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Self-Reflection Processes of the Novice Middle School Mathematics Teachers *

Erhan Bozkurt [1], Pınar Yıldız [2], Ramazan Gürel [3], İffet Elif Yetkin Özdemir [4]

Abstract

In this case study the aim is to examine the self-reflection processes (self-evaluation, causal attribution, emotional reactions and inferences) of novice mathematics teachers. The participants were six middle school (grades of 5-8) mathematics teachers who have less than five years teaching experience working in the Western and Central Anatolia Regions of Turkey. The data of the study were collected through the semi-structured interviews developed based on classroom observations. First, the instructional situations were determined by observing the mathematics lessons of the participants (approximately 10 hours for each participant). Afterwards, through semi-structured interviews, the participants were asked to reflect on these instructional situations. During the data analysis, first within case analyses were made, and the self-reflection of each teacher was described. Then by comparing the data obtained from six teachers, it was defined which self-reflection processes the novice mathematics teachers performed and to what extent they performed them. The findings suggest that the participants did not consider their teaching behaviors when they were asked to evaluate the lesson. They attributed the cause of the failure in their lessons to factors beyond their control (e.g., low involvement of parents, insufficient physical facilities of the school). In addition, it is observed that they were less likely to develop positive emotional responses for the observed lessons and were insufficient in taking adaptive decisions for their future lessons. These findings indicate the necessity of pre-service and in-service practices that will support newly recruited middle school mathematics teachers to gain much more comprehensive self-reflection skills.

Keywords

Mathematics teachers
Self-regulation
Self-reflection
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[1] Uşak University, Faculty of Education, Mathematics and Science Education, Turkey, erhanb82@gmail.com
[2] Çanakkale Onsekiz Mart University, Faculty of Education, Mathematics and Science Education, Turkey, pinaryildiz@comu.edu.tr
[3] Burdur Mehmet Akif Ersoy University, Faculty of Education, Mathematics and Science Education, Turkey, rgurel@mehmetakif.edu.tr
[4] Hacettepe University, Faculty of Education, Mathematics and Science Education, Turkey, ozdemiry@hacettepe.edu.tr

Introduction

First years in teaching profession are of great importance because the views, approaches and practices that novice teachers may develop have significant effects on their future professional life (Hebert & Worthy, 2001). Research indicates that mathematics teachers, in the early years of their professional life, encounter various problems in teaching-related duties such as planning the instruction, using the teaching materials and different teaching methods effectively, and it is reported that they have difficulty in overcoming these problems (Borko & Livingston, 1989; Hebert & Worthy, 2001; Murtafiah, Sa'dija, Chandra, & Zayyadi, 2019; Reynolds, 1992; S. Wang & Ye, 2020). Mathematics teachers need to have self-regulation skills that will enable them to constantly update and improve themselves in order to pass this critical stage of their professional life successfully.

This study focused on novice mathematics teachers' self-reflection processes of their teaching practices. To this end, Zimmerman's (2000, 2002) self-regulated learning model was used. This model explains self-regulated learning in terms of three cyclical phases (forethought, performance control, and self-reflection) in which self-regulatory processes (e.g., goal-setting, planning, self-monitoring, self-evaluating) and associated beliefs (e.g., self-efficacy, attributions) come into play. These processes and beliefs interact with each other and influence the ways learners analyze the tasks, set goals and devise a plan (forethought phase); select, adapt, and implement strategies and, monitor their progress (performance-control phase); and reflect on the outcomes (self-reflection phase) which influence the subsequent goals and efforts. While Zimmerman's model explains self-regulation of learners, it can also be used to describe teachers' regulation of their teaching. In this respect, self-reflection phase which involves two processes, namely self-judgment (self-evaluations and causal attributions) and self-reaction (emotional reactions and adaptive-defensive inferences), plays an important role for novice teachers to develop adaptive skills and dispositions for their future career.

The process of self-judgment involves one's evaluations of his or her performance (self-evaluations) and attributions of causal consequences to the results (causal attributions) (Zimmerman, 2000, 2002). Self-evaluation refers to teachers' assessment of his or her teaching performance as successful or unsuccessful by comparing it with a set of criteria (teaching goals, previous teaching performance, student participation, time management, etc.) (Çapa-Aydın & Uzuntiryaki-Kondakçı, 2014; Ross & Bruce, 2007; Yetkin-Özdemir, Gürel, Akdal, & Bozkurt, 2014). In this process, teachers are expected to use clear and meaningful criteria for the comparison and evaluate their teaching performance in a realistic way. Otherwise, they may carry out unrealistic evaluations of their teaching performance (Bozkurt & Yetkin Özdemir, 2018). Teachers' judgments about their performances are also related to the factors that they attribute their success and failure to (Çapa-Aydın, Sungur, & Uzuntiryaki, 2009; Çapa-Aydın & Uzuntiryaki-Kondakçı, 2014; Ghanizadeh & Ghonsooly, 2014; Yetkin-Özdemir et al., 2014). Teachers can attribute their success and failure to internal factors that they can control such as using effective teaching methods or lack of planning; or external factors that they do not have any control over, such as low involvement of parents or curriculum overload. Teachers who attribute their failure to internal factors are more likely to have higher levels of motivation and are much more open to change to perform better in their future career (Ghanizadeh & Ghonsooly, 2014; H. Wang, Hall, & Rahimi, 2015; Yetkin-Özdemir et al., 2014).

Self-judgment process may lead to some feelings and associated affect (emotional reactions) as well as decisions (adaptive-defensive inferences) that reflect teachers' self-reactions. While teachers feel positive emotions such as happiness, self-confidence and peace after the lessons that they consider themselves as successful in delivering whereas they are likely to express negative emotions such as sadness, disappointment and anger after the lessons that they think they performed poorly (Çapa-Aydın et al., 2009; Çapa-Aydın & Uzuntiryaki-Kondakçı, 2014; Yetkin-Özdemir et al., 2014). Such

emotions have effects on their future teaching practice (Richert, 1987; Sutton, 2007). Besides these emotional reactions, teachers put forward a number of inferences and decisions for their future lessons. They may be adaptive conclusions aiming to make adjustments and demonstrate better performance in future lessons or defensive conclusions that will cause them to exhibit self-withdrawal behaviors (Çapa-Aydın et al., 2009; Çapa-Aydın & Uzuntiryaki-Kondakçı, 2014; Yetkin-Özdemir et al., 2014). The former type allows individuals to continue their development (Zimmerman, 2000, 2002). Therefore, for novice teachers to reach adaptive conclusions is very significant for their professional development (Yetkin-Özdemir et al., 2014).

Extensive research has been carried out on teacher reflection processes both in mathematics education and in other disciplines. Some of these studies were conducted with a large number of teachers by using survey designs (e.g., Baştürk, 2012; Öztürk, 2007), while others were conducted with a few number of teachers by using qualitative designs such as case study (e.g., Gabriele & Joram, 2007; Kwon & Orrill, 2007; Ross & Bruce, 2007). Findings of these studies show that teachers mostly focus on teaching practices that they evaluated as unsuccessful when judging their performance (Bozkurt & Yetkin Özdemir, 2018; Kwon & Orrill, 2007; Lin, 2001; Maat & Zakaria, 2010; Nathan & Knuth, 2003). It has also been reported that teachers generally employ their pre-established lesson goals or outcomes as well as student related factors (e.g., student learning or affect) as criteria in their evaluations and that their positive emotional reactions mostly occur when they believe that they meet these criteria (Gabriele & Joram, 2007). In addition, it is stated that the reasons for the successful and unsuccessful teaching situations are mostly attributed to the external factors that are not under their control (Hall & Smith, 2006; Kwon & Orrill, 2007; Öztürk, 2007).

There are numerous studies arguing that as teachers engage in self-reflection processes, they focus more on student-related dimensions (participation in class, academic achievement, etc.), and they can produce more specific and clear evaluations about these dimensions (Bozkurt, 2015; Gabriele & Joram, 2007; Kwon & Orrill, 2007; Ross & Bruce, 2007; Sherin & Han, 2004). In addition, as teachers engage with self-reflection, their positive emotional reactions become more related to their assessment of student status (Gabriele & Joram, 2007), and they manage to attribute the failure to themselves more (Bozkurt, 2015; Bozkurt & Yetkin Özdemir, 2018; Kwon & Orrill, 2007). In short, self-reflection help teachers realize their strengths and weaknesses in teaching and contribute to improving their teaching (Bozkurt, 2015; Bozkurt & Yetkin Özdemir, 2018; Kwon & Orrill, 2007; Maat & Zakaria, 2010; Wood, Cobb, & Yackel, 1991). The studies that examined the reflection processes of senior teachers and novice teachers in a comparative manner conclude that generally novice teachers had difficulties in remembering classroom situations, especially situations related to student errors, in their reflection processes (Allen & Casbergue, 1997; Hall & Smith, 2006). In addition, it is found that novice teachers mostly focus on their own teaching behaviors rather than student-related situations in the reflection processes and produce mostly ambiguous and inconsistent evaluations.

While the findings of these studies contributed our understandings about teacher reflection, most of them examined aspects of teacher reflection separately. Particularly, most studies conducted in mathematics education examined teachers' self-evaluations (e.g., criteria for evaluation, interpretations on teaching practices or on student thinking), or their beliefs and affects (e.g., causal attributions or emotional reactions) that play role during self-reflection separately. This fragmented focus in studies on teacher reflection may constrain our understandings because several processes and beliefs interact with each other and impact teachers' judgments and reactions during self-reflection. Researchers suggest examining teacher reflection as a whole process and in relation to natural teaching environments in order to get a full understanding of the concept (Hall & Smith, 2006; Marcos, Miguel, & Tillema, 2009). Zimmerman's (2000, 2002) self-regulation model allows examining teacher self-reflection as interactive processes and beliefs. Therefore, the aim of this study is to analyze the self-reflection processes (self-

evaluation, causal attribution, emotional reactions and adaptive-defensive inferences) of novice middle school (grades of 5-8) mathematics teachers. Examining novice mathematics teachers' self-reflections in terms of the interactions among several processes and beliefs and in relation to their own teaching practices contributes to the understandings about the complexity of teacher reflection process.

Method

Study Design

The study is designed as a case study. Case study is one of the qualitative research methods in which researchers examine one or more bounded situations through in-depth data collection based on multiple data sources (i.e., observation, interview, and document review) and report context-based themes. This design is suitable for gaining an in-depth understanding of the situations of which boundaries can be clearly defined as well as for comparing multiple situations (Creswell, 2007). In the present study the cases involve the experiences of six middle school mathematics teachers who are in the first five years of the teaching profession. Each teacher is considered as a separate case and it is aimed to obtain a detailed understanding of the self-reflection processes of novice mathematics teachers by conducting within and across case analysis.

Participants

The participants of the study were six middle school mathematics teachers working at public schools in the Western and Central Anatolia Regions of Turkey who have less than five years of teaching experience. For the selection of the participants, the researchers set individual meetings with fourteen novice teachers, who were interested in participating the study. The researchers explained the purpose and requirements of the study. Among the teachers who were willing to participate, six of them were selected. Because the study would take place over a long period of time (approximately 4 weeks for each teacher) and the data collection would include both lesson observations and interviews, the teachers working in schools with easy transportation options and who were observed to be able to express themselves comfortably were preferred. Table 1 presents the information about the participants of the study (Nihal, Özlem, Ayla, Serkan, Hale and Ender).

Table 1. Information about the Participants

Names	Teaching Experience (Years)	Educational Background	School Place	Grades They Teach
Nihal	1	MA	Rural	5th and 8th grades
Özlem	2	Undergraduate	Rural	6th, 7th and 8th grades
Ayla	2	Undergraduate	Rural	5th, 6th, 7th and 8th grades
Serkan	5	Undergraduate	Urban	6th and 8th grades
Hale	4	Undergraduate	Rural	5th, 6th, 7th and 8th grades
Ender	5	Undergraduate	Urban	5th and 7th grades

As can be seen in Table 1, Nihal had the least teaching experience whereas Serkan and Ender were the most experienced teachers in the group. They were all graduates of mathematics teacher training programs at public universities. Nihal had a MA in the field of mathematics education. Since novice teachers are usually recruited in rural areas in Turkey, except for Serkan and Ender, the participants were working at rural schools which serve the children from families with limited social and economic sources. All of the participants were teaching mathematics in two different grade levels, but Ayla and Hale were teaching mathematics at every grade levels.

Data Collection Tools

The data of the study were collected through interviews. Before the data collection an ethical permission was taken from Hacettepe University's Ethics Committee (dated 27.09.2012 and numbered B.30.2.HAC.0.70.01.00/431-3629). Another permission was taken from the Ministry of National Education (dated 25.12.2012 and numbered 10230228/44/42696). The data collection procedure started with preliminary interviews and observations to establish a rapport with the participants, to have more detailed information about them and to be familiar with their approach towards education in general and mathematics education in particular. Then, each participant's mathematics lessons were observed for an average of ten lesson hours (one lesson hour is 40 minutes). Through these observations, the instructional situations that teachers were expected to reflect on were determined. Instructional situations refer to the events that the participants encountered during the explanation-guidance, questioning-problem solving or activity-material usage processes of their mathematics lessons. Students' common errors or misconceptions observed in the lesson, the teacher's feedback to an individual student or students' interaction with a material used in the class could be considered as examples of instructional situations. In order to obtain more comprehensive information about the self-reflection processes of teachers, the researchers observed lessons in different grade levels and topics for each teacher. The lesson interviews were conducted after the completion of teaching a subject (e.g. probability). In these interviews, the participants were asked to self-reflect on the instructional situations observed. Due to the differences in the number of subjects taught by the participants during the observation period, the lesson interviews were conducted with the participants in different numbers. A final interview was also carried out with the participants which focused on their self-reflection concerning the semester. The purpose of all these lesson and final interviews were to obtain information about the participants' self-reflection processes (self-evaluation, causal attribution, emotional reactions and inferences). Table 2 presents information about the class observations and lesson interviews carried out in the data collection process.

Table 2. Information about the Class Observations and Lesson Interviews

Teacher	Class Observations		Lesson Interviews
	Topic	Lesson Hour	
Nihal	Polygons – 5th grade	2	Interview I
	Circumference of quadrilaterals – 5th grade	4	Interview II
	Area of quadrilaterals – 5th grade	4	Interview III
Özlem	Surface area of prisms – 8th grade	2	Interview I
	Surface area of cone and prisms – 8th grade	2	Interview II
	Volume of prisms – 8th8th grade	4	Interview III
	Pie charts – 7th grade	2	Interview IV
Ayla	Circle – 7th grade	2	Interview I
	Prisms – 6th grade	4	Interview II
	Angles in the circle – 7th grade	2	Interview III
	Surface area of cone – 8th grade	2	Interview IV
Serkan	Probability – 8th grade	4	Interview I
	Multiplication and division with fractions – 6th grade	3	Interview II
	Decimals – 6th grade	2	Interview III
Hale	Multiplication and division with fractions – 6th grade	4	Interview I
	Basic geometry concepts – 5th grade	6	Interview II
Ender	Linear relationships – 7th grade	3	Interview I
	Basic geometry concepts – 5th grade	5	Interview II
	Proportion – 7th grade	4	Interview III

In the data collection process, an open-ended class observation form and three semi-structured interview forms (preliminary, lesson interview and final interview forms) which were developed by the researchers were employed. In the development of these tools, the related studies were reviewed to generate draft forms (Çapa-Aydın & Uzuntiryaki-Kondakçı, 2014; Ross & Bruce, 2007; Weiner, 2010; Yetkin-Özdemir et al., 2014; Zimmerman, 2000). These draft forms were used in a pilot study on the sample of three teachers. Based on the findings from this pilot study, necessary modifications were made on the forms. Following the completion of the class observations, the interview forms were modified based on the observed instructional situations. Sample items from the interview forms are given as follows:

- *What are your strengths as a math teacher? (Preliminary Interview Form)*
- *You drew a shape on the board, made of two squares with sides 9 cm and 2 cm, one is inside the other and asked the students to find the area between them. Most students gave incorrect answers. Why do you think that your students make mistakes in this question? (Lesson Interview Form - Nihal)*
- *If you would teach this topic (estimation of area) again, would you add or change any part of your teaching? (Lesson Interview Form - Nihal)*
- *Do you think that the semester was successful in terms of the development of your students' mathematical skills? (Final Interview Form)*
- *Have you made any decision about your future teaching? (Final Interview Form)*

In the data collection process, a total of 61 lesson hour observations and 31 interviews were carried out. The interviews were conducted in a room suitable for the interviews at the schools where the participants were working. The interviews were conducted approximately 40 minutes on average (approximately 20 minutes minimum and 60 minutes maximum). All observations and interviews were recorded using video and audio recording devices. Recordings of class observations were reviewed in order to determine the instructional situations that were used to develop interview questions. On the other hand, recordings of interviews were used to conduct in-depth analysis about teachers' statements related to their reflections.

Data Analysis

The data were analyzed based on the "self-regulation model" developed by Zimmerman (2000, 2002). Since the model explains self-reflection processes of learners, it was adapted to describe teachers' self-reflection processes (self-judgment and self-reaction) as they carry out teaching duties such as making decision over and applying teaching methods for mathematics lessons, preparing and implementing activities and materials, identifying and addressing students' misconceptions. In this study, self-reflection processes of teachers towards other teaching duties such as classroom management and communication with parents were not taken into consideration. Firstly, the main themes and codes were determined and defined based on the model (Zimmerman, 2000, 2002). Then, the data analysis framework was tested on the pilot study data. Afterwards, the data analysis framework was finalized by organizing and elaborating the main themes and codes. For instance, the codes related to the criteria for the evaluation of the success or failure of a lesson were identified (e.g., teaching goals, previous teaching performance, student participation) and grouped to form themes (i.e., student-oriented criterion and teaching-oriented criterion). Table 3 presents the data analysis framework of the study.

Table 3. Data Analysis Framework

Themes	**Definitions and Sub-Themes**
Self-Judgment	Teacher's judgment about the success/failure of the lessons and the reasons for it.
Self-Evaluation	Teacher's judgment about the success/failure of the lessons.
	Student-oriented criterion: Evaluating the lesson by using student-oriented criteria (student participation, achievement, motivation, gestures and facial expressions, etc.) *Teaching-oriented criterion*: Evaluating the lesson by using teaching-oriented criteria (teaching goals, teaching method, teaching motivation, time management, prior teaching performance, etc.) *Uncertain evaluation:* Not making a clear evaluation of the lesson.
Attribution	Judgments about the reasons for teacher's evaluations.
	Internal: Attribution of success or failure to internal factors (for instance, planning, teaching method, communication skills, the use of materials, technology use, motivation, the lack of experience etc.) *External*: Attribution of success or failure to external factors (for example, students' readiness levels, their study habits, parents' involvement, physical facilities of the school, curriculum etc.).
Self-Reaction	Teachers emotional reactions towards the lesson and her/his decisions for future lessons.
Emotional Reactions	Emotional reactions of teachers towards the lesson. *Satisfaction*: Lessons evoke positive emotions (e.g., happiness, comfort, peace, pride, self-confidence, etc.) in the teacher. *Dissatisfaction*: Lessons evoke negative emotions (e.g., frustration, restlessness, boredom, anxiety, anger, loss of self-esteem etc.) in the teacher.
Inferences	Decisions made by the teachers about future lessons. *Adaptive*: Teacher's decisions to adapt the situations. For example, changing the teaching method, using a different material, changing the sequence in the lesson, increasing the teaching knowledge, making detailed planning, using technology, etc. *Defensive*: Teacher's decisions that do not contain any solutions to problems. For example, the decision not to make any changes in the next lesson following the unsuccessful lesson, etc.

Data analysis was carried out in a two-stage process. In the first stage, the video recordings obtained from each teacher were transferred to the computer environment and examined in detail. In this phase, the instructional situations that the participants encountered during the lessons were identified. These data obtained from the video recordings were used in developing the lesson interview forms. In the second stage, the recordings of the interviews were transferred to the computer environment and transcribed. The interview transcripts obtained at this stage were coded based on the data analysis framework given above. That is, the teacher's self-evaluation regarding an instructional situation was coded as success, failure, or uncertain evaluation (not evaluated), the reasons for the evaluation were coded as internal or external. Likewise, teachers' emotional reactions and inferences regarding each instructional situation were coded according to the framework. While analyzing the data, patterns indicating possible relationships among the processes and associated beliefs were sought. Firstly, the analyses were made for each teacher separately. Then, the cross-case analyses were carried out where teachers' individual self-reflection processes were compared. NVivo10 qualitative data analysis software was used for all analysis works.

Various methods were used in this study to increase the credibility, transferability and consistency of the findings. In order to increase the credibility of the study, four methods were used: (a) lesson observations and interviews were carried out through a long-term that lasted about three months, (b) interviews were developed based on classroom observations to enhance more valid data

collection, (c) during the data collection and analysis process, the researchers consulted with the participants for their descriptions and comments that they hesitated or deemed critical, and (d) the whole process was carried out with the continuous exchange of information between the researchers. In order to increase the consistency of the study, the following three methods were used: (a) The data collection and analysis process was described in detail, enabling the readers to follow the arguments and comments based on the data, (b) the teacher behaviors observed and the teacher expressions in the interview records were examined comparatively, and the consistency of the findings was tested, and (c) the researchers worked together during the coding process, discussed the coding they hesitated and took care to make joint decisions. In order to increase the transferability of the findings, the teachers who participated in the study and their working environments were described in detail.

Results

In this section, first the findings related to self-reflection processes (self-evaluation, attribution, emotional reactions and inference) of each teacher obtained are presented separately. Then, the findings from cross case analyses are reported.

Self-Reflection Process of Nihal

Nihal's teaching of the topics "Polygons", "Perimeter of Quadrilaterals" and "Area of Quadrilaterals" to the fifth-grade students was observed. Nihal, the least experienced teacher in the group, made both successful and unsuccessful judgments about her lessons. She evaluated these lessons based on the student- and teaching-oriented criteria. For instance, the dialogue with Nihal given below indicates her student-oriented evaluation. She stated that the lessons on the measurement of the areas were successful due to the student participation and students' answers to the questions in the lessons. She attributed the success to the external factors (familiarity of the topics to the students and the use of visuals in the lessons):

Researcher: What is your general evaluation about these lessons?

Nihal: I think they understand this topic [area] better than the perimeter… I noticed that they understood more quickly.

Researcher: You said they understood better than the perimeter. How did you decide this?

Nihal: Based on the answers they gave and the number of students actively participating in the lesson. (Measurement of Area – 5th Grade)

The following dialogue with Nihal shows her teaching-oriented evaluations. In this dialogue, she stated that the lessons on polygons were insufficient in terms of the teaching methods she used and time management:

Nihal: I generally taught the topic with the direct instruction method. It wasn't a student-centered lesson... Maybe I could have explained it in more detail, I could have taught the topic a little faster... You know, as I said, it would be better if the lesson was a little more visual, you know, in a way that they could draw in the computer environment, if they actively participated. (Polygons – 5th Grade)

Nihal attributed the reasons for the unsuccessful teaching situations in her lessons to various internal and external factors. In regard to the external reasons, she emphasized the low level of readiness of the students and the insufficiency of the physical facilities of the school. For example, in the dialogue below, Nihal attributed the reason for taking an overly active role in the lesson and passing some topics quickly to the low level of readiness of the students:

Researcher: You asked various questions to the students, such as what is the perimeter, what is the feature of the square. However, you answered most of them yourself. Was this a conscious choice?

Nihal: Sure, but I guess it would be better if I waited, it is true… I think I'm answering myself, thinking they can't answer. (Area of Polygons – 5th Grade)

Concerning the internal reason for failure, she emphasized her lack of teaching knowledge and experience. For example, she directly attributed her failure on the topic "estimation of the area of quadrilaterals" to her own lack of teaching knowledge:

> *Nihal: As I said before, I do not have enough knowledge and experience in teaching the estimation of area. I don't think this subject is very important either... So, we passed it quickly... My knowledge is insufficient in estimation; I think it reflects into my teaching. (Area of Quadrilaterals – 5th Grade)*

During the interviews, it appeared that Nihal did not show a concrete emotional reactions to her lessons. However, she revealed some adaptive conclusions (using materials, using technology, using different solutions, self-improvement in the teaching of estimation and planning student reactions) for her future lessons. For example, in the dialogue below, she made decisions over the use of materials and technology in her next lessons and to prepare more for possible student responses in the lessons:

> *Researcher: If you were to teach these topics again, would you do something differently?*
>
> *Nihal: As I said, I give more importance to using materials now that I have a little more control over the topic… I would like to use a computer, for example. I would like students to practice on the computer. (Area of Quadrilaterals - 5th Grade)*
>
> *Nihal: I could not predict some of the students' responses. It is necessary to make extra preparations for the potential responses of the students in order to address their misconceptions. (Measurement of Area – 5th Grade)*

Self-Reflection Process of Özlem

The following lessons of Özlem were observed: "Surface Area of Prisms", "Surface Area of Cone and Prisms" and "Volume of Prisms" to the eighth-grade and "Pie Graphs" to the seventh-grade. In the interviews Özlem emphasized the student performance in her evaluations and described the lessons as not successful in terms of student participation and achievement. She mostly attributed the reasons for this failure to external factors (low level of readiness of students, low involvement of parents, the lack of time, and inadequate physical facilities of the school). For example, in the following dialogue, Özlem emphasized the deficiencies in her students' basic skills such as reading comprehension, the lack of study habit, the lack of motivation, the lack of parent involvement and the lack of time as the reasons for the failure:

> *Özlem: In fact, everything is resulted from their reading comprehension. They read the question but do not understand what it says in the question. Frankly, I feel the need to explain it. (Volumes of Prisms – 8th Grade)*
>
> *Özlem: They come the next day forgetting what I taught today. I know that the student really understands it in the lesson, they apply it in the question, they solve it, but when the next day comes, they come back as if we have never seen that topic... Our students stop studying completely after school. There is no additional work, no parental support. (Volumes of Prisms – 8th Grade)*
>
> *Özlem: The students do not listen to the lesson; it usually happens in all our lessons. I have a little difficulty in getting students' attention. Their readiness is not at the level we want. In fact, the students have no desire to learn. Believe me, it is difficult for me to draw their attention to the lesson because they come saying that they will not continue their further education. Students think, "What will the lessons do for me, I'll be a farmer anyway." (Surface Area of Prisms – 8th Grade)*
>
> *Özlem: There are activities in the textbook. For example, there is an activity for the volume of triangular pyramids. To determine the volume of the triangular pyramid, the triangular prism of the same height and base area is filled with sand. By filling it 3 times, they are allowed to see*

that the volume of the pyramid is equal to one-third of the volume of the prism. I think I don't have enough time to do these activities in my lessons. Maybe it would be more effective if I taught it concretely but directly saying the volume of the pyramid is one third of the volume of the prism… I did it in this way. (Volumes of Prisms – 8th Grade)

In the interviews, it was observed that the failure caused some negative feelings on Özlem. For example, in the dialogue below, Özlem reflected her sadness, disappointment, and the loss of self-confidence due to the fact that students exhibited in the low level of participation in regard to the topic of the surface area of the prisms:

Researcher: Very few students wanted to answer your questions. Was it an expected situation for you?

Özlem: I had not expected this much. I had not expected the students to be so quiet in the lesson.

Researcher: How did you feel?

Özlem: I felt inadequate. You cannot control the whole class, only a certain group of students actively participate in the lesson. I get upset when I cannot get what I teach. It makes me feel that the things I have done are wasted. (Surface Area of Prisms – 8th Grade)

Özlem's conclusions for her future lessons are mostly defensive. Her defensive reactions seem to be related to the criteria (student-oriented) she used when evaluating her lessons and to her attributions (external, student related factors). For example, in the dialogue below, Özlem, when asked what she thought about students' participation for future lessons, highlighted the basic knowledge deficiencies of her students in mathematics and stated that it is not possible for her to solve these problems in the lesson:

Researcher: What do you plan to do to increase the students' active participation in the lesson?

Özlem: I want to increase their active participation in the lesson, but unfortunately I have students who do not even know the area of the square. I should reteach all these topics to them. I should re-teach even the simplest of subjects so that all my students are actively involved in the lesson… But I can't do it… (Surface Area of Prisms – 8th Grade)

Self-Reflection Process of Ayla

The following lessons of Ayla were observed: "Prisms" for the sixth-grade, "Circle" to the seventh-grade and "Surface Area of Cone" to the eighth-grade. Ayla, another teacher with two years of professional experience, used student- and teaching-oriented criteria while evaluating her lessons and made both success and failure judgments. For instance, in the student-oriented evaluation in the dialogue below, Ayla described the teaching of prisms as successful considering the positive feedback she received from the students:

Ayla: I think they understand the topic. I find the opportunity to get feedback from their questions we solve in a lesson or their questions they bring after a lesson. Eighth graders always bring me questions. When we finish a lesson, they solve questions at home. In general, the feedback I have received for this topic is good. Of course, there are a few students in every class who can't understand or can't do it, but as I said, I think the students understand more or less. (Final Interview)

In her teaching-oriented evaluation presented in the dialogue below, she regarded the seventh-grade lesson on circle as not successful due to inconsistency between her plans and actual teaching:

Ayla: I could not teach the lesson as I had planned. I think I taught the lesson a bit fast. I would have been better if it had been a bit slow. For example, if I had taught the circumferential angle in one lesson and the central angle in the next lesson, maybe it would have been a little better. Actually, I thought the lesson could have been a little better. But I think I passed to the second

topic too quickly. For example, the students confused the circumferential angle and the central angle a lot. I think I created a mess in their minds when the lesson was done too quickly. (Circle – 7th Grade)

In the interviews she mostly attributed the failure to the internal reasons. As seen in the dialogues below, she highlighted her own faulty teaching practices, inexperience, and indecisive and impatient behaviors in the lessons as the reason for many mistakes made by students in mathematics and the confusion they experienced in the lessons:

Ayla: Every mistake that students make is actually due to my wrong teaching. Sometimes I teach students a topic, then they ask a question and I realize that I taught the topic wrongly and it was actually me who caused the students to misunderstand. (Prisms – 6th Grade)

Ayla: I don't know, but I guess the reason for the failure is a little bit of my inexperience. I think about too many things at once in class. While teaching a topic, something comes to my mind and then the topic is left unfinished. As I said, more than one thing comes to my mind in class. That's why I'm having such a mess. I can't understand why I did it at that moment. (Circle – 7th Grade)

Ayla: When I should teach fast I do not give importance to these (using ruler and compass). I ask the students to draw directly, just to be quick. But I also want them to use such devices. Actually, I want students to use these tools, but they may not use them due to my indecision. Sometimes I ask them to draw fast. I'm impatient. Normally I have to wait for them, even for 5 minutes they have to work on it. (Circle – 7th Grade)

She emphasized the deficiencies related to the students and the intensity of the curriculum in her attribution of external reasons for the failure. For example, in the dialogue below, Ayla attributed the reason why she did not use mathematical tools and materials in her lessons to the lack of knowledge and skill of the students in using these materials and the time limitations due to the intensity of the curriculum.

Ayla: The students are not very competent in using these tools (ruler and compass). My own teacher asked us to use rulers and to draw the straight lines. But my students have no such worries.… The habits of the students also affect me a little. (Circle – 7th Grade)

Ayla: I should teach the topics fast. I finished the curriculum completely in the fifth-grade. They spent one hour to draw the squares. It took me long time to make the students draw a rectangle. Frankly, I don't care too much about using these tools, since the curriculums in other grades are intense. (Circle – 7th Grade)

The lessons observed caused negative feelings (feeling of unhappiness) for Ayla in the interviews. As seen in the dialogue below, Ayla emphasizes that when the lessons are taught in harmony with the plan in her mind, she can be satisfied with the lessons:

Ayla: In some classes I can implement what I have in my mind. I can answer the student questions in a clear way. I do not say that I am happy because students do not challenge me. Instead, I would like them to challenge me. Otherwise, I would be an ordinary teacher who does not need to improve herself. When I implement what I have in my mind, I become very happy. (Final Interview)

Ayla reported completely adaptive conclusions (such as using materials and increasing teaching time) for her future lessons. For example, in the following dialogue, it is seen that Ayla made some decisions to teach the topic of the circumferential angle in a longer time and to benefit from the materials while teaching the topic of the prisms next year:

Ayla: First, I will teach the topic in a longer period of time. I mean I expand the teaching duration. I may teach the topic of the circumferential angle in one lesson hour and then, begin to teach the other topic. (Circle – 7th Grade)

Ayla: As I said, maybe I can use a material such as rope while creating the diagonal of the prisms. Or if I could draw it with a chalk or something like that, I want it. (Prisms – 6th Grade)

Ayla's success in self-reflection seems to be related to her success in monitoring and in setting specific goals for her lessons. She usually was specific about the criteria for evaluation. For instance, she not only considered whether students participated in the lesson, but also how they participated in the lesson (the questions they asked, whether they challenged her). She also made clear descriptions about her own teaching performance and compared her performance with her teaching goals and planned actions. Hence, even though she demonstrated negative feelings after unsuccessful lessons, she made clear and concrete decisions for next lessons.

Self-Reflection Process of Serkan

The following lessons of Serkan were observed: "Multiplication and Division with Fractions" and "Decimals" to the fifth-grade and "Probability" to the eighth-grade. Serkan, the most experienced teacher in the group, focused on the students' performance in evaluating the lesson which he considered as successful in terms of student participation and achievement. For instance, as can be seen in the dialogue below Serkan evaluated the lesson on multiplication and division with fractions as successful because more than half of the students gave the correct answer to a question he asked in this lesson:

Serkan: I think it was a successful lesson.

Researcher: How did you understand that?

Serkan: They can solve the problems now… I mean, if there are 22 students in the class and at least 13 or 14 of them give correct answer when they ask a question, it shows that they understand the topic. (Multiplication and Division with Fractions – 6th Grade)

Serkan attributed the success to both internal and external factors. Concerning the external factors, he emphasized the student readiness and parent involvement. In regard to the internal factors he emphasized his own teaching practices and motivation. For example, in the first dialogue below, Serkan attributed the reason for his success in the topic of probability to the support of the parents and the fact that these students come to the lesson ready with the information they have received outside of school. In the second dialogue, Serkan attributes the success of the eighth grade students to his own effort and motivation he displays to achieve high success in the high school entrance exam the students will take at the end of the year. Serkan stated that he made a special effort to include the questions similar to the questions of this critical exam in his lessons, and defined the inclusion of these questions in the lesson as an important indicator for the success of mathematics lessons:

Serkan: The reason for their success is their readiness. Most of them learn about these topics from their families and private teaching institutions before the lesson. After I teach them, they are successful because they don't have anything missing anymore. (Probability – 8th Grade)

Serkan: We are also concentrating on the exam (high school entrance exam), we are also preparing… I mean, the students are working all the time, and we are working all the time in the same way. What will we teach, what kind of questions can be asked in the exam, we are in a constant rush.… I consider myself successful in eighth-grade. We had solved most of the questions that they encountered in the exam. There were twenty questions in this exam and I believe that nearly nineteen of them were discussed in the classroom. It is very nice for me. I had continuously worked for these questions and we solved all of them except one question in the class. (Final Interview)

Serkan attributed the reasons for some of the negative situations observed in his lessons to external factors (the low level of readiness of students, the lack of study habit of the students, the low involvement of the parents, and the lack of time and the difficulty of the topic). For example, in the following dialogue, Serkan reported that some sixth-grade students have difficulties in solving easy

questions about the multiplication and division operations and decimals, due to the lack of basic mathematical knowledge of these students and their lack of study habit:

> *Serkan: For me the reason for their continuous mistakes is that they do not repeat the topics regularly. (Multiplication and Division with Fractions - 6th Grade)*

> *Serkan: The reason for their failure is the lack of their prior knowledge. Because in the classroom, there are many students who understand and many who do not understand at all. (Decimals - 6. Grade)*

During the interviews, Serkan did not provide any concrete emotional response in regard to the lessons observed. However, as can be seen in the following dialogue, he stated that the readiness level of the students in some classes was very low and that the lessons he taught in these classes caused the feelings of anger and the lack of self-confidence in him:

> *Serkan: At each grade level there are several classes. One of these classes is always very unsuccessful… I could not do everything that I would like to which makes me angry and frustrated. I feel inadequate. I wish these classes are a little more successful, I feel myself much more competent. Unfortunately, you feel inadequate because the student did not give you a positive feedback. (Final Interview)*

Serkan did not report concrete adaptive conclusions for his lessons that were observed. On the other hand, he reported a defensive conclusion about the topic of multiplication and division with fractions, in which he taught using models. As seen in the dialogue below, Serkan decided not to include area model in his future lessons on this topic due to the complexity he experienced while teaching the topic:

> *Serkan: In the multiplication operation, I might have not used the model. Instead, I could tell the students that the numerator is multiplied by the numerator and the denominator is multiplied by the denominator… After the lesson I made my decision over this. In fact, I had not used that model in my previous lessons. It was the first time for me to use the model, but I couldn't get out of it for a while. It caused confusion. But if I had said that the numerator was multiplied by the numerator and the denominator was multiplied by the denominator, they might have easily understood the operation. The model made the topic much more complicated. (Multiplication and Division with Fractions – 6th Grade)*

Self-Reflection Process of Hale

The following lessons of Hale were observed: "Basic Geometry Concepts" to the fifth-grade and "Multiplication and Division with Fractions" to the sixth-grade. Hale evaluated these lessons based on the student performance. In her evaluation, she described these lessons as successful in general, considering the answers given by the students to the questions:

> *Hale: In general, I think that they understand better than the topics of line, line segment, and ray. Because there were less incorrect answers. There were many wrong answers in the topics of line, line segment, and ray. There wasn't much in this topic. (Basic Geometry Concepts - 5th Grade)*

> *Hale: In their written exam I can see their progress much clearer but when I was walking among them in class, I saw that most of the students understood. Even some students who I considered that they cannot do understood the topic. (Multiplication and Division with Fractions – 6th Grade)*

Hale stated that she had a successful year in general with the fifth and sixth graders because the topics were easy, the curriculum was manageable and students had a higher readiness. All of these reasons are of external type:

> *Hale: The reason is that fifth and sixth grade topics are easier than other grades. In the new curriculum, the topics have been reduced a little more and the sixth-grade students do not have much incomplete knowledge of the fifth-grade subjects. (Final Interview)*

Hale attributed the negative situations to the external factors, too. For instance, in the following dialogue she stated that the reason for having difficulty in showing students the multiplication with fractions through the model was the lack of study habit of the students and low involvement of the parents:

> *Hale: First of all, the students appear not to know how to study. They do not know how to study mathematics. I do not think that they try to solve problems… They do not repeat the topics after the lessons. For me, parents are very important, but the parents in this school are very uninterested. Only few parents come to the meeting with me. Both parents support and the habits of students are very significant. Students do not know how to study. All these three are very significant, and when all of them do not exist success is not possible. (Final Interview)*

Hale emphasized the internal factors in very few of her causal attributions. In the following dialogue, she attributed the reason for a student's incorrect answer to a question on multiplication and division in fractions to her own teaching practice:

> *Hale: It was my mistake, I think. Eda asked a question, I remember it very well. I taught the rule as Eda stated. The child will naturally reply that as I said, "it was the rule". As I stated earlier if I had used the model, it would have been more useful. So I think it's all my fault, to be honest. (Multiplication and Division with Fractions – 6th Grade)*

During the interviews, Hale did not show emotional reactions towards her lessons observed. However, she reflected how she felt in some positive and negative situations in these lessons. For example, in the first of the dialogues below, she expressed the happiness due to a correct answer from a student. In the second, she talked about her disappointment caused by the poor performance of some of her students on a topic:

> *Hale: I was pleased that the student gave the correct answer. I had not expected it. I had not thought that the student could think of it. (Basic Geometry Concepts – 5th Grade)*

> *Hale: The topic was simple. I came to the class hoping that they would understand, but I did not see it much. Therefore, I can say that I was disappointed. (Basic Geometry Concepts – 5th Grade)*

Hale's decisions over her future lessons were mostly adaptive. Even though she rarely attributed the failure of the lessons to internal factors, she demonstrated adaptive reactions related to these lessons. For example, in the first of the dialogues below, she decided to change the flow of the lesson. In the second one, it is seen that she made the adaptive decisions again in regard to the use of teaching materials in future:

> *Hale: If I teach sixth-grade students next year, I am planning to give the modelling first and then explain the multiplication and division operations. (Basic Geometry Concepts – 5th Grade)*

> *Hale: I want to make a research for math websites and design materials that students can understand more easily or I can explain the topics to them more easily. (Final Interview)*

Self-Reflection Process of Ender

The following lessons of Ender were observed: "Basic Geometry Concepts" to the fifth-grade and "Linear Relationships" and "Proportion" to the seventh-grade. Ender made evaluations based on the student- and teaching-oriented criteria. For instance, in the following dialogue he presented a

student-oriented evaluation and considered the lesson as successful citing the higher level of student participation:

> *Ender: It was like I had expected and I did not have any difficulty in teaching the topic to them… Most of the students tried to be active in answering in the inverse and direct ratio questions. (Proportion – 7th Grade)*

In the following dialogue that contain a teaching-oriented criterion Ender stated that the lesson on linear relationships was successful in that he managed to attract student attention through the teaching activities:

> *Ender: In the topic of linear relationships there was no negative case, particularly about coordinate system… I felt I was awakening a sense of wonder among the students. The activities were interesting such as one about movies and the other one. I thought that I had some positive effects on students. (Linear Relationships – 7th Grade)*

Ender mostly attributed the reasons for his teaching situations, which he considered successful, to internal factors (such as his preparation, the teaching method he used and his communication skills). For example, in the following dialogue, Ender reported the reason for the success of the lesson on the direct and inverse proportions to the seventh-grade as his preparation to the lesson and his effective communication with the students:

> *Ender: Regarding the topic of direct proportion, I developed the following strategy: first explaining the topic and then presenting questions. I had identified the important questions about all possible direct proportions and I included those questions in the lesson. Then I asked one more example and we solved those questions together. There were students on the board. The lesson was very enjoyable. So, I think I achieved my goal of the lesson. (Proportion – 7th Grade)*

> *Ender: The reason for this success is the good dialogue between us. I try to make our lessons as enjoyable as possible. Here we are not teaching all of the 5 hours of math class per week. Sometimes we chat, sometimes we watch funny videos. I think I establish this positive communication by doing such fun activities. (Final Interviews)*

Ender attributed the reasons for some of the negative situations he encountered in the lessons to various internal and external reasons. For example, in the first dialogue below, Ender attributed the reason why students behaved carelessly while performing mathematical operations to his own assessment-evaluation method, which is an internal factor. He believes that the multiple-choice exam system, which attaches importance to the results, led to negative habits among the students. In the second and third dialogues, Ender attributed the students' inability to remember basic mathematics facts at some moments to their lack of study habits and the inadequacy of the physical facilities of the school:

> *Ender: One reason for this failure is my exam system. I do not do written exams. I'm always testing. For this reason, even if the students make mistakes in the operations, they get full points if their results are correct. I can't reduce their points for their operation errors. This may also have an effect. (Proportion – 7th Grade)*

> *Ender: It usually happens like this; they don't repeat the topics during the summer break even though we warn them so much. I say and unfortunately I see that mathematics is a very ungrateful lesson, if they do not show interest in it, mathematics will treat them indifferently and they will forget most of what they have learned. (Linear Relationships – 7th Grade)*

> *Ender: If the school's facilities were better, if there was a projector or a smart board that would provide visualization, as I said, the lesson would have been different. As a school, we have some deficiency in this respect. (Basic Geometry Concepts – 5th Grade)*

During the interviews, Ender did not show any emotional reaction to his lessons observed. However, he revealed some defensive conclusions for his lessons. For example, in the dialogue below, Ender stated that he did his best for his students despite the conditions he was in, and explained his decision that he would teach these lessons in a similar way in the next year as long as the physical facilities (projection, smart board) of the school are not improved:

Researcher: Are there anything that you will modify for next year?

Ender: There is nothing that I will modify. At the moment, I see my lessons as sufficient in line with our own conditions. But if the facilities are wider, I said, if there is a projector or a smart board that will provide visualization, my lessons may be different. (Final Interview)

Comparison of the Self-Reflection Processes of the Teachers

Here, the self-reflection processes of the participants (self-evaluation, causal attributions, emotional reactions and inference) are discussed in a comparative way. Table 4 shows the findings obtained from this comparison.

Table 4. Comparison of the Self-Reflection Processes of the Teachers

Self-Reflection Processes				**Nihal**	**Özlem**	**Ayla**	**Serkan**	**Hale**	**Ender**
Self-evaluation	Criteria of self-evaluation	Student-oriented criterion	Success	✓		✓	✓	✓	✓
			Failure		✓				
		Teaching-oriented criterion	Success						✓
			Failure	✓		✓			
	Attribution	Success	Internal				✓		✓
			External	✓			✓	✓	
		Failure	Internal	✓		✓		✓	✓
			External	✓	✓	✓	✓	✓	✓
Self-reaction	Emotional reactions		Satisfaction						
			Dissatisfaction		✓	✓			
			Uncertain	✓			✓	✓	✓
	Inference		Adaptive	✓		✓		✓	
			Defensive		✓		✓		✓

Table 4 shows that in the evaluation of the lessons observed, the teachers mostly employed student-oriented criteria (for instance, active participation of students, student achievement, and student motivation). It is common among all six participants. Except for Özlem, the teachers evaluated their lessons as successful based on the student-oriented criteria. Three teachers (Nihal, Ayla and Ender) evaluated their lessons based on the teaching- oriented criteria (for instance, teaching method, teaching motivation, time management). Of them, Nihal and Ayla regarded their lessons as unsuccessful, but Ender evaluated his lessons as successful based on the same criteria. Nihal and Ayla who reported that their lessons were unsuccessful depending on the teaching-oriented criteria are less experienced teachers within the participant group. It was also observed that the more experienced teachers (Serkan, Hale and Ender) tend to evaluate their lessons as successful whereas less experienced teachers can make judgments about their lessons as failure.

Concerning attributions, it is found that the teachers mostly make attributions for unsuccessful teaching situations. All of the teachers attributed the failure to the external factors (the low level of readiness of students, the lack of study habit of the students, the low involvement of the parents, the insufficient physical facilities of the school, the lack of time, and the intensity of the curriculum). There are four teachers, namely Nihal, Ayla, Hale and Ender, who also attributed the failure to internal factors (lack of planning, ineffective teaching method, poor communication skills, inability to use materials and

technology). It should be noted that Nihal, Ayla and Ender employed the teaching-based criteria in their evaluations, which might be related to making attributions to internal factors. Attributions to the success are the external factors for Nihal, Hale and Serkan such as "higher levels of student readiness", "parents' involvement", "manageable curriculum" and "a simple content". On the other hand, Serkan and Ender, the most experienced teachers of the participant group, attributed success to internal factors such as "detailed lesson planning", "effective teaching method", "effective communication skills", "effective material use" and "high motivation for teaching".

The majority of the teachers (Nihal, Hale, Serkan and Ender) did not provide an emotional reaction towards the lessons observed. None of the teachers reflected any positive emotional reaction (e.g. happiness, comfort, peace, pride, self-confidence) regarding the observed lessons. However, two teachers (Özlem and Ayla) produced negative emotional responses (for instance, disappointment, anger and the loss of self-confidence) concerning the lessons observed. Concerning the inferences, it is found that the half of the participants (Nihal, Ayla and Hale) reported adaptive inferences (for instance, changing the teaching methods, using a different material and changing the lesson flow), whereas the remaining three (Özlem, Serkan and Ender) reported defensive inferences. It is noteworthy that two (Nihal and Ayla) of the three teachers who reported adaptive conclusions for their future lessons are teachers who take their own teaching situations into account in self-evaluation and causal attribution processes. On the other hand, all participants who developed defensive inferences (Özlem, Serkan and Ender) attributed the failure to the external factors. Overall, these results indicate that teachers, who used teaching oriented criteria while evaluating their lessons, seem to attribute the success or failure of the lesson to internal factors and these teachers demonstrated more adaptive reactions compared to the teachers who made attributions to external factors.

Discussion, Conclusion and Suggestions

In this study, based on Zimmerman's (2000, 2002) model of self-regulation, teacher self-reflection is examined in terms of their self-judgments (self-evaluation and causal attribution) and self-reactions (emotional reaction and inference). The findings indicate that the novice middle school mathematics teachers participated in the study mostly used the student-oriented criteria (e.g., active participation of students, student achievement) rather than teaching-oriented criteria (e.g., teaching methods) when making self-evaluations about their lessons. The reason for this finding may be the weakness of teachers' self-observation skills. Monitoring several situations in lesson process (e.g., use of materials, feedbacks) help novice teachers make appropriate evaluations about their performance. If the teachers do not systematically monitor their teaching performance in mathematics lessons, they may have difficulty in remembering these critical situations during their self-reflection. In this study, only one participant (Ayla) was able to make clear descriptions about her own teaching performance. Likewise, the goals teachers set may also serve as criteria to assess their performance. The teachers may not have taken into account teaching-oriented criteria in their evaluation processes, since they did not set goals for their own teaching. Another remarkable finding about teachers' self-evaluation process in this study is that as their professional teaching experience increased, the teachers tend to evaluate their lessons as successful and they move away from using teaching-oriented criteria in their self-evaluation processes. These findings are consistent with the literature (Allen & Casbergue, 1997; Gabriele & Joram, 2007; Hall & Smith, 2006). Research suggests that novice teachers have difficulty in remembering their teaching performance in their self-reflection processes, and that more experienced teachers focus more on student-oriented criteria than their own teaching performance when they evaluate their lessons.

Another critical finding of the study is that novice middle school mathematics teachers mostly attribute their failures in their lessons to the external factors. The teachers avoided associating such failure with internal factors or the factors related to themselves. The teachers who associate failure with themselves are teachers who use teaching-oriented criteria in the self-assessment process and have less teaching experience in the participant group. With the exception of Ender, the more experienced teachers in the participant group associated their successful performance with internal factors, but not

their unsuccessful performances. These findings are consistent with the literature (Bozkurt, 2015; Hall & Smith, 2006; Kwon & Orrill, 2007; Öztürk, 2007; Soysal & Radmard, 2017). Previous research also shows that teachers tend to associate failure more with factors that are not under their control (for example, the difficulty of the topic).

In this study most of the novice teachers did not show any emotional response towards their lessons observed. Similarly, in the study of Gabriele and Joram (2007), it was observed that teachers often did not openly express their feelings of satisfaction or disappointment when talking about their instructional practices. In this study, only two teachers shared negative feelings related to their lessons. In addition, there was no positive emotional response (e.g., happiness, comfort, peace, pride, self-confidence) towards their mathematics lessons. The reason for this result may be that the teachers focused more on unsuccessful teaching situations in self-evaluation and attribution processes. These negative judgments about mathematics lessons may have triggered their negative emotions. This finding could also be related to their low monitoring of emotions or their unwilling to share their feelings through interviews.

In parallel to the previous research findings (Maat & Zakaria, 2010; Westerman, 1991) the mathematics teachers usually did not produce adaptive conclusions for their future lessons. The teachers who produced adaptive inferences for their future lessons or who made decisions to improve themselves were teachers who considered their own teaching performance in the processes of self-evaluation and attribution. In other words, the teachers who were able to critically evaluate themselves in the self-judgment process were able to make decisions about improving their teaching performance for future mathematics lessons. Therefore, this study reveals the importance of the criteria used by teachers in the process of self-judgment (self-evaluation and attribution), which is the first step of self-reflection.

In short, in this study, it has been concluded that novice middle school mathematics teachers cannot perform effective self-reflection processes related to the mathematics lessons they taught. This result may be related to the fact that the participants did not have such experiences in the lessons they took during their undergraduate education and therefore, they could not acquire these skills. Research also suggests that pre-service mathematics teachers' self-reflection skills are not at a desired level (Baki, Güç, & Özmen, 2012; Chikiwa, 2020; Erdoğan, 2020; Rodgers, 2002). It is important that pre-service teachers have sufficient experience in teaching practice in real classroom environments during their undergraduate education and should be allowed to systematically observe and reflect these teaching experiences. They need more experience in setting goals for students' learning as well as for themselves and use these goals as criteria when evaluating their lessons. When they start their teaching profession, they can improve these skills by performing lesson observations and self-reflection processes jointly with experienced teachers in the collaborative professional development practices. Research suggests that teachers' self-reflection skills improve through engaging in such processes (Bozkurt, 2015; Bozkurt & Yetkin Özdemir, 2018; Gabriele & Joram, 2007; Kwon & Orrill, 2007; Ross & Bruce, 2007). However, it is also important to provide the necessary conditions (physical setting, cooperation with colleagues and administrators, etc.) that will encourage novice teachers to make adaptive decisions about their teaching performance. For example, it is necessary to facilitate the provision of these materials to teachers who decide to use such materials in their lessons or to provide opportunities in terms of time and meeting room for teachers who will come together for group studies.

In this study, teachers who were in their first five years in the teaching profession are defined as novice teachers. However, the findings showed that even within this group, there are differences in terms of self-reflection processes. For example, it is found that as the professional experience of teachers increase, they move away from using teaching-oriented criteria in their self-evaluation processes. Because novice teachers usually recruited in rural areas in Turkey, only two teachers, with more teaching experience, are working in urban areas. Even though it was observed that teachers' attributions

are related to the characteristics of the school place (e.g., student readiness, motivation, parent involvement), further work is required to establish this relationship. In addition to the teaching experience and the school places (urban vs. rural), the opportunities and constraints in the schools (e.g., support from other teachers and school administration), teachers' knowledge of subject matter and pedagogy as well as their values, beliefs and motivations to teach (e.g., self-efficacy) might also affect self-reflection processes. Furthermore, in this study, the self-reflection processes of mathematics teachers were not examined in a specific learning area (e.g. algebra, geometry). We examined each teachers' self-reflection processes while they taught different topics and grade levels and observed some differences in their self-reflection processes. The findings suggested that the self-reflection processes of mathematics teachers may differ in learning areas where different mathematical concepts and skills are prominent and indicated the complexity of teachers' self-reflection processes. For this reason, there is a need for further studies to examine how teachers' self-reflection processes differ based on certain variables such as seniority, school environment and teacher knowledge and beliefs.

References

Allen, R. M., & Casbergue, R. M. (1997). Evolution of novice through expert teachers' recall: Implications for effective reflection on practice. *Teaching and Teacher Education, 13*(7), 741-755. doi:10.1016/S0742-051X(97)00018-8

Baki, A., Güç, F. A., & Özmen, Z. M. (2012). The investigation of pre-service mathematic teachers' reflective thinking skills toward problem solving. *Uluslararası Eğitim Programları ve Öğretim Çalışmaları Dergisi, 2*(3), 59-72.

Baştürk, S. (2012). Sınıf öğretmenlerinin öğrencilerin matematik dersindeki başarı ya da başarısızlığına atfettikleri nedenler. *Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 4*(7), 105-118.

Borko, H., & Livingston, C. (1989). Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal, 26*(4), 473-498. doi:10.3102/00028312026004473

Bozkurt, E. (2015). *Ders araştırması modeli bağlamında ortaokul matematik öğretmenlerinin öğretim faaliyetlerine yönelik grup temelli öz-düzenlemelerinin incelenmesi* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

Bozkurt, E., & Yetkin Özdemir, İ. E. (2018). Middle school mathematics teachers' reflection activities in the context of lesson study. *International Journal of Instruction, 11*(1), 379-394. doi:10.12973/iji.2018.11126a

Chikiwa, S. (2020). *Exploring pre-service teachers' reflective practice in the context of video-based lesson analysis* (Unpublished doctoral dissertation). Rhodes University, Grahamstown, South Africa.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Çapa-Aydın, Y., & Uzuntiryaki-Kondakçı, E. (2014). Öğretmen özdüzenlemesi. In G. Sakız (Ed.), *Öz-düzenleme: Öğrenmeden öğretime öz-düzenleme davranışlarının gelişimi, stratejiler ve öneriler* (pp. 218-230). Ankara: Nobel.

Çapa-Aydın, Y., Sungur, S., & Uzuntiryaki, E. (2009). Teacher self regulation: Examining a multidimensional construct. *Educational Psychology, 29*(3), 345-356. doi:10.1080/01443410902927825

Erdoğan, F. (2020). The relationship between prospective middle school mathematics teachers' critical thinking skills and reflective thinking skills. *Participatory Educational Research, 7*(1), 220-241. doi:10.17275/per.20.13.7.1

Gabriele, A. J., & Joram, E. (2007). Teachers' reflections on their reform-based teaching in mathematics: Implications for the development of teacher self-efficacy. *Action in Teacher Education, 29*(3), 60-74. doi:10.1080/01626620.2007.10463461

Ghanizadeh, A., & Ghonsooly, B. (2014). A tripartite model of EFL teacher attributions, burnout, and self-regulation: Toward the prospects of effective teaching. *Educational Research for Policy and Practice, 13*(2), 145-166. doi:10.1007/s10671-013-9155-3

Hall, T. J., & Smith, M. A. (2006). Teacher planning, instruction and reflection: What we know about teacher cognitive processes. *Quest, 58*(4), 424-442. doi:10.1080/00336297.2006.10491892

Hebert, E., & Worthy, T. (2001). Does the first year of teaching have to be a bad one? A case study of success. *Teaching and Teacher Education, 17*(8), 897-911. doi:10.1016/S0742-051X(01)00039-7

Kwon, N. Y., & Orrill, C. H. (2007). Understanding a teacher's reflections: A case study of a middle school mathematics teacher. *School Science and Mathematics, 107*(6), 246-257. doi:10.1111/j.1949-8594.2007.tb18286.x

Lin, X. (2001). Reflective adaptation of a technology artifact: A case study of classroom change. *Cognition and Instruction, 19*(4), 395-440. doi:10.1207/S1532690XCI1904_1

Maat, S. M. B., & Zakaria, E. (2010). An exploration of mathematics teachers' reflection on their teaching practices. *Asian Social Science, 6*(5), 147-152.

Marcos, J. J. M., Miguel, E. S., & Tillema, H. (2009). Teacher reflection on action: What is said (in research) and what is done (in teaching). *Reflective Practice, 10*(2), 191-204. doi:10.1080/14623940902786206

Murtafiah, W., Sa'dija, C., Chandra, T. D., & Zayyadi, M. (2019). *Novice and experienced mathematics teachers' decision making process in designing math problem*. Paper presented at the The 1st International Conference on Education and Technology, Jawa Timur, Endonezya.

Nathan, M. J., & Knuth, E. J. (2003). A study of whole classroom mathematical discourse and teacher change. *Cognition and Instruction, 21*(2), 175-207. doi:10.1207/S1532690XCI2102_03

Öztürk, H. (2007). *Self-serving biases of students and teachers*. Paper presented at the The International Conference on Foreign Language Education, İstanbul, Turkey.

Reynolds, A. (1992). What is competent beginning teaching? A review of the literature. *Review of Educational Research, 62*(1), 1-35. doi:10.3102/00346543062001001

Richert, A. E. (1987). *Reflex to reflection: Facilitating reflection in novice teachers*. Stanford: Stanford University.

Rodgers, C. (2002). Defining reflection: Another look at John Dewey and reflective thinking. *Teachers College Record, 104*(4), 842-866.

Ross, J. A., & Bruce, C. D. (2007). Teacher self-assessment: A mechanism for facilitating professional growth. *Teaching and Teacher Education, 23*(2), 146-159. doi:10.1016/j.tate.2006.04.035

Sherin, M. G., & Han, S. Y. (2004). Teacher learning in the context of a video club. *Teaching and Teacher Education, 20*(2), 163-183. doi:10.1016/j.tate.2003.08.001

Soysal, Y., & Radmard, S. (2017). An exploration of Turkish teachers' attributions to barriers faced within learner-centred teaching. *Educational Studies, 43*(2), 186-209. doi:10.1080/03055698.2016.1248903

Sutton, R. E. (2007). Teachers' anger, frustration, and self-regulation. In P. A. Schutz & R. Pekrun (Eds.), *Emotion in education* (pp. 259-274). Cambridge, Massachusetts: Elsevier.

Wang, H., Hall, N. C., & Rahimi, S. (2015). Self-efficacy and causal attributions in teachers: Effects on burnout, job satisfaction, illness, and quitting intentions. *Teaching and Teacher Education, 47*, 120-130. doi:10.1016/j.tate.2014.12.005

Wang, S., & Ye, L. (2020). A comparative study of the teaching language of a novice teacher and an expert teacher in algebra instruction. *Korean Society of Mathematical Education, 23*(1), 13-22. doi:10.7468/jksmed.2020.23.1.13

Weiner, B. (2010). The development of an attribution-based theory of motivation: A history of ideas. *Educational Psychologist, 45*(1), 28-36. doi:10.1080/00461520903433596

Westerman, D. A. (1991). Expert and novice teacher decision making. *Journal of Teacher Education, 42*(4), 292-305. doi:10.1177/002248719104200407

Wood, T., Cobb, P., & Yackel, E. (1991). Change in teaching mathematics: A case study. *American Educational Research Journal, 28*(3), 587-616. doi:10.3102/00028312028003587

Yetkin-Özdemir, İ. E., Gürel, R., Akdal, P., & Bozkurt, E. (2014). Öğretmenlerde özdüzenleme: Matematik dersi örneği. In G. Sakız (Ed.), *Öz-düzenleme: Öğrenmeden öğretime öz-düzenleme davranışlarının gelişimi, stratejiler ve öneriler* (pp. 233-247). Ankara: Nobel.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). New York: Academic Press.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice, 41*(2), 64-70. doi:10.1207/s15430421tip4102_2