to have these skills as well as to use

their skills in a suitable and coordinated way. In order for teachers to recognize students, they need to pay attention to their way of thinking, how they understand the subject, where and why they think wrong, and plan their teaching processes accordingly (Goldsmith & Seago, 2011; Jacobs, Lamb & Philipp, 2010; Smith & Stein, 2011). Therefore, for a good teacher to manage the teaching process effectively, he must have the ability to notice (van Es & Sherin, 2010). However, since more than one student-teacher and student-student interaction takes place in the classroom, it is not easy for teachers to use the skill of noticing. Teachers need professional development experiences where they will develop their noticing skills because they do not pay attention to the way they think, and have difficulties in determining the underlying causes of their wrong thinking (Jacobs, Lamb & Philipp, 2010). The ability to notice is a skill that has not been adequately emphasized in the teacher training. However, teachers and student teachers can develop this skill with the necessary professional development experiences (Goldsmith & Seago, 2011; Güner & Akyüz, 2017; Jacobs, Lamb & Philipp, 2010; Sherin & van Es, 2009; van Es, 2011; van Es & Sherin, 2008).

Based on these findings, the aim of the study is to examine the noticing skills of teachers and student teachers. Accordingly, the purpose of the research is seeking answers to the following research questions:

1. How do student teachers' level of noticing change?
2. How do teachers' level of noticing change?

2. Method

In the research, noticing level of teachers and student teachers was examined through a case study. This research method was used to identify and see the details that make up a situation, to develop possible explanations about a situation and to evaluate a situation (Gall, Gall & Borg, 2007; Yin, 2003)

2.1. Participants

The participants of this study were 12 student teachers in the Elementary Mathematics Teaching program of a state university, and met the criteria of school practice as part of an elective course. Within the scope of this elective course, 33 student teachers were taking the teaching practice course in the same school. With the condition of school practice 12 student teachers who volunteered by explaining the scope of the study were included in the study. At the same time, the other participants of the study were 3 mathematics teachers in the school where these 12 student teachers were pursuing their school practice.

Every 4 student teachers had 1 mentor teacher. These teachers were included in the study on voluntary basis by explaining the scope of the study. Implementation Process

The student teachers analyzed mathematical thinking-oriented videos with students' problem solutions in the 3-hour course. After these analysis processes, student teachers go to school practices in their schools. For 5 weeks, student teachers watched 2 videos that take 15 minutes and then discussed them with the questions of the researcher. Sample questions used by the researcher during the discussion are as follows:

- What are the important points you see in the video you watched?
- What did you notice?
- What are the situations that attract your attention in student thinking?
- Are students thinking differently?

The focus of the questions was to concentrate student teachers on student thinking. During the 5-week period, a total of 15 minutes of 10 videos were discussed with student teachers. These videos were from 5th, 6th, 7th and 8th grades. The videos contained the processes of solving open-ended problems of groups of 3 students, and they were selected by 3 mathematics educators amongst a total of 17 videos based on a clearer transfer of thinking processes. In groups' working, in order to reveal students' thinking processes the following sample questions were addressed:

- What are you doing right now?
- Which approach do you prefer?
- Why did you choose this approach?

Teachers' lessons were analyzed for 5 weeks in schools. Every week, a teacher's lesson was analyzed. The course was attended by researcher, 2 other teachers and 4 trainee teachers who were the interns of the teacher who taught the lesson. During their observations, they were asked to note the points that caught their attention. At the same time, the course was recorded on video. Following the course, follow-up meetings were held with the participation of 12 teacher candidates, 3 teachers and researchers. In this meeting, first, the course video was watched and then the teachers and student teachers were asked to write the things they noticed, regarded as important in the course and found significant. Later, these written opinions were collected and everyone's opinions were opened for discussion. However, the issues that were not noticed by student teachers and teachers at these meetings were not opened to discussion. In these meetings, teachers and student teachers discussed the issues they determined within the scope they determined. The role of the researcher in these discussions was to encourage all participants to

participate in the discussion. Video was recorded at follow-up meetings. The researcher kept observation notes in lectures and follow-up meetings.

2.2. Data Collection Tools and Data Analysis

The data collection tools of the study consisted of the written opinion forms of student teachers and teachers, observation notes, video recordings of lecture and follow-up meetings and one-to-one transcriptions of these records.

Written opinions of student teachers and teachers were analyzed week by week with Van Es (2011) theoretical framework in order to determine their level of noticing. Van Es (2011) examined noticing in two main categories: what do the teachers realize and how teachers realize it. The first dimension, what does the teacher realize, covers who the subject (subject / actor) noticed in the video clip he watched and the subject he noticed. The subject size is related to whether the noticed is the whole class, a group of students, specific students or teachers. The subject dimension reflects focused situations such as pedagogical strategies, behavior, mathematical thinking or classroom environment. The second dimension of the theoretical framework addresses how teachers analyzed what they realized, and included the analytical attitudes of teachers and the level of detail. Analytical attitude related to teachers' approach to analyzing classroom events and addressed whether teachers conducted an efficient questioning of teaching and learning. It also included whether they evaluated or interpreted the events they observed. Analytical attitude consisted of three levels: descriptive, evaluative and interpretive. The description was the re-mentioning of the events taking place in the classroom. Evaluation included judgments of the teachers on what is good and bad or how it could be done differently. Interpretation was about the teacher's reasoning about his observations, trying to understand the origin of a thought, and explaining what was meant by a particular expression, drawing, mimic / movement and explanation. Finally, the level of detail dealt with whether the teacher gave details when explaining his/her thoughts or supports with evidence, and whether he/she expressed the analysis in detail (van Es, 2011).

Van Es (2011) examined the categories of how to notice and how he realized the difference in four levels. These levels are Level 1 (Basic), Level 2 (Mixed), Level 3 (Focused) and Level 4 (Extended). The scope of each level is expressed as follows.

Level 1: The primary focus of the pre-service teacher or teacher is the whole classroom environment, classroom behavior, learning and teaching pedagogy. The trainee or teacher presents general impressions about the classroom, evaluates what they observe, and provides little evidence to support their analysis. The explanations are more descriptive and evaluative, with little evidence to support the explanations.

Level 2: The pre-service teacher or teacher primarily pays attention to the pedagogy of the practitioner teacher, but also begins to focus on students' mathematical thinking.

There is a tendency to cover the whole class and pay attention to certain students. In the context of how he notices, he continues to talk about his general impressions, but also identifies remarkable events. It also tries to interpret them while continuing to evaluate what they are observing. Despite mentioning specific moments and students to support his statements, he is inconsistent in deepening his comments and providing details about what he observed.

Level 3: The pre-service teacher or teacher begins to focus mainly on specific students and their mathematical thinking in terms of what is noticed. In terms of how it realized, the pre-service teacher or teacher reasoned what they observed. It examines important situations and uses details in these situations to make inferences about students' mathematical thinking and understanding. The feature that distinguishes this level from the first two levels is the focus on mathematical thinking of certain students.

Level 4: At this level, student teachers or teachers continue to examine the details of students' mathematical thinking using the lessons in the lesson to understand what they are observing and support their ideas. It bases its reviews on various explanations or comments. It expands its analysis to understand the relationship between student thinking and teacher pedagogy. The feature that distinguishes this level from previous levels is that student teachers and teachers associate their analysis of certain student ideas with the specific approaches observed in their video recordings and suggest alternative teaching approaches depending on their analysis.

In this research, the data is divided into meaningful whole by reading the data carefully within the scope of descriptive analysis. Significant situations were obtained in the context of noticing in the expressions of student teachers and teachers in their written responses. Then, it was determined which level in the frame (van Es, 2011) corresponds to the weight of each emerging situation. To ensure the reliability of the research, two mathematics educators coded. The percentage of the comparative match between the two raters for meaningful situations and level determination in the context of difference was calculated using the percent agreement formula of Miles and Huberman (1994). 87% coherence was found among the coding for meaningful situations in the context of noticing. The percentage of adaptation calculated for leveling was 92%. The fact that the percentage of

agreement between coders is above 70% is generally accepted as acceptable limit in the related literature. A consensus was reached by discussing the parts of the conflict.

3. Results

The student teachers' levels of noticing change over the course of 5 weeks, is given in Table 1. In this part, student teachers are coded as PT (Prospective Teachers).

Table 1. The Student teachers' levels of noticing change

Weeks	Levels	Student teachers											
		PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8	PT9	PT10	PT11	PT12
1st Week	Basic	X	X	X				X		X	X	X	
	Mixed				X	X	X		X				X
	Focused												
	Extended												
2nd Week	Basic	X		X						X	X		
	Mixed		X				X	X	X			X	X
	Focused				X	X							
	Extended												
3rd Week	Basic												
	Mixed	X		X				X		X	X		
	Focused		X			X	X		X			X	X
	Extended				X								
4th Week	Basic												
	Mixed									X			
	Focused	X	X	X		X		X			X	X	
	Extended				X		X		X				X
5th Week	Basic												
	Mixed												
	Focused	X								X			
	Extended		X	X	X	X	X	X	X		X	X	X

When Table 1 is examined, it is observed that the noticing levels of all student teachers have improved. Level development is observed from Basic (Level 1) to Extended (Level 4). Except for 2 pre-service teachers, the levels of other pre-service teachers have reached the extended level. However, the level of 2 student teachers was determined as Focused (Level 3) in the 5th week. Below, the student teachers have been presented with their codes and their opinions from the views they explained in the weeks.

"The teacher creates situations where students can think differently, but it does not allow students to express themselves. Only a certain part of the class attends the lesson. This prevents everyone from conceptual learning the lesson and there is no opportunity to correct their misconceptions. " PT2-2nd week-Basic

"… After the teacher solved the slope question during the lesson, they were discussing why the slope about that question was positive. One of the students said that the slope cannot be negative. When the teacher asked why, he replied that we were getting positive in ramp questions. Teacher asked, is there any effect on whether the line is tilted left or

right on the graphics? The student answered, but always positive. Most likely, the questions that the slope was positive in the classroom were solved, which may have caused the student to be over-generalized. ” PT11-4th week –Focused- student teacher written statements focused on mathematical thinking of certain students.

“… one of the students said that if an event with a probability of ¾, the probability of not having is also ¾. When the teacher asked the student why he thought that way, he replied, "just as there is a possibility of a child being a girl or a boy". The student seems to generalize this situation to every situation. If we just look at his first comment, he might have said ¼ accidentally, ¾ as well. In this case, the student would have made only mistakes. However, it was revealed from the speech of the teacher with the student that this was a misconception caused by excessive generalization. The teacher did not realize that the student had a misconception. He just said, "You have to get it out of 1" and he continued the lesson. If I were the teacher, I would use the dice, two currencies, or a ready model to make the student find the sum of the probability of an event and not happening is 1… ” PT6-5th week-Extended

How teachers' noticing levels changed during 5 weeks is given in Table 2 below. In this table, teachers are coded as T (Teacher).

Table 2. The Teachers' Levels of Noticing Change

Weeks	Teachers	Noticing Levels			
		Basic	Mixed	Focused	Extended
1st week	T1	X			
	T2	X			
	T3	X			
2nd week	T1		X		
	T2		X		
	T3		X		
3rd week	T1		X		
	T2		X		
	T3			X	
4th week	T1			X	
	T2			X	
	T3			X	
5th week	T1			X	
	T2			X	
	T3			X	

When Table 2 is examined, it is observed that all teachers' level of noticing has improved. However, no teacher commented on Extended (Level 4) for 5 weeks. Below, the codes of the teachers, along with their views, are presented by specifying the week from their views.

"The teacher gave the angle features of the rhombus on the board. Then one of the students asked that, if all the sides are equal, shouldn't all the interior angles be equal? If the angles are changing, won't it change the edges? Then the teacher explained the subject again. As a teacher, it is important that we repeatedly explain what students do not understand. Considering their questions is important for students to learn. Here, the student thinks that if all the sides are equal, all the inside angles should be equal, but it is not always so. " T2-3rd week-Mixed

"In the question of nested circles (shown in figure 1), while most of the students listed the angles, they said that the outermost circumference was larger. There, my friend (teacher who applied the lesson) emphasized that these arcs shrinking from the outermost to the inside but the angle remained constant and the angle measurement did not change. A student also made a very nice comment there and commented that the lengths of the arcs were $(\alpha/360).2\pi r$ and that it varied depending on r, also apply this by giving random values" T3-5th week-Focused

Question: The point "O" is the center of the given circle, find the measure of the angles: $(\widehat{AOB}), (\widehat{COD}), (\widehat{EOF})$ and compare.

Figure 1. Question that was used in the Lecture

When the content of the lessons where student teachers analyze mathematical thinking-oriented videos with problem solutions of students, attending 3 hours every week, it was seen that student teachers were increasingly noticing important mathematical thoughts in unedited video recordings. By making video analyzes of student teachers, it has made progress in determining the points that students experience difficulties and the underlying causes of these difficulties. At the same time, it was found that the same level of progress was made when examining the discussions on providing suggestions for improving

teaching to overcome these difficulties. An example discussion dialogue section, in which these findings are reflected, is given below. Since there are 33 teacher candidates in this course, the participants of the study were expressed with the same codes, and the student teachers other than the participants of the studies were coded between PT13 and PT33.

…

PT15: In these solutions, I found that the students had difficulty in finding the least common denominator.

PT3: For example in that question: Which players' two-point shooting achievements are higher than the free-throw and three-point shooting achievements?

PT15: Yes yes

PT3: They could have found there without equalizing the denominator

PT22: How?

PT 31: By equalizing the numerator?

PT3: No, no it can be find by closing to half, for example 17/34 is half 16/30 is smaller than half so this situation can be compared by considering

PT15: Yes, but they all went to the denominator or the numerator and they both had difficulties and lost a lot of time

PT28: There were situations interpreted in close proximity to the whole

Researcher: Can you explain what you mean?

PT28: For example, when comparing the fractions between 60/61 and 47/49, they immediately equalized the denominator, whereas 61/61 had a difference of 1 unit for the whole here, but they could say that there is a difference of 2 units to the whole of 47/49.

PT7: But if they do not examine the proximity of this half and the whole in their lessons, it is very difficult to make inferences.

PT4: Teachers should definitely address this situation in terms of rational numbers. Activities that include proximity to the half and proximity to the whole must be done.

PT18: Students can find the strategy themselves by writing such fractions on the board and asking questions.

…

When the contents of the follow-up meetings attended by 12 student teachers, 3 teachers and researchers after a teacher lesson each week, it was observed that as the study progressed, student teachers and teachers started to focus more on student thoughts in the course analysis. It was determined that the students in the course videos began to examine their answers without acting hasty, paying more attention to the mathematical thoughts underlying the answers. In the process, it was determined that student teachers and

teachers became more prone to discuss students' thinking with an interpretive or analytical stance. But in order to understand what teachers are observing and support their ideas, they continue to examine the details of students' mathematical thinking using the details in the lesson, but they do not recommend alternative teaching approaches based on associations and analysis. It was observed that teachers were hastier in their comments. This situation detected in teachers is presented below with a sample discussion dialogue section.

The teacher gives the angle properties of the rhombus on the board. Then one of the students asked that, if all the sides are equal, shouldn't all the interior angles be equal? If the angles are changing, won't it change the edges? On top of that, from the discussion of the section where the teacher re-explains the properties of the rhombus. (From 3rd week discussion)

…

T2: My friend (teacher) explains again without getting tired

PT10: But did the student understand?

T1: He did not ask me a question, he probably understood.

T3: In general, students make this mistake

PT5: I think that at this stage, students could be asked socrative question or be given examples that they could observe. For example, if 4 equal-sized pencils were used and form a square with these pencils and then tilted with their perpendicular sides parallel to each other, it would be shown to the students that the angles could change without changing the edge lengths. Students would grasp that the 4 side length equations could not only be in the square but also in different quadrilaterals.

T3: If we offer different expressions according to the thinking of each student, we cannot train the subjects in the curriculum. Of course, you think that everything can be done because you are not in the profession.

…

4. Discussion

In this study, where the noticing levels of student teachers were examined, it was determined that the noticing levels of student teachers improved. This development, from initially presenting general impressions about the classroom, providing little evidence to support their assessment and analysis, giving descriptive and evaluative explanations, providing very little evidence to support explanations. In the process, it has been directed towards focusing on students and their mathematical thinking, basing these studies on various explanations or comments, associating their analysis of specific student thoughts

with certain approaches observed in video recordings and suggesting alternative teaching approaches depending on the analysis.

Findings show that student teachers and teachers fail to understand students' thoughts in the first weeks of the research and to examine the emerging thoughts. This finding is similar with the conclusion that many studies in the literature initially paid attention to the non-mathematical aspects of what students did and that students were deficient in focusing on mathematical thinking (Goldsmith & Seago, 2011; Kazemi & Franke, 2004; Sherin & Han, 2004; Sherin & van Es, 2009; van Es, 2011; van Es & Sherin, 2008). In parallel with this finding, there are many studies in the literature that student teachers have noticed substantially their students' thinking, but often come to the conclusion that they present with superficial shares without going into much detail (Crespo, 2000; Fernandez, Llinares & Valls, 2013; Güner & Akyüz, 2017; Özdemir & Altay, 2016).

As the study progressed, it was obtained that the comments of student teachers and teachers in the course analysis changed from teacher to student, from the events in the lesson to more specific events, as well as from the evaluator to the interpreter and their analysis became more evidence-based. It was also observed that student teachers and teachers started to focus more on student thoughts in their course analysis. It was determined that the students in the course videos began to examine their answers without acting hasty, paying more attention to the mathematical thoughts underlying the answers. In the process, it was determined that student teachers and teachers became more prone to discuss students' thinking with an interpretive or analytical stance. This finding is parallel with the findings in the literature that teachers' ability to recognize the characteristics of the student's mathematical thinking can be improved through professional development efforts (Ball & Cohen, 1999; Kazemi & Franke, 2004; Sherin & Han, 2004; Sherin & van Es., 2009; van Es, 2011; van Es & Sherin, 2008). To ensure a good teaching and students 'understanding, teachers need to pay attention to students' responses, comments and reasoning, consider how they think and try to make sense of them when planning the lesson, during and after teaching (Goldsmith & Seago, 2011; Jacobs, Lamb & Philip, 2010; Smith & Stein, 2011). For an effective mathematics teaching, it is important for teachers to understand students, realize their mathematical thoughts and present their lessons accordingly (van Es & Sherin, 2010). In this sense, improvement of the noticing levels in the study can be interpreted as a positive development for an effective mathematics teaching.

5. Conclusion

It was found that teachers did not make extended interpretations at the level of noticing. In order to understand what teachers are observing and support their ideas, they continue to examine the details of students' mathematical thinking using the details in the lesson, but they do not recommend alternative teaching approaches based on associations and

analysis. It was observed that teachers were hastier in their comments. This is considered as a result of the fact that the education system so far is exam-oriented and teachers always have to train something in the curriculum, and they try to do in-class teaching quickly. However, considering the structure where more mathematics literacy comes to the fore in the transition to high schools, this learning environment should change. In this sense, professional development approaches can take place in different contents. In these approaches, it is important for Mathematics teachers to have the opportunity to examine their own practices, analyze student learning and discover the relationship between teaching movements and learning that results in everything that happens in the classroom. In this sense, professional development approaches can be applied that focus on students' mathematical thinking and offer opportunities for teachers to observe the change in the applications of these processes.

Studies with student teachers are guiding to develop this skill by revealing their existing noticing skills. It is very important for student teachers to be aware of this skill before starting the job and graduate with this skill. For this reason, this study provides a different learning environment with a video-based learning environment and real-state analysis and discussion environment with experienced teachers. It is thought that a lesson module should be created and implemented on the ability of students to realize their undergraduate education. The teaching profession is a dynamic profession and requires constant development, renewal, and keeping up with the new generations. Therefore, the events that need to be noticed in the classroom are constantly changing and increasing. For this reason, different learning environments should be designed not only for student teachers, but also for teachers in in-service training programs. In this study, which was observed that general course video discussions were not sufficient, it is thought that the analysis of videos focused on mathematical thinking in the content of in-service development programs will have more productive results.

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