MATHEMATICS TEACHER CANDIDATES NOTICE HOW?

Hatice Nur Erbay[1],
Ali Rıza Küpcü[2i]
[1]PhD, Istanbul University-Cerrahpaşa,
Department of Mathematics Teacher Education,
Turkey
orcid.org/0000-0002-0112-8271
[2]PhD, Marmara University,
Department of Mathematics Teacher Education,
Turkey
orcid.org/0000-0002-0090-876X

Abstract:

The aim of this research is to examine how mathematics teacher candidates' expressions about what they noticed in videos changed with video-clubs. The study group consisted of 5 teacher candidates studying in the 4th grade of Mathematics Education Department. The data of the study, which used focus group interviews that one of the qualitative research methods, consisted of students' notes while watching the videos and focus group interview video recordings. For the analysis of the data, content analysis that is one of the qualitative data analysis methods was used. Changes in the ways in which teacher candidates expressed the situations they noticed during the meetings were examined separately. It has been determined that teacher candidates' expressions change according to the teacher they see in the video. If the teacher candidates like the teacher on video, they will use a more affirmative language, if they do not like the teacher in the next video, they will suddenly become critical and judgmental.

Keywords: teacher noticing, video club, mathematics teacher candidates

1. Introduction

The word of *noticing* is a common word among people. People always notice something in their daily life. In fact, there are many things that we don't notice. The reason is that we are either not sensitive or compatible, or our attention has been directed to another place. For example, students from mathematics class often ignore the verbally stated structural relationships in a word problem, so they try to change the numbers to reach a

---

[i] Correspondence: email hatice.erbay@istanbul.edu.tr, arkupcu@marmara.edu.tr

response; students often forget to check the conditions that it requires before attempting to apply a theory to a particular situation (Mason, 2011).

In everyday language, we use the noticing skills to recognize the things we know from the complex world as a result of our general observations (Sherin, Jacobs & Philipp, 2011). Teacher noticing is much more complicated (Biccard, 2020). By this concept, how a teacher understands the way students thinking in class and teacher does not allow the students the wrong learning. Teacher noticing is the ability to interpret what is happening in a classroom (Frederiksen, 1992; Berliner, 2001; Mason, 2002). It includes identifying what is important and reasoning about these situations and making sense of what is observed (van Es & Sherin, 2002). This concept means that the teacher focuses on what, when, where, when, why and how he / she watches throughout the lesson considering all the points that the teacher misses and catches in the classroom (Sherin, Jacobs & Philipp, 2011). Teacher noticing what can be considered as an important component of professional expertise in teaching can be defined as teachers' attention and understanding of students' ways of thinking (Bas, 2013). As a construct, teacher noticing is discussed as being composed of two key processes, attending and interpreting (Sherin & Van Es, 2009; Walkoe, Sherin & Elby, 2020).

Teachers often differ from things that they don't notice as they do. The expert view is often elegantly adjusted to the requirements of expertise. As Miller (2011) says, a skilled teacher is the one who learns to ignore (partially) the trivial features.

According to the current studies of the experts, experienced teachers are distinguished from those who has just started teaching in the following areas (Miller, 2011):

1) Experienced teachers should be able to continue their interest in the understanding of students while lecturing.
2) The experienced instructors exhibit more systematic screening templates for their students, while teachers who has just started teaching tend to focus on a smaller sample of students while ignoring others.
3) Experienced teachers should be quicker in identifying situations that require intervention (negative behaviors, inability to understand, disruptive activities).

For example, lesson planning and starter presentations of the course are very similar to inexperienced and experienced teachers. However, differences arise when students start asking questions. Experienced teachers, simply ignore many superficial or irrelevant questions or postpone their response. New or inexperienced teachers repeat all student questions. Perhaps they will do this to give themselves time to answer questions. They answer all the questions, even if the questions lead to a different direction. Therefore, it is seen that new teachers have a higher level in both knowledge of content and pedagogical content knowledge, but they have more difficulties compared to experienced teachers when faced with a class that is hard to predict (Ma, 1999).

A teacher with a high level of ability to notice can understand the student's thinking about the subject from the answers of the student, from the questions he/she asks, and from any sentence he/she has created during the lesson. If there is wrong learning or misconception, he/she can identify it, determine missing learning, and correct

it at the right moment (Sherin & Han, 2004; Sherin & van Es, 2005; Star, Lynch & Perova, 2011; Chan, Xu, Cooper, Berry & van Driel, 2021). Determining the right moment here is entirely related to the teacher's ability to notice. There are some moments in which students are well suited for permanent learning. These moments have been named in the literature in different ways. Such as *"critical moment"* (Walshaw & Anthony, 2008), *"a potentially powerful learning opportunity"* (Davis, 1997), *"significant mathematical instances"* (Davies & Walker, 2005), *"crucial mathematic hinge moment[s]"* (Leatham, Peterson, Stockero & Van Zoest, 2015).

Teacher noticing is not entirely a passive process. Teachers do not try to figure out what is happening in the classroom by sitting. Instead, they are the actors themselves in the teaching environment they observe. Although the teacher's ability to notice is handled in different ways, two main processes can be mentioned. These:

- *Attending to particular events in an instructional setting*: The teacher should be able to ignore other stimuli by paying attention to certain events in a complex classroom environment. In other words, they have to choose where and for how long they should pay attention and where they should not be paying attention.
- *Making sense of events in an instructional setting*: Teachers are not passive observers. Instead, they need to interpret what they see, and associate the observed events with abstract categories or known instructional events (Sherin, Jacobs & Philipp, 2011).

Teachers' ability to notice and interpret interactions in class can be improved over time. In other words, teachers should be supported to learn to notice. Some experienced teachers may already have these skills. However, the most important point here is whether or not teachers can be helped in teaching to notice (Van Es & Sherin, 2002).

The studies about the ability to notice are mostly directed to general teaching processes (Sherin & Han, 2004; Sherin 2007; Star & Strickland, 2008; van Es & Sherin, 2008; Star, Lynch, & Perova, 2011). But one can only notice something he/she knows. Therefore, it is not possible to consider the noticing skills of teacher candidates separately from the concept knowledge. It is preferred to focus on a particular subject as teacher candidates' noticing skills in a subject that they are well trained will be different from their noticing skills in a subject they have their own misconceptions. Because of the subject of fractions is a subject in which students and teacher candidates have too many errors and misconceptions (Soylu & Soylu, 2005; Yılmaz & Yenilmez, 2007; Kucuk & Demir, 2009; Kocaoglu & Yenilmez, 2010; Alacaci, 2012; Yanik, 2013; Karaagac & Köse, 2015) research was conducted with video-clips in the context of fractions.

2. Method

The study group consisted of 5 mathematics teacher candidates who were willing to participate in the study. The study group was created with the purposive sampling. The objective in the selection of purposive sampling is to select information-rich situations to make the research more in-depth (Patton, 2014). Information-rich situations are preferred because of the researcher can obtain as much information as possible for the purpose of

the research. It provides opportunities for in-depth comprehension to study information-rich situations.

While determining the participants, teacher candidates who can understand the scientific research process and who can be very rigorous in this regard have been selected. In addition, it was tried to determine the teacher candidates who were appropriate for the teaching profession, who liked the teaching and mathematics, and whose academic success was above average. It was taken into consideration that they were keen on professional applications, successful in applied school teaching and they have been given great importance in mathematical teaching methods.

In the research, while teacher candidates' opinions about the video-clips were taken, focus group interview technique was used. According to Maxfield and Babbie (2014), focus group interviews are conducted with the participation of 8-10 people and not more than 2-3 hours. Patton (2014) defines the focus group interview as an interview with a small group of participants on a specific topic. Unlike a series of one-to-one interviews, participants in the focus group are able to express additional comments and opinions beyond their original responses as they listen to each other's answers. The participants don't need to agree or disagree on a consensus with each other. As Patton (2014) states, the aim of the technique is to obtain high quality data that people can evaluate their views in a social context.

As a data collection tool, teacher candidates' hand-writing notes during the video-clubs and focus group interview video recordings were used. Written notes consist of short notes taken by teacher candidates while watching video-clips. These notes were used to guide them during the focus group discussions. Thus, it was tried to prevent them to change their personal ideas by being influenced by each other. In addition, teacher candidates may notice something while watching the video-clip, but they may forget to mention it during the video-club. Thanks to written notes, such issues are avoided. The basic data of the research is video recordings from video-clubs. Focus group interview video recordings have been transcripted. Written focus group discussion records were used as research data.

For six weeks, by meeting with teacher candidates in a seminar hall the video-clips that were created from videos in the mathematics class were watched. The researcher led the video monitoring process. Teacher candidates took notes while watching videos and gave them to the researcher at the end of the meeting. After watching the videos, teacher candidates were asked to discuss among themselves what they noticed. These discussions of teacher candidates were recorded. Each meeting was planned as 60-90 minutes. Watched video clips consisted of 5-10 minute sections taken from real classroom environments' videos.

Table 1: Features of videos watched in video-clubs

	Teachers	Level	Subject
1st Video-Club	Teacher A	6th Grade	Problem solving with fractions
2nd Video-Club	Teacher B	6th Grade	Division of fractions
3rd Video-Club	Teacher C	6th Grade	Definition of fractions
4th Video-Club	Teacher B	6th Grade	Division of fractions
5th Video-Club	Teacher A	6th Grade	Problem solving with fractions
6th Video-Club	Teacher C	6th Grade	Addition with fractions

Video-club is a method that, teacher or teacher candidates come together at certain time intervals, accompanied by a moderator, they watch videos taken from the lessons and discuss on videos (Van Es, 2004). The video-club environment is a particularly suitable method to support teachers who want to learn to notice. It has been suggested that the use of video in teacher training is important for teachers to come together to examine the artificial phenomena of their classes (Roberts & Wilson, 1998). Through the replay of videos, teachers are given the opportunity to become aware of the class features that they may not be aware of when they first see the video or when the event occur in the classes (van Es & Sherin, 2006). Discussing a video in a group setting can be important for teacher learning because in this environment, participants can hear each other's ideas, force each other and think about opposite ideas (Sherin & Han 2004; Sherin & van Es 2009; Tripp & Rich 2012; Santagata, König, Scheiner, Nguyen, Adleff, Yang, & Kaiser, 2021). Studies show that the video-club method helps teachers to make sense of class interaction and teachers who participate the video-club develop their skills to focus on student thinking (Sherin & Han 2004; Borko, Jacobs, Eiteljorg & Pittman, 2008; Sherin & van Es 2009; Jacobs, Lamb & Philipp, 2010).

After focus group interviews were written, analyzes were carried out by the researcher with the NVivo11 qualitative analysis program. In this process, every situation the teacher candidate noticed was considered as "code". Attention was not paid to creating a meaningful sentence in determining the codes. In this case, the sentences were considered as a single subject. Related codes have been identified. Similar codes are divided into various headings to create "categories". These categories are collected under various "themes" by getting support from the literature. Both authors independently coded the data using written video transcripts from video-clubs. Then the authors compared coding, revise the code definitions and recode together. After an interruption of about 4 weeks, the analysis was repeated, and the number of categories was decreased while the themes remained the same. Similarly, in the third analysis, the themes and categories remained the same. When the coherence between the distribution of codes in the last two analyzes was examined, it was determined that it was 92% compatible.

3. Results

According to the weeks, the number of teacher candidates' discourses varies. For this reason, in the comparison between video-clubs, the percentages were used instead of the frequencies.

Table 2: Statements coded from teacher candidates' speeches

	Categories	Amy	Bella	Cassie	Denise	Emily
Notice How	By judging	28	38	35	30	26
	By approving	38	36	22	25	39
	By making inference	53	79	76	50	69
	Only by depicting	41	53	58	39	51
	By adding what should be	27	33	26	31	32
Total		**187**	**239**	**217**	**175**	**217**

Tables were formed by calculating the percentage values for each video-club over the total number of statements of teacher candidates about the situations they noticed in a video-club.

The comparison of how teacher candidates noticed is as follows:

▪ The teacher candidate who made statements by judging the most is Bella, the least is Emily.

▪ The teacher candidate who made statements by approving the most is Amy, the least is Cassie.

▪ The teacher candidate who made statements by making inference the most is Bella, the least is Denise.

▪ The teacher candidate who made statements only by depicting the most is Cassie, the least is Denise.

▪ The teacher candidate who made statements by adding what should be the most is Bella, the least is Cassie (Table 2).

As seen above, although the participant teacher candidates tend to express mostly by making inferences, the usage levels of other forms of expression differed among themselves. The expressions that the teacher candidates used at the closest level to each other were "by adding what should be".

The data on how Amy's expressions change along video-clubs are as shown in the table below.

Table 3: Amy's noticing according to weeks

	Categories	VC1 (%)	VC2 (%)	VC3 (%)	VC4 (%)	VC5 (%)	VC6 (%)
Notice How	By judging	10	41	3	24	14	-
	By approving	19	9	30	38	7	29
	By making inference	14	16	38	33	24	43
	Only by depicting	33	9	22	5	36	21
	By adding what should be	24	25	8	-	19	7
Total (%)		100	100	100	100	100	100

As seen in Table 3, Amy talked about her noticed things mostly by depicting in the first video-club (33%). The rate of judging statements in the first video-club was 10% while it increased to 41% in the second video-club. In the second video-club, she made mostly judgmental statements. The third and fourth video-clubs showed similar values. In both, she mostly talked by approving and making inference. Although she mostly talked by

depicting in the fifth video-club, it is seen that in the last video-club her most used form of expression is by making inference (43%).

During the application Amy's way of expressing the situations noticed differed. If a general evaluation is made, it is seen in Figure 1 that Amy's most frequently used expression is by making inference.
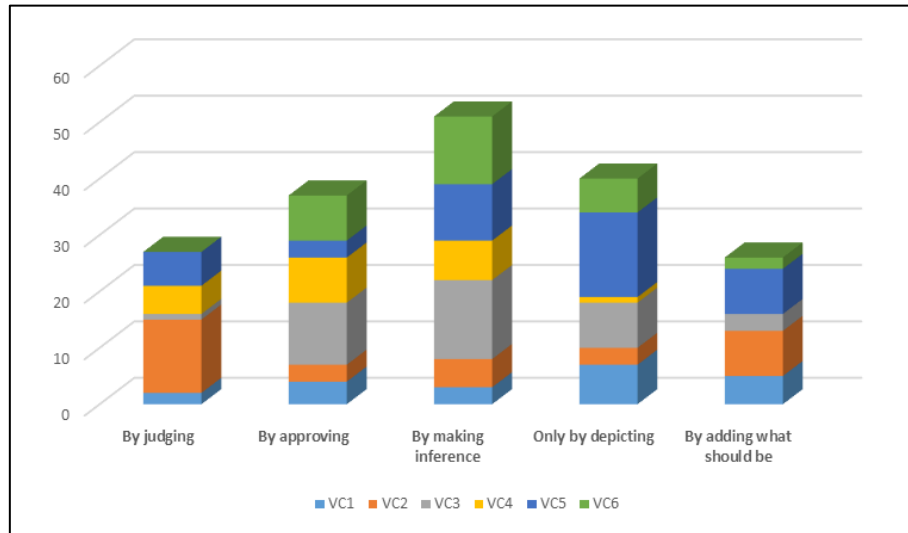

Figure 1: Overall tendency of Amy about her noticing

In the first video-club, Amy said *"the teacher did not turn the blackboard exactly, the teacher could see the class from the side, this is a good thing"* by approving. When she talked about the teacher with judgmental expressions, she stated that she did not like the teacher's behavior at the time by saying *"the teacher listens students with smiling face but not enough"*. When she focused on the pedagogical content knowledge of the teacher, she stated that *"there is a reinforcer effect, but I think it would be more distracting"* by making inference. In the second video-club, she used judgmental statements by saying *"because of the teacher focused on the student on the board, teacher's classroom management was weak"*. She also emphasized the teacher speech and said *"the teacher spoke in a monotonous way and it was distracting"* by judging. In the third video-club, Amy mentioned the teacher's pedagogical content knowledge in an affirmative language by saying *"it was aimed students to think through the wrong example"*. She also expressed *"the teacher told fractions with figures"* and *"I liked the teacher used terms of wholes instead of whole"* by approving. In the fourth video-club, Amy emphasized the teacher by saying *"asking how many halves are in 3 and then reinforcing it with figures"* and expressed that she liked that because of enhancing the students' learning permanence. She also drew attention in an affirmative language by saying *"it was very nice that the teacher focused on 3 times ½ and 3 divided by ½ and interpret them"*. In the fifth video-club, Amy said *"the teacher began the lesson by asking how the rectangle's area was found, so prepared the students for lesson"* by approving. Then, she added what should be by saying *"if I were in teacher's place, I would start the lesson by asking what the area is. The question as easy as this couldn't be solved, so there was a problem"*. In the sixth video-club, she talked about the teacher's pedagogical content knowledge in

an affirmative language by saying *"the teacher taught that the students could find the answer through the definition of everything, in other words, that small parts actually lead to an answer"*. Similarly, she stated that *"it was very useful to reinforce about the subject of equal parts with the scenario"* by approving. Also, Amy drew attention to the teacher's body language in an affirmative statement as *"the teacher used his gestures very well, I even listened carefully"*. The data on how Bella's expressions change along video-clubs are as shown in the table below.

Table 4: Bella's noticing according to weeks

	Categories	VC1 (%)	VC2 (%)	VC3 (%)	VC4 (%)	VC5 (%)	VC6 (%)
Notice How	By judging	20	45	3	17	15	-
	By approving	20	15	31	21	5	13
	By making inference	24	21	34	41	20	60
	Only by depicting	12	6	28	7	37	26
	By adding what should be	24	12	3	14	23	2
Total (%)		100	100	100	100	100	100

According to Table 4, Bella showed a balanced dispersion in the first video-club, while in the second video-club she mostly used judgmental statements (45%). In the third and fourth video-clubs, the most common form of expression was to make inferences. Bella's biggest change is observed between the fifth and sixth video-clubs. While her judgmental statements, which were 15% in the fifth video-club, disappeared completely in the sixth video-club, the rate of her expressions by making inferences, which were 20%, reached a very high value like 60% in the sixth video-club.
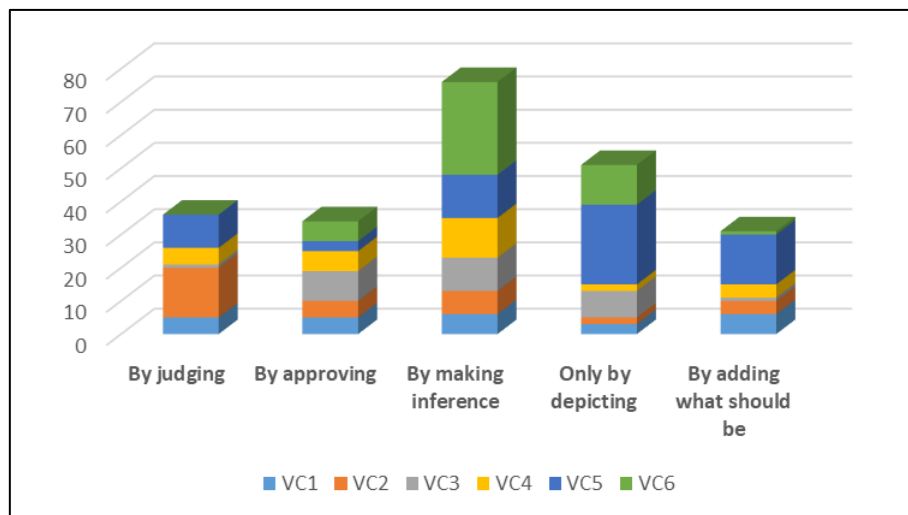

Figure 2: Overall tendency of Bella about her noticing

It is seen in Figure 2 that during the application, Bella's tendency to express the situations she noticed by making inferences, while the least used phrase is expressed by adding what should be.

In the first video-club, Bella criticized the teacher by saying *"after the question was read, the teacher immediately wrote her own clues on the blackboard without giving the students the opportunity to think"*. She expressed that she liked that the teacher did not solve the questions and received ideas from the students about the solution, but she emphasized the teacher's pedagogical knowledge by saying *"students had not yet focused on the lesson, so it was not efficient to try to get ideas"*. She said *"she tried to solve the question with ratio by using discovery learning technique but it would be better if the students found the ratio themselves"* by adding what should be. In the second video-club, she criticized the teacher's speech by saying *"she seemed to be very confused when she could tell in a very simple way, she talked too much, so there was too much verbality"*. She made an inference by saying *"students are generally troublous about problem solving, troubles arising from ability or teaching, I do not know"* about students' mathematical thinking. In the third video-club Bella said *"I could not remember which child had answered first, but every fraction definition was told, the teacher remarked such deficiencies. For example a definition was told, the teacher analyzed it without saying the student was wrong"* by depicting the situation. She made an inference about the student's mathematical knowledge by saying *"as the student has understood better than the other, at least he could give an example"*. In the fourth video-club, she said *"the teacher says you're very quiet today, but then she goes back. She doesn't question why they are quiet, she doesn't do anything to get students active in class"* by judging. She made an inference from a student's statement in the lesson by saying *"he knows only mathematical operation part, so he cannot adapt his knowledge to different situations"*. In the fifth video-club, Bella focused on the pedagogical knowledge of the teacher and described the situation by saying *"the teacher did not give the students time to think and did not allow the students to solve the question although it was a simple question"*. When she talked about the teacher's pedagogical content knowledge, she used an affirmative language by saying *"the only thing I liked about question solution was the teacher's transition from rectangular area formula to square"*. In the sixth video-club, in a descriptive language, Bella commented that *"it was nice for the teacher to ask the student who could not tell anything about solution to define the fraction and to go to the conclusion from the definition of the fraction"*. Drawing attention to the body language of the teacher, she expressed her appreciation as *"he uses hand and arm movements very actively and gestures are very effective"*.

The data on how Cassie's expressions change along video-clubs are as shown in the table below.

Table 5: Cassie's noticing according to weeks

	Categories	VC1 (%)	VC2 (%)	VC3 (%)	VC4 (%)	VC5 (%)	VC6 (%)
Notice How	By judging	13	54	3	41	-	-
	By approving	21	4	11	9	6	7
	By making inference	33	21	37	25	33	58
	Only by depicting	29	8	40	6	36	36
	By adding what should be	4	13	9	19	24	-
Total (%)		100	100	100	100	100	100

As it is seen in Table 5, Cassie mostly expressed by depicting and making inference the situations that she noticed in the first video-club. In the second video-club, there was a remarkable increase in judgmental statements (54%). In the third video-club, her judgmental statements were decreased from 54% to 3%, while her descriptive statements were increased from 8% to 40%. In the fourth video-club, the rate of judgmental statements was increased again. In the fifth and sixth video-clubs there were no judging statements. The fifth video-club showed similar features to the first video-club, and Cassie mostly expressed by depicting and making inferences. In the sixth video-club, Cassie mostly talked by making inferences (58%).
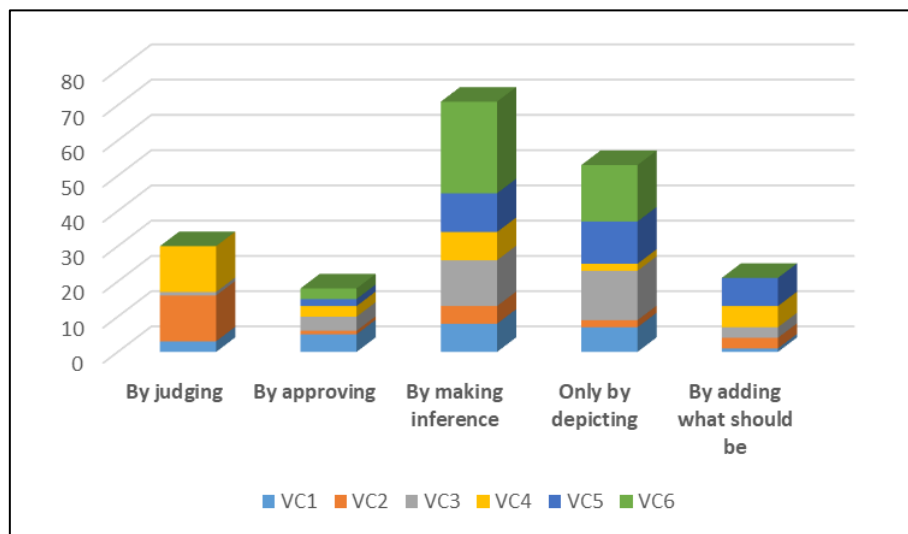
Figure 3: Overall tendency of Cassie about her noticing

Figure 3 shows that Cassie has a tendency to make inferences in order to express the situations Cassie has noticed during the application. The least used phrase of expression is by approving.

In the first video-club, Cassie focused on the teacher's pedagogical content knowledge by mentioning about the problem as *"the first clue was how many kilometers could go with a liter of fuel, she wrote on the blackboard"* and *"she found the road he took in 1 liter by dividing 100 by 21/4"*. She used an affirmative language by saying *"it was remarkable that students had high self-confidence they can express themselves very comfortably"*. In the second video-club, Cassie said *"instead of 36, she could have given a smaller number of samples or a sample of bread from real life"* by adding what should be. She expressed *"the use of the blackboard was disorganized, because there were other writings on the board. She started from the right and wrote it down, one went down, there was no integrity"* by judging. In the third video-club, Cassie added what should be about teacher's pedagogical knowledge by saying *"there could be visual, concrete materials instead of drawing"*. She told the schema sketched on the blackboard about fractions by teacher, and expressed her appreciation as *"I liked network of concepts created by teacher, so the teacher valued every idea of the students even they were wrong"*. She mentioned the teacher's knowledge about mathematical knowledge of the students with a descriptive language by saying *"the teacher tried to remind students what the fraction was and questioned their fraction definitions to get the right definition"*. In the fourth

video-club, she said *"I think he should have supported it with the visual, later he drew shape but not enough"* by adding what should be. She emphasized the teacher's pedagogical content knowledge with an affirmative language by saying *"the idea of looking for a half in the whole was good, because the first that comes to mind to understand the logic of the division is half"*. She described the student's mathematical knowledge by saying *"a student tried to adapt the rule that learned in addition and substraction to division, tried to equalize the denominator"*. In the fifth video-club, Cassie said *"the teacher tried to activate others by listening to so many students but it was not very effective"* by depicting. She made an inference by saying *"if the student had memorized the short edge-long edge, then he would learn parrot fashion. But when he draws, he shows two different sides. So it seemed to me that he was thinking the truth"*. In the sixth video-club, she said *"teacher's taking the sample from real life made it easier for students to visualize"* by depicting. She made an inference by saying *"a student who learns parrot fashion states that the denominators are not equal. He has learned in a way, he has knowledge, but he cannot comprehend"* about a student's mathematical knowledge.

The data on how Denise's expressions change along video-clubs are as shown in the table below.

Table 6: Denise's noticing according to weeks

	Categories	VC1 (%)	VC2 (%)	VC3 (%)	VC4 (%)	VC5 (%)	VC6 (%)
Notice How	By judging	47	29	-	21	13	4
	By approving	-	10	32	-	5	37
	By making inference	13	19	32	42	24	44
	Only by depicting	33	13	36	29	21	11
	By adding what should be	7	29	-	8	37	4
Total (%)		100	100	100	100	100	100

According to Table 6, Denise mostly provided judgmental statements in the first video-club (47%). She showed a balanced dispersion in the second video-club while in the third video-club there were no expressions by judging and by adding what should be. In the fourth video-club, she mostly talked by making inferences (42%). The rate of adding what should be was 8% in the fourth video-club, while it was increased to 37% in the fifth video-club. It was seen that Denise expressed the situations that she noticed in the sixth video-club mostly by approving and making inferences.
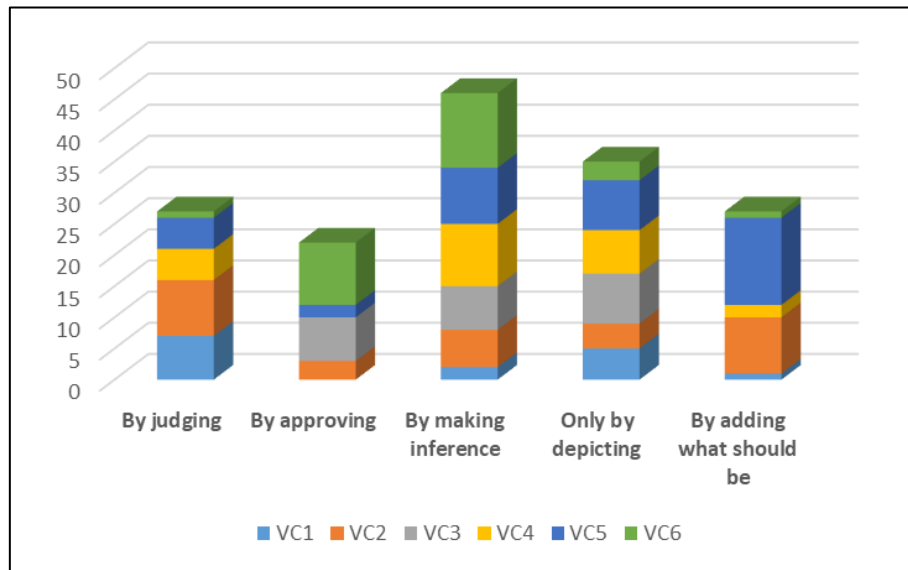
Figure 4: Overall tendency of Denise about her noticing

During the application, it is seen that Denise expresses the situations that she noticed by mostly making inferences. The least used phrase of expression is by approving (Figure 4).

In the first video-club, Denise described the teacher's pedagogical knowledge as *"the teacher gave students time to think after writing the question, but nobody attended"*. She also added what should be by saying *"the teacher lifted the student on the blackboard, but erased the student's solution directly, sat the student down. She should have guided him by stating you made a mistake here or it would be better if you did like that, but I've never heard such things"* about the teacher's pedagogical knowledge. In the second video-club, she said *"a student in the class raised a finger while there was a student on the blackboard, it was nice to ignore the teacher there"* by approving. She focused on the teacher's pedagogical content knowledge by saying *"the students would be able to understand better if the teacher exemplified the question with a smaller number rather than 36"* by adding what should be. In the third video-club, she used statements like *"the definition step by step made students think"* or *"it was nice to not give the definition of a fraction directly, that is to find it with the students, instead of writing it like this on the blackboard"* to emphasize the teacher's pedagogical content knowledge with an affirmative language. She described students' behaviors by saying *"a student raised a finger; he was spinning the pencil in his hand while talking. At first, they seemed distracted, they didn't understand what the teacher wanted to do"*. In the fourth video-club, she talked about the teacher's behavior in a judicial way with the annoyance of asking *"are there any problems"*. Denise added what should be by saying *"it is easier for students to see and understand if the teacher draws shapes or use material when searching 1/2 within 3"* about the teacher's pedagogical content knowledge. In the fifth video-club, she noted that the teacher had to warn the students over and over again. She said *"I think the teacher should have a sanction if she warns. Students should know that the teacher has a limit, they cannot exceed that limit after a certain point"* by adding what should be. In addition, she mentioned the teacher's pedagogical content knowledge as *"it was nice for the teacher to ask the question step by step and remind the preliminary information, it was nice to ask piece by piece like the area*

of the square, the area of the rectangle" by approving. In the sixth video-club, she used confirmatory statements like *"it was nice to look for answers after asking questions to the students, then it was nice to give them hints".* Denise talked with an affirmative language by saying *"at the beginning of the lesson, on the question of the teacher, the students made a prediction at first, they were all eager, they started to say something, they started to attend. They didn't start the lesson by complaining".* She made an inference about a student's mathematical knowledge by saying *"the second student is aware of the importance of how many parts of a whole are divided, and I think he grasped well. In other words, the definition is well understood, he can make inferences from there".*

Table 7: Emily's noticing according to weeks

	Categories	VC1 (%)	VC2 (%)	VC3 (%)	VC4 (%)	VC5 (%)	VC6 (%)
Notice How	By judging	34	32	-	-	6	2
	By approving	22	5	34	24	9	14
	By making inference	13	16	29	53	34	51
	Only by depicting	25	-	34	18	23	28
	By adding what should be	6	47	3	6	28	5
Total (%)		100	100	100	100	100	100

The data on how Emily's expressions change along video-clubs are as shown in the table above.

According to Table 7, Emily mostly expressed by judging the situations that she noticed in the first video-club (34%). The rate of adding what should be was 6% in the first video-club, while it was increased to 47% in the second video-club. In the second video-club, she talked mostly by adding what should be. In the third video-club, she used equal rate of approving and depicting statements. In the fourth video-club, her 53% of the expressions made by making inferences. It is noteworthy that Emily did not use any judgmental statements in the third and fourth video-clubs. In the fifth video-club, her adding what should be statements were increased from 6% to 28%, while her making inference statements were decreased from 53% to 34%. In the sixth video-club, the rate of the expressions made by making inferences increased to 51%. The least used form of expression is judgmental statements.
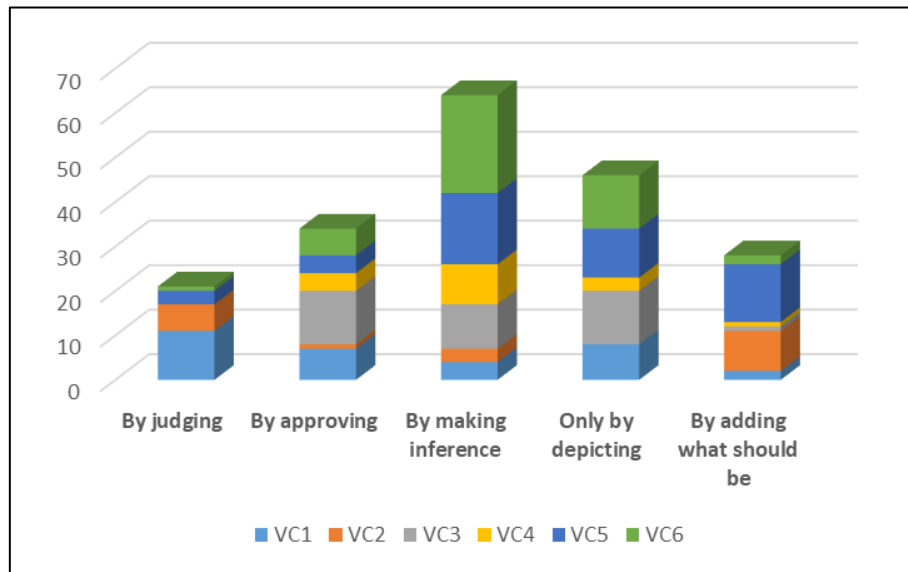
Figure 5: Overall tendency of Emily about her noticing

During the application, Figure 5 shows that Emily has a tendency to make inferences in order to express the situations Emily has noticed. The least used phrase of expression is by judging.

In the first video-club, Emily made an inference about teacher's pedagogical knowledge by saying *"there were students who did not look at the board while the teacher wrote the solution on the blackboard. This made me think that she was not able to dominate the classroom at the same time and that she was not successful in classroom management"*. About the classroom environment, she said *"I noticed that the medicine cabinet in the classroom was empty"* by depicting. In the second video-club, she added what should be by saying *"the teacher warned the student who raised the finger while she was lecturing, students distracted. In other words, she could ignore it at the time"*. She used a judgmental language about the teacher's use of the blackboard and said *"the teacher used the blackboard very irregularly"*. In the third video-club, Emily said *"it was good to summarize for the students who didn't hear and understand after the students had said their ideas"* in an affirmative language. She emphasized the students' mathematical thinking as *"how many pieces were divided, how much was taken, was Kate's fraction definition. I thought she understood the fraction at the level of comprehension"* by making inferences. In the fourth video-club, she mentioned about the teacher's pedagogical content knowledge *"firstly the teacher expressed its logic and then she began to solve the question. In other words, first she verbally explained what the problem was, and after that she switched to mathematical operations"* by depicting. She drew attention to the monotony of the teacher's speech and made an inference by saying *"I noticed the emphasis on the teacher's speech at first, but I think the teacher may be bored of lecturing because of she cannot get feedback from the students"*. In the fifth video-club, she added what should be about the teacher's class management by talking *"if the teacher shows her attitude at the first entry to the class, if the students and teacher form the rules together and continue according to them, maybe there will be no need"*. She expressed his appreciation for the teacher's outfit by saying *"teacher's white smock wearing, the pen in her upper pocket drew my attention. I like the white smock"*. In the sixth video club, she stated *"one of the students raised his finger and*

the teacher let him talk. The teacher was telling him something. At that time the other student raised her finger and the teacher said 'you're doing it wrong, don't lift the finger while I am talking' to the student who lifted a finger" only by depicting. Emily expressed her appreciation for the teacher's way of speaking by saying *"teacher's ability to draw attention, tone of voice and emphasis on definition was very good".*

4. Discussion and Conclusion

Sherin and van Es (2009) have focused on two main areas while studying teacher noticing; what teachers noticed and how they noticed. "What the teachers noticed" includes that teachers focus to whom or what headings (which situations). "How teachers notice" includes teachers' analytical attitudes (eg, descriptive, evaluative and interpretive) and the depth of their analysis (eg, focusing on a few details, basing their comments on evidence, combining their analysis with the principles of teaching and learning, or making alternative pedagogical suggestions). Based on these two dimensions, van Es (2011) has developed a theoretical framework that is suitable to teach teachers how to notice student thinking is a developmental trajectory through four levels: Level 1 (baseline), Level 2 (mixed), Level 3 (focused) and Level 4 (extended). Teachers at Level 1 tend to focus on superficial classroom activities (students' behaviors, classroom setting, etc.), to create general impressions, to provide descriptive comments, and to evaluate comments with little or no evidence. On the other hand, teachers at Level 4 tend to pay attention to events about learning process such as mathematical thinking of students, to make sense these events, to establish connections and to make alternative pedagogical suggestions.

Although it was seen that teacher candidates tend to express the situations, they noticed by mostly making inferences in this study, some differences were revealed. It was observed that the teacher candidates who made more judging statements at the beginning had more approving and interpretative statements in the following weeks. In the literature, it was stated that the attention of the teacher candidates in the video-clubs process changed from teacher to student and the expressions of the teacher candidates changed from evaluative expressions to descriptive expressions (van Es & Sherin, 2002; van Es, 2004; van Es & Sherin, 2006; Sherin & van Es, 2009; Sherin, Linsenmeier & van Es, 2009; van Es, Tunney, Goldsmith & Seago, 2014).

During the process, teacher candidates' expressions about what they noticed has turned into from judgmental and critical statements to making inference or adding what should be. If the entire implementation process is considered, it can be said that most of the expressions of teacher candidates are interpretative and descriptive statements are not used much. In the literature, it is stated in many studies that inexperienced teachers spend more time evaluating the lesson and the teacher while experienced teachers making mostly interpretative statements (Erickson, 2011; Star, Lynch & Perova, 2011; Erdik, 2014). Experienced teachers consider an event in more detail and interpret them with a better understanding than teacher candidates (Sabers, Cushing, & Berliner, 1991). In other words, experienced teachers analyze what they observe within the framework

of their own experiences, specific objectives of mathematics curriculum, the class information they have (Santagata, 2011). However, the interpretative expressions in the literature refer to multidimensional thinking and different suggestions. In this study, teacher candidates' interpretative expressions refer to explain by making inferences from their observations. Therefore, although the teachers who made interpretative expressions in the literature were more experienced and their noticing skills was higher, they did not match the features of the participants in this study. So, in this study, the teacher candidates presented simple explanations to the events or situations while using interpretative expressions.

According to the theoretical framework developed by Van Es (2011), it is stated that the while teachers expressing the situation in videos, the teachers with lower level of noticing skills are mostly using descriptive and evaluative phase. It is seen that the teachers begin to use interpretative statements as their level of noticing skills increased. Although van Es' theoretical framework is used as a guide in this research, this rating does not correspond to the study group due to cultural differences. It is accepted by many that our people make more comments on issues that are not competent and that they make more cautious and impartial statements as the level of knowledge and awareness increases. Therefore, in this research, descriptive expressions were arranged in a way to show higher noticing level for the model showing the noticing situations.

The expressions of teacher candidates about proposing solutions have remained at the book knowledge level. In other words, although theoretically made some suggestions, the applicability of the solutions showed uncertainty. Jacobs, Lamb and Philipp (2010) showed that teaching experience and professional development support to interpret the students' mathematical thinking and guide them in deciding how to react in the teaching environment. In this context, it can be said that the participants in the research have difficulty in making realistic suggestions due to the lack of teaching experience. One of the important findings of the study is that teacher candidates' suggestions about solutions are mostly related to teacher's pedagogical knowledge. It was seen that they did not try to offer a solution to a problem about fractions, while they made suggestions about the teacher's attitude and behavior or his/her pedagogical approach. For example, they have not suggested another type of lecture style or teaching model that may be more effective by calling attention to a material or representation used by the teacher in the video.

When video-clubs were examined in weeks, the ways in which teacher candidates express the situations they noticed changed between video-clubs by showing accumulation. If the teacher candidates like the teacher on video, they will use a more affirmative language, if they do not like the teacher in the next video, they will suddenly become critical and judgmental. Also, as Ozmantar and Akkoc (2017) stated that teacher candidates had a good impression of the teacher when they saw the behaviors, they heard good about it, they had a bad impression of the teacher when they saw the behaviors, they heard bad about it. Their comments could be based only on hearsay, because of they haven't had any teaching experience. Many studies have revealed that teaching experience has a positive effect on the level of noticing skills (Jacobs, Lamb & Philipp,

2010; Dreher & Kuntze, 2015). As the duration of the teaching experience increases, encountering with different student situations and amounts of facing different class problems over time will increase, so that the teacher candidates will be able to understand that everything they think over time may not be true in every situation.

5. Recommendations

Similar studies can be done with teacher candidates in different branches and teachers. In view of the impact of co-operative sharing in this study, experienced teachers and teacher candidates can be brought together and carry out applications for the development of noticing skills within the context of professional development models such as lesson study.

In this study, teacher candidates exhibited similar noticing skills as they passed through similar educational processes. Although they showed improvement in the process, they could not reach the desired point. In this context, it is suitable to work with teachers and teacher candidates in the same video-club. As the points that the experienced teachers will notice different situations in the videos, it can be ensured that the teacher candidates develop better noticing skills.

An expert may be included in the video-clubs where teacher candidates participate. At the end of each meeting, if the expert explains the important situations related to the video-clip after teacher candidates discuss among themselves, it can be ensured that teacher candidates have an idea about the issues that may be important in the video. Thus, in the next video-clubs, they are directed to what can be considered in a video-clip.

Conflict of Interest Statement
The authors declare no conflicts of interests.

About the Author(s)
Dr. Hatice Nur Erbay is working as a research assistant at Faculty of Education, Istanbul University-Cerrahpasa, Turkey. She received her MA and PhD degrees in Mathematics Education from Marmara University. Her research interests are mathematics teacher noticing, teacher training, problem solving, teaching algebra, and technology-assisted mathematics teaching.
Dr. Ali Rıza Küpcü is working as an assistant professor at Faculty of Education, Marmara University, Turkey. He received his MA and PhD degrees in Mathematics Education from Marmara University. His research interests are teacher training, teaching algebra, mathematical misconceptions, problem solving, and mathematical reasoning.

References

Alacaci, C. (2012). Öğrencilerin kesirler konusundaki kavram yanılgıları. Bingölbali, E., & Özmantar, M. F. (Ed.). *İlköğretimde Karşılaşılan Matematiksel Zorluklar ve Çözüm Önerileri* (3. Baskı, ss. 63-95). Ankara: Pegem Akademi.

Baş, S. (2013). An investigation of teachers' noticing of students' mathematical thinking in the context of a professional development program. (*Unpublished doctoral dissertation). Middle East Technical University, Ankara.*

Berliner, D. C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research, 35(5),* 463–482.

Biccard, P. (2020). The development of noticing in primary school mathematics teachers. *The Independent Journal of Teaching and Learning*, 15(2), 92-106.

Borko, H., Jacobs, J., Eiteljorg, E., & Pittman, M. E. (2008). Video as a tool for fostering productive discussions in mathematics professional development. *Teaching and Teacher Education, 24(2),* 417-436.

Chan, K. K. H., Xu, L., Cooper, R., Berry, A., & van Driel, J. H. (2021). Teacher noticing in science education: do you see what I see?. *Studies in Science Education*, 57(1), 1-44.

Erickson, F. (2011). On noticing teacher noticing. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics Teacher Noticing: Seeing Through Teachers' Eyes* (pp. 17-34). New York: Routledge.

Frederiksen, J. R. (1992). Learning to "see": scoring video portfolios or "beyond the hunter-gatherer in performance assessment.". In *Annual Meeting of the American Educational Research Association,* San Francisco.

Jacobs, V. R., Lamb, L. L., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education, 41*(2), 169-202.

Karaağaç, M. K., & Köse, L. (2015). Öğretmen ve öğretmen adaylarının öğrencilerin kesirler konusundaki kavram yanılgıları ile ilgili bilgilerinin incelenmesi. *Sakarya Üniversitesi Eğitim Fakültesi Dergisi*, (30), 72-92.

Kocaoğlu, T., & Yenilmez, K. (2010). Beşinci sınıf öğrencilerinin kesir problemlerinde yaptıkları hatalar ve kavram yanılgıları. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 14*, 71-85.

Küçük, A. & Demir, B., (2009). İlköğretim 6-8.sınıflarda matematik öğretiminde karşılaşılan bazı kavram yanılgıları üzerine bir çalışma. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 13*, 97-112.

Leatham, K. R., Peterson, B. E., Stockero, S. L., & Van Zoest, L. R. (2015). Conceptualizing mathematically significant pedagogical opportunities to build on student thinking. *Journal for Research in Mathematics Education, 46(1),* 88-124.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States*. Routledge.

Mason, J. (2002). *Researching Your Own Practice: The Discipline of Noticing.* London: Routledge Falmer.

Mason, J. (2011). Noticing: Roots and branches. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics Teacher Noticing: Seeing Through Teachers' Eyes* (pp. 35-50). New York: Routledge.

Maxfield, M. G., & Babbie, E. R. (2014). *Research Methods for Criminal Justice and Criminology*. (7th ed.). Cengage Learning.

Miller, K. F. (2011). Situation awareness in teaching: What educators can learn from video-based research in other fields. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics Teacher Noticing: Seeing Through Teachers' Eyes* (pp. 51-65). New York: Routledge.

Patton, M. Q. (2014). *Nitel Araştırma vçe Değerlendirme Yöntemleri*. (Çev.: Bütün, M. & Demir, S.B.). Ankara: PegemA Akademi.

Roberts, L., & Wilson, M. (1998). *An integrated assessment system as a medium for teacher change and the organizational factors that mediate science teachers' professional development*. BEAR Report Series SA-98-2. Berkeley, CA: University of California.

Santagata, R., König, J., Scheiner, T., Nguyen, H., Adleff, A. K., Yang, X., & Kaiser, G. (2021). Mathematics teacher learning to notice: A systematic review of studies of video-based programs. *ZDM–Mathematics Education*, 1-16.

Sherin, M. G. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video Research in the Learning Sciences* (pp. 383-396). Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.

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

Sherin, M. G., & van Es, E. A. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of technology and teacher education, 13(3), 475-491*.

Sherin, M. G., & van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education, 60*, 20-37.

Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (2011). Situating the study of teacher noticing. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics Teacher Noticing: Seeing Through Teachers' Eyes* (pp. 1-13). New York: Routledge.

Soylu, Y., & Soylu, C. (2005). İlköğretim beşinci sınıf öğrencilerinin kesirler konusundaki öğrenme güçlükleri: Kesirlerde sıralama, toplama, çıkarma, çarpma ve kesirlerle ilgili problemler. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi, 7*(2), 101-117.

Star, J. R., & Strickland, S. K. (2008). Learning to observe: Using video to improve preservice mathematics teachers' ability to notice. *Journal of Mathematics Teacher Education, 11*(2), 107-125.

Star, J. R., Lynch, K., & Perova, N. (2011). Using video to improve preservice mathematics teachers' abilities to attend to classroom features. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics Teacher Noticing: Seeing Through Teachers' Eyes* (pp. 117-133). New York: Routledge.

Tripp, T. R., & Rich, P. J. (2012). The influence of video analysis on the process of teacher change. *Teaching and Teacher Education, 28(5)*, 728-739.

Van Es, E. A. (2004). Learning to notice: The development of professional vision for reform pedagogy (Order No. 3132618). Available from ProQuest Dissertations & Theses Global. (305137241). Retrieved from https://search.proquest.com/docview/305137241?accountid=11637.

Van Es, E. A. & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of Technology and Teacher Education, 10(4),* 571-596.

Van Es, E. A., & Sherin, M. G. (2006). How different video club designs support teachers in "learning to notice". *Journal of Computing in Teacher Education, 22(4),* 125-135.

Van Es, E. A., & Sherin, M. G. (2008). Mathematics teachers' "learning to notice" in the context of a video club. *Teaching and Teacher Education, 24*(2), 244-276.

Walkoe, J., Sherin, M., & Elby, A. (2020). Video tagging as a window into teacher noticing. *Journal of Mathematics Teacher Education*, *23*(4), 385-405.

Yanık, H.B. (2013). Rasyonel sayılar. Zembat, İ. Ö., Özmantar, M. F., Bingölbali, E., Şandır, H., & Delice, A. (Ed.). *Tanımları ve Tarihsel Gelişimleriyle Matematiksel Kavramlar* (ss. 95-110). Ankara: Pegem Akademi.

Yılmaz, Z. & Yenilmez, K., (2007). İlköğretim 7. ve 8. sınıf öğrencilerinin ondalık sayılar konusundaki kavram yanılgıları. *Afyon Kocatepe Üniversitesi Fen Bilimleri Dergisi, 8(1),* 269-290.