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Supporting teacher noticing based on student mathematical thinking through video club

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ABSTRACT Video clubs, which are accepted as one of the video-based professional development models, are environments where teachers come together to analyze class videos and develop discourses based on these analyses. This study aims to examine the development of secondary school mathematics teachers' skills to notice student mathematical thinking through a video club design. The study was conducted in the context of a video club with five secondary mathematics teachers that lasted for 12 weeks. The data collection tools of the research, which use the case study from qualitative research designs are video club discussion meetings, written notes taken by teachers while monitoring video lessons and reports containing reflective opinion. The data obtained were analyzed in a theoretical framework. The findings reveal that teachers participating in the video club process focused more on student thinking in the actor dimension, adopted an interpretive analytical approach based on student mathematical thinking in the following weeks and presented pedagogical suggestions based on student thinking by detailing their interpretations. In addition, the findings indicate that the transitions between dimensions that teachers noticed may be related. Research results support that the video club is an efficient process for improving teachers' noticing skills.

Keywords: *Mathematical thinking, Professional development, Teacher noticing, Video club*

Video kulübü aracılığıyla öğrencinin matematiksel düşünmesine dayalı öğretmenin fark etmesinin desteklenmesi

ÖZ Video temelli mesleki gelişim modellerinden biri olarak kabul gören video kulüpler, öğretmenlerin bir araya gelerek ders videolarının analizlerini yaptıkları ve bu analizlere dayalı söylemler geliştirdikleri ortamlardır. Bu çalışmanın amacı, bir video kulübü tasarımıyla ortaokul matematik öğretmenlerinin öğrenci matematiksel düşünmelerini fark etme becerilerinin gelişimini incelemektir. Çalışma, beş ortaokul matematik öğretmeni ile 12 haftalık bir süre boyunca devam eden bir video kulüp bağlamında yürütülmüştür. Nitel araştırma desenlerinden durum çalışmasının kullanıldığı araştırmanın veri toplama araçlarını; video kulüp tartışma toplantıları, öğretmenlerin video derslerini izlerken almış oldukları yazılı notları ve yansıtıcı görüşlerini içeren raporları oluşturmaktadır. Elde edilen veriler, teorik bir çerçeve kapsamında analiz edilmiştir. Bulgular, video kulüp sürecine katılan öğretmenlerin konu boyutunda daha çok öğrenci düşünmelerine odaklandıklarını, ilerleyen haftalarda öğrencinin matematiksel düşünmesine dayalı yorumlayıcı bir analitik yaklaşım benimsediklerini ve yorumlamalarını detaylandırarak öğrenci düşünmesine dayalı pedagojik öneriler sunduklarını ortaya koymaktadır. Ayrıca bulgular, öğretmenlerin fark ettikleri boyutlar arasındaki geçişlerin ilişkili olabileceğine de işaret etmektedir. Araştırma sonuçları, video kulüp modelinin öğretmenlerin öğrenci düşünmesine dayalı fark etme becerilerini geliştirmede etkili olduğunu desteklemektedir.

Anahtar Sözcükler: *Matematiksel düşünme, Mesleki gelişim, Öğretmen fark etmesi, Video kulüp*

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INTRODUCTION

Teacher noticing based on student thinking is an essential component that forms the basis of teaching expertise and student-centered education (Sherin et al., 2011). Experienced teachers need to improve their skills in the context of understanding and interpreting the mathematical thinking of the student though they may notice the meaningful events in the classroom better than prospective teachers (Jacobs et al., 2010). Thus, teacher can learn to notice through learning tools that will divert their attention to specific features of classroom interactions and help guide how to describe teaching activities (Sherin & van Es, 2009). As a learning tool, videos pioneered research to identify what and how teachers notice.

This study was conducted within the context of a video club (VC), which is a video-based professional development process. In this process, a group of teachers develop discussions to monitor and analyze each other's classroom videos.VC helps teachers understand and interpret student thinking by allowing them to shift the focus from themselves to the students (Van Es & Sherin, 2021). By carefully monitoring the specific interactions that arise in a lesson, teachers analyze how these interactions affect students' progress towards learning goals (Santagata & Yeh, 2013). In this process, teachers can develop discourse-rich environments by transferring their own experiences and perspectives to make sense of students' mathematical thinking (SMT). Researches indicate that VC helps teachers learn to notice essential classroom interactions (Stockero et al., 2017) and supports the development of interpretative skills (Barnhart & van Es, 2020; Girit Yıldız et al., 2023). In addition, studies demonstrate teachers cannot develop these skills by just monitoring classroom videos and reflecting on them. Therefore, this situation enabled the facilitating effects of VC to come to the fore. In this direction, studies are focusing on participant-centered discussions that the facilitator leads (Barnhart & van Es, 2020) and a selection of videos (Kosko et al., 2021; Walkoe et al., 2020) to support teacher noticing. For example, Superfine and Bragelman (2018) analyzed the relationship between the complexity of the videos and prospective teachers' noticing, and found that videos with certain qualities (emphasizing student mathematical thinking) increased prospective teachers' skills to notice SMT. Therefore, the structure of VC and the characteristics of the videos used differ in research (Amador et al., 2020).

Though previous studies reveal how VC supports teacher noticing of SMT, the current study shows the improvement of teacher's professional noticing in a different VC design. Particularly, unlike most of the studies (e.g., Amador et al., 2020; Coles, 2019; Van Es & Sherin, 2010), teachers monitored the whole video lesson in the VC discussion meeting. Having interesting mathematical moments with a higher chance of occurring in a longer video lesson, rather than a video segment, was considered a facilitating factor for the improvement of teacher's professional noticing. On the other hand, the literature review reveals those studies examining teachers' noticing skills in the context of VC in Türkiye are not common and are mostly conducted with prospective teachers (e.g., Erbay, 2018; Girit Yıldız et al., 2023; Ulusoy & Çakıroğlu, 2021). Therefore, in the current study, it is of particular importance that the VC is carried out with experienced teachers and that teachers analyze their own lesson videos by monitoring them. The results of this comprehensive study will lead to future VC designs. In this regard, it is the main purpose of this study to realize the applicability of VC aiming to develop noticing skills of teachers in the school environment and to monitor the development of teachers' skills to notice SMT in this process. For this purpose, the research question is as follows: How is the development of secondary school mathematics teachers' noticing skills of student mathematical thinking through a video club?

Related Literature

Teacher noticing

Teacher noticing is a theoretical framework that many researchers in mathematics education focus on to understand and investigate instruction (Jacobs et al., 2010). These researchers indicate that noticing skill is an essential component of mathematics teaching. In the literature, there are several conceptualizations of noticing. Rodgers (2002) expresses teacher noticing as developing the ability to

"see the student's learning: distinguish and explain what they learn, analyze and respond to learning." (p.231). Some researchers have defined this skill as seeing and responding to what is necessary for effective teaching (Mason, 2002). Van Es and Sherin (2002) stated that, based on the teacher's professional vision, noticing skill includes three basic components; (1) identifying significant classroom events, (2) informed reasoning to make sense of these events, and (3) making connections between learning and teaching principles and current events. Based on this conceptualization, some researchers emphasized two key aspects of teacher noticing, selective attention and knowledge-based reasoning (Sherin & van Es, 2009; Walkoe, 2015). Many researchers argue that the teacher noticing is the ability to attend to significant teaching features, reason about what they observe and decide how to answer the student question (Barnhart & van Es, 2015; Sherin et al., 2011; Ulusoy, 2020). Therefore, although the researchers do not share a common definition for the teacher noticing, they agree that this skill has two main components. The first is the teachers' attention to significant interactions or events in the teaching environment. The second is the teachers' interpretation of these interactions or events using their existing knowledge.

In mathematics teaching, events related to SMT are considered as essential classroom events (Van Es & Sherin, 2010). Therefore, the first component of noticing skill, identifying significant classroom events, is paying attention to SMT in the context of mathematics education. Jacobs and colleagues (2010) defined teacher noticing by three interrelated skills. These three skills are paying attention to the student's strategies, interpreting student thinking, and deciding how to respond based on students' understanding. Noticing the SMT goes beyond identifying the events that the student makes right or wrong (Doğan & Kılıç, 2019) and allows teachers to structure their own teaching knowledge based on student thinking (Mason, 2021).

Many research findings show that noticing SMT is not a unique skill that teachers have or only acquire during their teaching experience (Jacobs et al., 2020; Jazby, 2020). However, research has shown that this skill can be learned through professional development programs (Jacobs et al., 2010) and improved (Amador et al., 2023, Guner & Akyuz, 2020). An increasingly common professional development process to support the ability to notice in this direction is VC, where teachers analyze their lesson videos as a group.

Video club to support noticing

Research on video use is expanding across a variety of disciplines, in different subject contexts and focal points. In recent years, there has been extensive research on the use of video, particularly for teacher education and professional development. Most of this research has focused on group contexts (Amador et al., 2023).VC is a process used by a group of teachers to analyze each other's or colleagues' lesson videos and reflect them into practice. The main purpose of VC is to support teachers to notice and interpret meaningful events in the classroom through video analysis (Van Es & Sherin, 2008).

Related studies in the literature provide evidence that VC supports teachers' noticing skills. These studies used various theoretical frameworks to determine teacher noticing skills. For example, Van Es and Sherin (2008) examined the changes that occurred during a VC process for teachers to learn to notice SMT. Researchers found that teachers developed three different ways of learning to notice SMT: direct, cyclic and incremental. Similarly, Van Es (2011) created a theoretical framework to determine the level of noticing (Baseline, Mixed, Focused, and Extended) of teachers participating in a VC. The researcher also took the role of facilitator by directing various questions so that teachers could notice SMT. In another study, Van Es and Sherin (2010) examined the teacher's noticing skill in five dimensions (actor, topic, stance, specificity, and evidence). In the first dimension, Actor was examined as the person that teachers focused on in video lessons. Under this dimension, Student, Teacher, Self, and Curriculum Developers are defined as categories. In the second dimension, Mathematical Thinking, Pedagogy, Climate and Classroom Management categories were examined under the title of Topic, which is defined as the theme that teachers focus on. Mathematical Thinking refers to mathematical ideas and understandings. Pedagogy includes the techniques and strategies used by the teacher to teach the subject.

Climate refers to the social environment of the classroom and Classroom Management is the provision and maintenance of the learning order, and environment. The third dimension focuses on how teachers analyze their practices or events. In other words, it deals with teachers' approach to analyzing classroom events and whether teachers can conduct an efficient inquiry for teaching-learning purposes, as well as whether they evaluate or interpret the events they observe. Van Es and Sherin (2010) analyzed the Analytical Approach in three categories: Description, Evaluation and Interpretation. In the Description, the teacher again mentions the events that occurred in the classroom. In the Evaluation, teachers make decisions about what is good or bad or what needs to be done differently. In Interpretation, they talk about the reason for the events they observed, try to understand the thoughts, and make inferences. The fourth dimension is the level of detail teachers use to discuss the events they notice. It consists of two categories, General and Specific. General includes events that describe the whole class or that are comprehensive generalizations. An example of this situation is that most of the students are making the same mistake. Specific are those specific to certain events, ideas, individuals, or topics, such as a student's idea or the movement of a particular teacher. Finally, the fifth dimension is the Evidence dimension, in which the source of evidence used by teachers is controlled whether they are based on video lessons they monitor or events other than these video lessons (video-based or non-video-based). In the Van Es and Sherin's study including targeted guidance, it was revealed that VC contributed to the development of teachers' noticing skills. Jacobs et al. (2010) examined how teachers and prospective teachers with different professional experience periods noticed students' mathematical understanding. Researchers coded participants' ability to interpret student understandings and decide how to respond based on student understandings on a 3-point scale reflecting the extent of evidence: strong evidence (2), limited evidence (1), and lack evidence (0). Results, based on participants' written opinions, indicated that noticing can be learned and both teaching experience and professional development support this skill.

Some of the related studies focused on specific mathematical topics. Walkoe (2015) stated that the prospective teachers participating in VC noticed the algebraic thinking of the students and interpreted the events they noticed in a more detailed way. Similarly, Amador and colleagues (2022) investigated teachers' analytical approaches based on proportional reasoning in their study. As a result of the research, it was revealed that teachers used lower-level analytical stances (such as description, evaluation). Ulusoy and Çakıroğlu (2018) investigated how prospective teachers noticed SMT in the video-based learning environment, using selected micro video cases on basic geometric concepts, and analyzed the events they noticed. Researchers found that prospective teachers made deeper analyses by making inferences based on SMT and by suggesting pedagogical strategies. On the other hand Coles (2019) revealed that in the VC, where he focused on the role of the facilitator, teachers initially made more judgmental comments, but as the process progressed, these comments shifted to productive interpretations. The researcher assumed the role of facilitator, enabling the participants to focus on the details of the events in the video. Thus, he argued that there is a significant relation between facilitator moves and teachers' focusing on the details of the events in the video.

Videos selected to be viewed at VC meetings play an essential role in influencing teachers' thinking (Sherin et al., 2009). In most studies in the literature, selected video segments were shown instead of the whole video (e.g., Amador et al. 2023, Jacobs et al., 2010; Sherin & van Es, 2009; van Es & Sherin, 2008, 2010). The use of video segments instead of whole video lesson is desirable for teachers to focus on the evidence in the video and to avoid initial assessment (Coles, 2019). These studies show that teachers improve SMT and noticing skills by analyzing video segments. In contrast, Stockero (2021) used long videos that included the whole class in her study. The decision to not create video segments aimed to preserve the complexity of noticing in the classroom. The researcher suggested that using a more complex classroom context to develop teachers' noticing skills would allow the transfer of noticing skills to classroom practices. Research results provided evidence that learning to notice in the whole-class context shown in the video supports real-time noticing when teaching in a whole-class context. Similarly, Mitchell and Marin (2015) used approximately 20-minute video clips in which students and teachers interacted in their study. In the studies conducted, the time of the videos varies as part of the meetings. In the current study, instead of the video section, the whole video lesson was monitored in

video club meetings. We think that there are interesting mathematical moments that are more likely to occur in a longer video clip, and that it makes it easier for teachers to evaluate these interesting moments as a whole. Thus, teachers can have the opportunity to observe events where different aspects of the same student are at the forefront in whole-class videos. For example, a student who explains the problem-oriented solution strategy, asks questions, discusses with friends, and is prominent in terms of misconception.

As a result, related studies reveal that video clubs support teachers' professional noticing skills by using different theoretical frameworks, focusing on specific mathematical topics, or highlighting the facilitative effects of video clubs. These studies show that teachers focus more on SMT during VC and make productive comments on student thinking. In the current study, experienced teachers' ability to notice SMT will be examined within the scope of the theoretical framework developed by Van Es and Sherin (2010).

METHOD

Research Design

A case study, one of the qualitative research patterns, was used. In the case study, the basic idea is to choose a case or multiple cases and explain how this situation shows the problem (Creswell, 2018). Therefore, the case study deals with a limited number of events and makes an in-depth analysis of the relationships. This study is specific to the type of instrumental case study defined by Stake (2005). Stake describes the instrumental case study as "it is carried out to provide an idea about a topic or to reconsider a generalization, the situation itself is of secondary importance, and it has a supporting role." (p.47). In this study, an instrumental case study was used to reconsider the generalization about video clubs that support teacher noticing skills and to support these skills of teachers. The main purpose of the research is to carry out the implementation of VC aiming to improve the noticing skills of secondary school mathematics teachers with teachers and to monitor the development of teachers in this process.

Participants

This study was carried out with the participation of five secondary mathematics teachers working in a public school in the Eastern Anatolia Region. Criterion sampling, one of the purposeful sampling methods, was used to determine the teachers participating in the study. The criteria for teachers was determined to work at the same school, to have at least five years of teaching experience and to participate in the research voluntarily. Because the study focused on teacher noticing, it was anticipated that teachers with more than five years of teaching experience to be able to identify important classroom interactions, taking professional development into account (Berliner, 1991). The teachers, T1 and T5 had been involved in the process of professional development in previous years. The fact that two teachers in VC participated in the lesson study may support teachers in developing rich discourses in VC discussion meetings. The characteristics of the teachers in the research group are given in Table 1. In accordance with the ethics of the research, pseudonyms were used.

Table 1.
Demographic Information of Participants

Teacher	Teaching experience (years)	Professional development programs attended*
T1	6	Lesson Study
T2	8	Never attended
T3	11	Never attended
T4	6	Never attended
T5	15	Lesson Study

** Apart from the standard trainings organized by the Ministry of National Education, it includes processes aimed at teacher professional development such as lesson study and VC.*

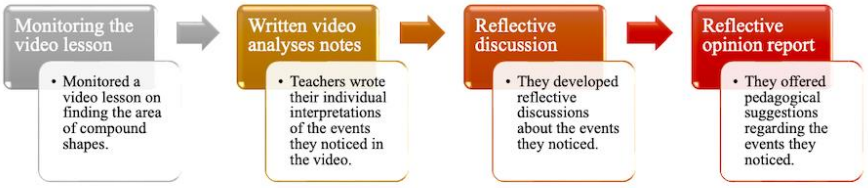
Data Collection

In this study, we examined the development of teachers' noticing SMT through the VC. Therefore, we gave information about the contribution of the study to the professional experience of teachers by meeting the managers of a state school in eastern Türkiye. At the meeting organized, we informed the teachers about the process of the study. After the meeting, five teachers out of eleven math teachers decided to volunteer in the VC.

Teachers participating in the VC met once a week in the school where they worked for a total of 12 weeks. Each teacher shared video clips of their classroom twice during the semester, and they monitored and discussed a video lesson at each meeting. In the first and last meeting, the teachers monitored and commented on the video lesson of a teacher not included in the VC. The purpose of monitoring the same video lesson for teachers in the first and last week is to reveal more clearly what situations teachers started to notice in the VC and how they interpreted these situations. First researcher recorded the math lesson that lasted 40 minutes with the teacher on video before each meeting. She tried to capture the central activities of the lesson and the events some interactions and discourses occurred especially during all class activities. In turn, during students' individual studying, the camera often followed the teacher as she/he moved throughout the classroom. After the recording, the researchers got the teachers to monitor a 30-minute video after cutting out the video segments including the extra-curricular events. In most studies, 5-10-minute videos are shown instead of the whole recorded video lesson. However, in this study, for the integrity of the course and in order not to overlook the different events in the classroom, the teachers took video analyses notes and discussed the events they noticed by monitoring the video lesson. Written video analysis notes consist of two parts. In the first part, teachers wrote about the events they noticed. In the second part, they wrote their comments about these events. Therefore, the VC meetings took about an hour and the meetings were video recorded. After the VC meeting, the teachers wrote reports expressing their reflective opinions on the video lesson they monitored. In the reflective opinion report of the teachers, "What would your respond be in a similar situation if you were the teacher of this class?" were asked to answer the question. In these reports, teachers offered pedagogical suggestions for the events they noticed in the video lesson.

At the first VC meeting, teachers began taking written notes, identifying the events they noticed in a video lesson showing the area of compound shapes. Meanwhile, the researcher, as a facilitator at each VC meeting, firstly made it possible to monitor the video lesson to be analyzed by the group, by summarizing the video lesson at which grade level and on which topic it was. Thus, one researcher took the role of the facilitator, while the other researcher played the role of a non-participant observer. The video lesson was monitored by pausing to make it easier for teachers to focus on SMT. These pauses were determined to include segments that would reflect student interactions and SMT. The facilitator asked them to answer the questions "What have you noticed so far?" or "What did you find interesting?" To continue the discussion, the facilitator asked the questions such as "Are there any other events you have noticed?" According to the teachers' answers, the facilitator asked the questions such as "How could the student think here?", "Why do you think he thought in this way?" to enable teachers to comment in more detail. The purpose of the facilitator at each meeting was to help teachers improve notice and interpret SMT. The steps followed in the first VC meeting are shown in Figure 1. The same steps were followed in subsequent meetings.

Figure 1.
The Steps Followed in the First VC Meeting



The data collection tools of the research are VC meetings, written video analyses notes taken by teachers while monitoring video lessons and reflective reports they wrote after the meetings. The reason for using several data collection tools in the research is both to increase the reliability of the data and to offer a holistic evaluation for the improvement of teacher's noticing.

Data Analyses

The analysis of the data is based on data from a 12-week VC, where teachers come together each week to monitor and discuss video lessons from each other's classes. We used the descriptive analysis technique to analyze the data obtained. While doing the descriptive analysis, we followed these steps: We first created a framework for descriptive analysis. At this stage, we used a framework developed by Van Es and Sherin (2010). The data obtained from the VC meetings, the video analysis written notes of the teachers, and the reflective opinion reports written after the meeting were organized and defined according to this framework. In addition, direct quotations from the answers of the teachers were frequently included. Finally, the findings were interpreted and tried to be correlated.

The coding categories created for this study are summarized in Table 2 by adding the Reflection category that Estapa et al. (2018) addressed in the analytical approach dimension to the theoretical framework that Van Es and Sherin (2010) created for the analysis of VC meetings.

Table 2.
Coding Categories for the Analysis of the Video Clubs

Dimension	Explanation	Category
Actor	Focused person	Student
		Teacher
		Curriculum Developers
		Self
Topic /Theme	Focused Topic	Classroom Management
		Climate
		Mathematical Thinking
		Pedagogy
Stance	Analytical Approach	Description
		Evaluation
		Interpretation
		Reflection
Specificity	Level of Detail	Specific
		General
Evidence	Source of Evidence	Video – based
		Non-Video-based

Every week after the VC meetings, the transcripts of video-recorded discussion meetings were obtained before moving on to the other video lesson. While making the transcripts, the data were carefully read and divided into idea units. What is meant by idea units is a focused situation or change in the topic (Jacobs et al.,1997). For example, at the first week's VC meeting, T1 said, *"The teacher showed how to find the area of the triangle from the area of the rectangle."* This sentence has been evaluated as an idea unit because it shows a case that the teacher focuses on. In the analyzes, it was coded in the "teacher" category in the actor dimension, since the person focused on in the sentence was the teacher, and in the "pedagogy" category in the topic dimension, since the focus was on the teacher's pedagogy. Similarly, the analytical approach was coded under the categories of "describe" in the stance dimension because it is the definition of the teacher's pedagogy, "specific" in the detail level specificity dimension because the area concepts of triangle and rectangle are mentioned, and "video-based" in the evidence dimension because the source of evidence is based on the video viewed. (Coding examples are given in Appendix 1). In accordance with the purpose of our study, while carrying out the analyses to reveal the development of teachers' noticing skills, we coded by evaluating teachers' written notes during VC, videos of discussion meetings and reflective reports. We decided that each idea unit corresponds to

which category under which dimension and how many idea units exist for each category. First of all, we determined idea units that the teachers focused on by examining the written notes while monitoring the video lesson. We encoded these idea units in the suitable category under each dimension in Table 2. Then, we determined the idea units by examining the discourses they developed in the discussion meetings regarding the events they focused on. At this point, we evaluated idea units that differ from those we obtained from written notes. Finally, we determined idea units by examining the reflective reports in which the teachers presented their pedagogical suggestions. If they expressed a different situation in their reflective opinion reports than they expressed in the discussion meetings, we took it into consideration. Thus, we followed the development of teacher's noticing skills with the data (idea units) we obtained from three data collection tools.

First researchers coded all of the VC meetings in this way while the second researcher coded 4 of the meetings. Two researchers analyzed the meetings of the first, fifth, ninth and twelfth weeks out of 12 meetings to show the monthly development of teachers in the process. Since it was not be possible to see this development in a short time, it was envisaged that it would be more appropriate to examine their monthly developments. While calculating the percentage of agreement between the two coders, the reliability formula suggested by Miles and Huberman (1994) was used and the agreement percentage between the researchers was calculated as 92%. The differences in coding between the two researchers were discussed and a consensus was reached. After all idea units were coded, percentages were calculated for each category in the five dimensions. In addition, for validity and reliability, data were directly presented in a descriptive way, data collection tools were diversified, and multiple methods were used in data collection and data analysis. To increase the validity of the data, teachers and researchers interacted for a long time. Moreover, in order to increase the reliability of the study, data analysis was conducted based on a certain theoretical framework.

Ethical Issues

This study was carried out with the decision of the relevant, Social and Human Sciences Ethics Committee Educational Sciences Unit Ethics Committee of the Atatürk University, dated 15.04.2020 and numbered E.2000108810.

RESULTS

When the analysis of the VC meetings were examined, it was revealed that teachers focused on SMT over time and made interpretations based on these thoughts (see Table 3).Throughout the process, there was an increase in the percentages of the teachers' focus on the student in the dimension of actor and on mathematical thinking in the topic dimension. In addition, the analytical approaches to the events they noticed in the video appear to evolve from evaluation to interpretation. These interpretations are mostly about special events and related to the events they monitored in the video recordings.

Teacher Noticing in The First Week of The Video Club

At the first meeting, teachers examined a video lesson on 6th grade (11-12 years) area calculations of a teacher not included in the VC and shared the events they noticed. It is understood that in the video that the teachers monitored in the first week, they focused on the teacher in the actor dimension and the teacher pedagogy in the topic dimension (see Table 3). Analytical approaches to the events that teachers realized were descriptive and evaluative. However, despite being the first meeting, it was noteworthy that most of the events that teachers noticed were video-based.

Table 3.
Teachers' Analytic Focus in the Analysis of Four Selected Video Lessons

Dimension	Category	1st week	5th week	9th week	12th week
Actor	Student	30 (36%)	43 (48%)	70 (70%)	95 (80%)
	Teacher	42 (51%)	30 (34%)	21 (21%)	14 (12%)
	Curriculum developers	2 (2%)	-	2 (2%)	-
	Self	9 (11%)	16 (18%)	7 (7%)	10 (8%)
Topic	Classroom management	6 (7%)	1 (1%)	-	-
	Climate	8 (10%)	8 (9%)	1 (1%)	2 (2%)
	Mathematical thinking	20 (24%)	40 (45%)	70 (70%)	94 (79%)
	Pedagogy	49 (59%)	40 (45%)	29 (29%)	23(19%)
Analytic approach	Describe	31 (37%)	20 (23%)	14 (14%)	17 (14%)
	Evaluate	40 (48%)	37 (41%)	37 (37%)	38 (32%)
	Interpret	12 (15%)	31 (35%)	48 (48%)	59 (50%)
	Reflective	-	1 (1%)	1 (1%)	5 (4%)
Level of detail	Specific	30 (36%)	59 (66%)	81 (81%)	99 (83%)
	General	53 (64%)	30 (34%)	19 (19%)	20 (17%)
Source of evidence	Video-based	66 (79%)	79 (89%)	92 (92%)	109 (92%)
	Non-video-based	17 (21%)	10 (11%)	8 (8%)	10 (8%)
Total idea unit		83	89	100	119

The findings obtained from the written notes of the teachers show that teachers focused primarily on the teacher in the actor dimension and accordingly the pedagogy of the teacher in the topic dimension. In addition, teachers' explanations about the events they noticed were more descriptive and evaluative. In the written notes of T1 and T4, firstly, they paid attention to the quietness of the class and the teacher to guide the students well. In addition, it is understood from the sample dialogues that teachers developed discussions focused on classroom management and pedagogy at the discussion meeting. Like others, T3 focused on the teacher and her explanation was: "The teacher gave instructions to the student to find the [missing] information, rather than giving it directly." She used expressions describing the pedagogy of the teacher with her statement. While monitoring the video, T2 and T5 focused firstly on the method the teacher used and then on the students' misconceptions. In this sense, they talked about the students' misconceptions about the area and shifted their focus on students.

In a situation where there were student interactions, while the teachers were monitoring the video lesson, the facilitator paused the video and asked the teachers, "Did you notice anything here?"

> *T3 First of all, the teacher did not ask "How did we find the area of the square?", "How we would find the area of the triangle?" but directed her students if there was any missing information…*
> *T5 …In other words, firstly she checked if the problem could be solved with this information. Students could solve the question after deciding that there was enough information.*
> *T3 Here the teacher did not teach the area of the rectangle; multiply the length by the width… The student, who does not know the area calculations cannot know if the given information is sufficient or not, right?*
> *T1 Yes, the student also needed to know the properties of the [rectangle]. I describe it as the product of the base length and the height of that base. Isn't it an appropriate approach?*
> *T3 Actually, the area of all of them is base times height.*
> *T2 It is more accurate to say the height of the base. It is better to explain like this, in order to be understandable and to avoid confusion.*

These dialogues reflect the content of the discussion teachers had at the first week's VC. The first thing T3 noticed was the teacher in the actor dimension. Therefore, she focused on the teacher's pedagogy on the topic basis. Although T5 first made statements about teacher pedagogy, she later shifted her focus on students. Meanwhile, T3 was trying to explain to the group what strategy the teacher had exactly developed. Teachers' discussions focused on pedagogy continued in this way. The facilitator asked the teachers whether they noticed anything else.

T4 Classroom management of the teacher is very good. She knows how to guide her students. But it takes a long time to solve the problem in this way. I wouldn't solve it that way.
T2 She will not always solve it like that. She will solve the first few examples.
T3 If we were to remind the area of this one that one, we could not finish the topics. We can't do that with every question…

In the continuation of the dialogues, T4 first focused on the classroom management of the teacher. She drew attention to the pedagogy of the teacher, emphasizing that it took time to solve the problem in this way. While T2 was making statements about the teacher's pedagogy, T3 shared her opinions by focusing on the curriculum. Therefore, we see that they discussed several topics that focused on pedagogy, especially in relation to classroom management and their own experiences. The actor they paid attention to was mostly teachers and themselves. Their approach to events was more descriptive and evaluative. They also talked about both general and specific events. In addition to sharing their own experiences, they mostly presented evidence based on the events they saw in the video. Therefore, it can be said that at the discussion meeting, based on the written notes of the teachers, they mostly developed discussions focused on the teacher's pedagogy.

After the VC meeting held in the first week, the teachers wrote a reflective opinion report stating their individual suggestions for the video lesson. When the reflective opinion reports of the teachers were examined, it was seen that they usually offered specific suggestions regarding the pedagogy of the teacher. For example, T1 argued in the reflective opinion report that *"…in some cases students should be given the opportunity to find their own mistakes"*. On the other hand, T2 and T4 expressed their suggestions that the confusion about the concept should be resolved immediately because it is an obstacle to learning. Unlike the other teachers, T5 mentioned the strategy she would use. In this respect, T5 focused on the mathematical thinking of the student and associated it with her own teaching strategy.

Teacher Noticing in The Fifth Week of The Video Club

In the fifth week, it is understood that the focus of teachers is a student in the actor dimension (see Table 3). In this sense, it is possible to say that in the fifth week, the focus of the teachers in the actor dimension shifted to the student. Accordingly, the focus on the actor dimension was mathematical thinking besides pedagogy. The teachers' explanations were more specific and related to the events they saw in the video. The group monitored a video lesson belonging to T5's class. The lesson subject was arithmetic average calculations in the 6^{th} grades (11-12 years). T5 brought unit cubes to her class and asked the students to solve the arithmetic mean questions using the cubes. Students calculated the arithmetic mean both by cubes and by doing calculations. Teachers took their written notes about the events they noticed while monitoring the video.

According to the findings obtained from analyses of the written notes of the teachers monitoring the video lesson in the fifth week; while T1, T3 and T4 initially focused on the pedagogy of the teacher, T2 paid attention to the classroom climate and T5 the SMT. In addition, the teachers started to make evaluative and interpretive explanations rather than descriptive, about the events they noticed. Regarding this, T4 made an evaluation regarding the pedagogy of the teacher by stating the opinion that *"it is a very good idea for the teacher to use unit cubes while teaching the subject."* Focusing on the same situation as T2, T5 explained the reasoning strategy of the student for the arithmetic mean question.

Sample dialogues from the teachers' VC meetings were presented in the fifth week. The facilitator paused the video in a situation involving student interactions and asked "Were there any events that interested you?"

T4 This is what I like most here. The teacher includes the students in the question…
T2 Students liked using materials. Attendance to the lesson increased, and there were students who wanted to solve the question even using cubes.
T3 It is a good idea for the teacher to show the average in both ways.

T2 At first, they did not have difficulty calculating with cubes. However, while trying to find the fifth in the last question, the students had a hard time.

These dialogues represent the types of discussion that teachers had at the fifth week of VC. The first thing that T4 noticed was that the teacher enlivened the students by including them in the problem. Here, T4 first focused on the pedagogy of the teacher. T2 mentioned that students' use of materials increased their attendance in the lesson. Therefore, the focus was on climate along with teacher pedagogy. Focusing on the pedagogy of the teacher, T3 took an evaluative analytical approach, stating that it was a good way to show the average computation in both ways. T2 then shifted the focus on the students and noticed a mistake made by all the students. In order to elaborate on this situation that the teacher noticed, the facilitator led the discussion with the question "How did you notice this situation?"

T2 What the student did here… Without adding the arithmetic mean, she collected four data and divided it by 4 to calculate the arithmetic mean again.
T5 Why did she do it so?
T4 Because she couldn't find the sum of the data here, she added up to 4 of them. Then she couldn't decide what to do with 5.
T1 It may be because the student considered she did not know how to process given data with all the data given.
Facilitator Well! What kind of strategy would you use?
T3 Since the cubes were in different colors, it was difficult for the student to notice the cubes that she later added. If I were, I would use one color cube and if the added cubes were in different colors, it would be easier for them to find on the 5th day. (Figure 2)

Figure 2.
A Situation that T3 Noticed While Watching the Video Lesson

In the ongoing discussion environment, T2, T3, and T5 talked about the student's mistake in trying to use blocks to find the mean. This moment can be considered critical in the VC, since then teachers started talking more about the student's mathematical ideas rather than the teacher and pedagogical actions. As can be understood from the dialogues, the teachers discussed a series of topics that focused on pedagogy and mathematical thinking in relation to both the teacher and the students at the VC. Their approach to the events was more evaluative and the specific events they saw in the video were in the foreground.

On the other hand, when we examine the reflective reports of the teachers for the fifth week, we see that they offered suggestions related to the pedagogy of the teacher as well as their own strategies and the mathematical thinking of the student. Focusing on the same student, T1, T4, and T5 mentioned that the student could not solve the question because she did not understand the question and offered alternative pedagogical suggestions. T5 stated that she had just noticed this situation while monitoring her own video lesson. As a reason why the student did not understand the problem, she stated that the problem was not using a symbol indicating that the fifth day was unknown. In addition, T4 paid attention to the

answer of the teacher in the video, "You don't have to, you can add in any order you want". The student asked the teacher, "Why did we change their order?", "Shouldn't we pay attention to the order of the days when taking the total?" T4, who drew attention to the teacher's answer, argued that it would be more correct to emphasize that the addition process has a commutative feature, rather than the answer that you can add in any order.

Teacher Noticing in The Ninth Week of The Video Club

VC meetings held after the fifth week began to be quite different from the previous meetings. In particular, T5 played a facilitating role for teachers to focus on SMT at each discussion meeting. Moreover, in some cases, she asked questions to the teachers before the facilitator, and sometimes she directed the discussions by highlighting the student's ideas. As a result, teachers began to understand and interpret students' mathematical thinking based on the events in the video. They continued similarly in the following weeks. They especially sought to understand and interpret their mathematical thinking, focusing on specific students. They also used details from video lessons to interpret how students thought.

At the meeting held in the ninth week, the group monitored and evaluated a video lesson belonging to T3's class. The subject was special quadrilaterals and their properties in 5th grade. T3 started the lesson with a question to make students realize the relationship between them using the properties of special quadrilaterals. She asked the students to find which of the shapes in Figure 3 are parallelograms. When the teachers' written notes about the video lesson they monitored in the ninth week are analyzed, it is seen that the teachers focused on the mathematical thinking of certain students rather than the general class. They also wrote interpretative explanations using the details in the video lessons about these events. For example, T1 first focused on all of the students, but later focused on specific students and tried to interpret student thinking about quadrilaterals. T4 explained how the student decided whether a shape was parallel or not with her statement *"The student took the extension of the lines and said that it was parallelogram when he saw that they did not intersect"*. Regarding this, T3 made interpretative explanations by realizing that the student perceived the non-standard drawings of figures as a different shape when they saw them. Focusing on another student, T5 stated that it was a practical way for the student to show that the remaining shapes we parallelogram after determining the non-parallelogram shapes. In the continuation of her explanations, she mentioned *"the student's use of such a practical way shows that he can relate between the quadrilaterals."*

While the teachers monitored T3's video lesson in the ninth week, the facilitator did not intervene. The teachers asked the facilitator to pause the video to discuss the events they noticed. First, T3 asked the facilitator to stop the video and turning to her, she asked her colleagues *"When I said parallelogram, the student could not show the shape but when I asked which ones were parallel, he answered. Did you notice?"* The teachers started to comment by focusing on this detail.

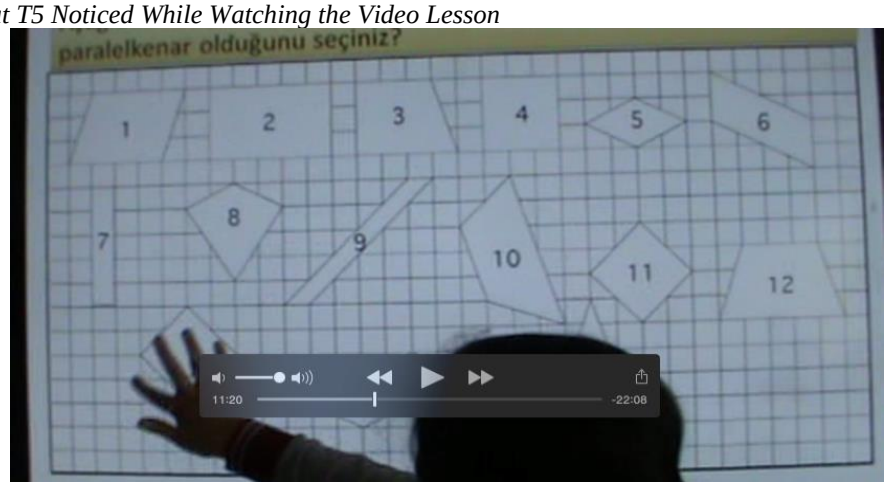
> *T1 Yes, the student answered, thinking that the parallelogram and the parallel are the same. He sought parallelism rather than a parallelogram. In fact, it makes sense when you think…*
> *T5 …with the same logic, he found non-parallel ones more easily.*
> *T4 Almost all students could see that the trapezoids were not parallelograms. One student said that the trapezoid was a parallelogram. She thought it would be enough just to have a pair of edges parallel.*

As can be seen from the dialogues, with the guidance of T3, the group focused on the mathematical thinking of the student. While determining the parallelogram shapes, the student responded only by considering parallelism. The teachers tried to understand and interpret this thinking of the student. Then the teachers continued to monitor the video lesson. While monitoring the video, T1 said, *"I thought she would do more. She would exclude the rectangle and square, and say only parallelogram to parallelogram. But she didn't do that."* and drew the attention of the group to this point.

T3 She didn't make that mistake because she decided to see if the opposite sides were parallel.
T5 Yes. It is actually the usual... Oddly enough, but the student said the rotated rectangle is a parallelogram. He couldn't decide on square and rhombus. He thought of that shape as a different shape as we rotated it.
T2 It is because the child always saw the rectangle horizontal. In other words, the standard drawing of the shapes caused the child to think about it. Besides these drawings, he must see the different events.
T5 How?
T4 Not just drawing on paper. He must understand that its properties will not change when the shape is rotated. It's best to use programs, geometry software programs.

These dialogues reflect the content of the teachers' discussions without the guidance of the facilitator. In the early weeks, while facilitators directed the discussions with their questions, later on, teachers sometimes asked the facilitator to stop the video to explain the events they noticed, and sometimes they started talking while the video was going on. When T1 started to explain the situation, she noticed while monitoring the video, the facilitator stopped the video. In the video lesson she monitored, she was surprised that the student thought the square and rectangle as parallelograms. She stated that the common mistake was not to think of these shapes as parallelograms. As can be seen from the dialogues, the teachers continued their discussions at the VC, focusing on the mathematical thinking of the student. They took an interpretive approach, using the details in the video lesson on events.

Figure 3.
A Situation that T5 Noticed While Watching the Video Lesson



The special suggestions made by the teachers in their reflective reports of the ninth week are in line with what they expressed in the discussion meeting. Teachers suggested using geometry software programs in both the discussion meeting and reflective reports so that students could grasp the properties of geometric shapes. This situation can be considered as an indicator that the student established a relation between mathematical thinking and teachers' classroom practices. Regarding this, T5 stated her opinion by using the expression “Dynamic software programs should be used while these kinds of subjects are being taught, the students should be able to rotate the shape as they like, change the angles, and see the different shapes”. T4 emphasized that students must first receive training to use geometry software. On the other hand, T3 stated that it was necessary to show non-standard drawings in order to understand these concepts especially in the 5th grades (10-11 years) and the properties of the rectangles were understood, and it would be more appropriate to teach the relations between the special rectangles.

Teacher Noticing in The Twelfth Week of The Video Club

At the meeting held in the twelfth week, the teachers monitored and evaluated the video they monitored in the first week. The reason for choosing the same video was to reveal the development of teachers more clearly. Also, what would the teachers differentiate from the first meeting and how would they

comment on these events? We are trying to find an answer to this question. The group monitored a video lesson on the area calculations of a teacher not included in the VC and shared the events they noticed.

When we examine the written notes of teachers about the video lesson, we see that they wrote comprehensive explanations about the events they noticed. T3 tried to explain how the student thought with the words "The student making generalization thought that the parallelogram area formula could also be used for the area of all quadrilaterals, and when calculating the area of the trapezoid, he multiplied the length of the floor by height." Focusing on the same point as T2, T3 also mentioned the student's generalization of the area formula with a similar explanation. Therefore, T2 and T3 made explanatory comments about the events they noticed and detailed the events by providing evidence from their observations. T1 focused on another student who wanted to solve the same question using the way of completing the rectangle. Then she evaluated the mathematical thinking of the student to solve the problem and paid attention to the relation between the path he followed and the teaching strategy of the teacher. T5, on the other hand, realized that a student who was on the blackboard never wrote mathematical notations and that another student could not write them correctly, and that this was a result of using test techniques more in lessons. Therefore, by generalizing this situation, she pointed out that most students could not use mathematical notations correctly.

While the teachers were monitoring the video, T5 asked the facilitator to pause the video and returned to her friends and said "…to find the area of the trapezoid, the student multiplied the base length and the height, thinking like a parallelogram." The teachers started to make their explanations by focusing on this detail.

T3 Here he added trapezoid into these parallelograms. Since the trapezoid was rectangular, he considered the area to be the base times the height.
T4 The student multiplied the base by the height in the triangle, but he ought to have divided. The boy went to a direct inference there and always multiplied the height by one base.
T1 Because it was a trapezoid square, she thought, if I multiply the base and height, I will find its area.

These dialogues represent the types of discussion teachers had last week. T5 focused on the student's error in calculating the area of the trapezoid, and had other teachers focus on the student's error. It can be said that these and similar moments previously experienced increased the facilitating effect of discussion meetings. Thus, the teachers realized the mistake made by the student and tried to understand and interpret how the student thought. However, in the discussion held in the first week, only T5, one of the teachers, noticed this mistake of the student and said "…the student had difficulty calculating the area". However, the teachers did not focus on this situation and did not have any discussion about it. In the continuation of the video, teachers noticed an event they noticed in the first meeting in the last meeting. However, their comments on this event were quite different from the last meeting. The teacher in the video class asked her students to use a different way to control the solution of the problem. One of the students, expressed his opinion by asking for a voice and the teachers developed a discussion about the SMT.

T4 He combined triangles. The child combined the bases from 4 cm to 6 cm and said "I multiply because the heights are the same"
T2 No…he wanted to make a rectangle by rotating it.
T4 Let's watch again.
T2 Aaa!... yes. But he couldn't express exactly what he was thinking, which I understood differently.
T4 He explained differently on the board. As his classmates reacted, he thought he made a mistake.
T5 When I first listened, I thought so. When the student said we would combine two triangles, I thought he wanted to make it a rectangle because he thought the triangles were the same without looking at the base length....

> *T1 He didn't really say we'd make the rectangle. When he said we would carry the shape there, the other students objected. The student thought that he was wrong because he could not express his opinion. However, it was a good and different idea.*

One of the students thought of combining the triangles because the height of the two triangles was the same. However, in the first meeting, teachers understood it as making rectangles by moving not combining them. In other words, none of the teachers could understand the student's way of thinking correctly in the first meeting. When the other students in the classroom intervened, the student could not express himself sufficiently considering what he was doing wrong. In the last meeting, firstly, the T4 noticed this situation and stated that the student was thinking of combining the triangles here, not moving them. She attracted the attention of other teachers in the group to this point. After the teachers monitored the same moment again, they agreed with T4. Therefore, at the last meeting, the teachers realized that the student had developed a different strategy for the solution to the problem. Regarding this, T5 stated that they did not guess that the student could think in this way. As can be seen from the sample dialogues, the teachers monitored every part of the video lesson more carefully at the meeting held last week and adopted an interpretive analytical approach, using details from the video regarding the events they noticed.

The reflective reports of the teachers for the twelfth week include different suggestions as well as the pedagogical suggestions made by the teachers at the discussion meeting. By detailing their comments, the teachers established a relation between the SMT and the pedagogical strategies of the teacher, and accordingly offered alternative solutions for a situation they noticed in the discussion meeting. In this direction with her proposal “Actually, I thought the student was wrong because I thought he couldn’t think of combining the triangles. If the teacher had not provided guidance, and asked the student to explain by drawing, he could have shown what he wanted to explain exactly.” T5 proposed an alternative solution by establishing a relation between the SMT and the pedagogy of the teacher. T1, T2, and T4 talked about the teacher's not giving the student an opportunity and related the way of thinking of the student with the teacher's pedagogy. Unlike the other teachers, T3 suggested a different solution with her proposal “problem-solving steps force the student more when solving geometry questions. I think different methods should be used for geometry questions instead of this method.” Therefore, the reflective opinion reports enabled the teachers to present the solution suggestions that they did not express in the discussion meeting.

DISCUSSION

Since we analyzed the events that teachers noticed in multiple dimensions, it was essential to reveal when and how teachers switched to each dimension. For this purpose, when we examine the development of teachers noticing skills according to the dimensions determined from the beginning to the end of the process, the percentage of teachers' focus on the student in the dimension of actor increased while the percentage of their focus on the teacher decreased (see Table 3). In fact, it is expected that teachers will focus on different actors in the first weeks. At this point, the facilitator tried to shift the focus of the teachers to the student in the actor dimension by asking targeted questions to the teachers. Therefore, it can be said that facilitator guidance is at the forefront from the first to the fifth week. In the first weeks, teachers who participated in the VC discussed a number of topics focusing on pedagogy, especially in relation to classroom management and their own experiences. Their approach to events was more descriptive and evaluative. In addition, the level of detail they used to discuss the events they noticed included events with extensive generalizations. It is not enough for teachers to make only descriptive explanations to show that their noticing is significant. In addition, teachers need to interpret and make sense of the events they notice in the classroom (Van Es, 2011).

Especially after the fifth week, we see that the difference between teachers' focus on students and teachers is high. Accordingly, until the fifth week, both pedagogy and mathematical thinking were the

focus of teachers in the topic dimension, while the percentage of focusing on mathematical thinking gradually increased after the fifth week. As a result, we can say that the change in the actor dimension is related to the change in the topic dimension, and the change in the topic dimension also affects the analytical approaches adopted by teachers. Therefore, this analysis also indicates that the transitions between dimensions noticed by teachers may be related. This transition between dimensions may occur due to the nature of the framework or may be related to the facilitator drawing attention to certain dimensions during VC meetings. As the process progressed, the focus of the teachers was on specific students instead of the overall classroom. Teachers tried to understand and interpret these SMT. They also adopted an interpretive analytical approach, using the details of the events in the video lesson to explain SMT. Therefore, their approach to events began to be interpretive rather than evaluative.

It is seen that starting from the eighth week, teachers adopt an interpretive analytical approach and develop alternative pedagogical suggestions by elaborating their comments (see Table 3). There were even cases where the analytical approaches to events were at the level of reflection. For example, at the meeting held in the twelfth week, with her words "there are such questions in the new type of questions in national exams questions, it is necessary to check whether they are missing or too much.... My students got used to doing this because I was looking at whether the data given were enough while reading the question...." T1 made explanations at the reflection level by stating that her students used the method she used internally and thus understood the questions more easily. As a matter of fact, since these situations occurred very rarely, there was only a small increase in the percentages showing teachers' reflective approaches. In fact, this finding was not surprising. Considering that the reflection is the internalization of the noticed events and their transfer to applications (Estapa et al., 2018), we think that it will take a long time to occur. On the other hand, it was noteworthy that the events that teachers noticed were more video-based since the beginning of the process. Although the teachers talked about their classroom experiences in the first meetings, they mainly talked about the events in the video. On the contrary, in some studies in the literature, at the beginning of the process, it was seen that teachers mostly developed discussions about non-video-based events (e.g., Van Es & Sherin, 2010). This may be because the facilitator asks questions based on the events in the video and directs teachers to these points.

In order to determine the individual video analysis of the teachers, we evaluated the written notes they took while monitoring the video lesson. In the discussion meetings, the primary focus of the teachers was the events that each teacher first stated in their written notes. For example, in her written notes T3 mentioned that the teacher did not give students information directly, that she provided the student with access to the information, and made statements that focused on the teacher's pedagogy in the discussion meeting. In this sense, every teacher tried to develop the discussions by bringing the written notes they took while monitoring the video lesson to the fore at the discussion meeting. However, in the ongoing process, the teachers overcame this situation and started to understand and interpret each other's ideas. Accordingly, the short sentences that teachers set up in their written opinions to describe the events in the first weeks left their place to interpretive and comprehensive sentences reflecting their own perspectives over time.

After the discussion meetings, the reflective reports we used to elaborate on the comments of the teachers played an essential role in developing alternative solutions for the events that teachers noticed. Reflective reports of the teachers for the first week generally included specific suggestions for the pedagogy of the teacher. This was because that the teachers continued the discussions about the pedagogy of the teacher more in the discussion meeting. In the fifth week, since the teachers focused on the student, they started to offer suggestions that related the SMT with their own strategies. Indeed, in both discussion meetings and reflective reports, they proposed alternative pedagogical suggestions based on students' comments on mathematical thinking. In this sense, the special suggestions given by teachers in their reflective reports are in line with what they expressed in the discussion meeting. However, it was observed that the teachers stated some pedagogical suggestions that they did not express in the last week's discussion meeting in their reflective reports. Similarly, the study of Ulusoy and Çakıroğlu (2021) with prospective teachers show that prospective teachers gained different perspectives

and alternative pedagogical ways of student mathematical understanding in micro-case video group discussions.

This study supports other research findings showing that VCs improve experienced teachers' noticing of and interpretation of SMT. That the first and last video lessons were the same in our study was important in terms of how teachers interpreted the events they noticed. Student ideas, which were not noticed by teachers in the first video lesson, became the events that teachers discussed and focused on the last video lesson. From this point of opinion, we can say teachers can pay attention to students' mathematical thinking and interpret them from a mathematical point of opinion with the reasoning strategies developed in the VC. In this direction, Stürmer et al. (2013) stated that VCs are more effective than "traditional" professional development courses and increase teachers' capacity to interpret events in the video more effectively. The findings of our study also show that the teachers who participated in the VC started to notice specific class interactions over time, make sense of the events they noticed, interpret what the events were based in the background, and offer special suggestions. It is possible to see this development both in VC meetings, written notes, and reflective reports. Observing progress in all three contexts supports our idea that VCs improve teachers' noticing SMT. It is possible to see similar results in other studies on the subject in the literature (Coles, 2019; Jacobs et al., 2010; Sherin & van Es, 2009; van Es & Sherin, 2008).

There is no single way to change teachers' thoughts or practical practices (Goldsmith & Schifter, 1997). We had previously examined how the lesson study professional development model supported teachers' level of noticing (Özdemir Baki & Işık, 2018). As a result of the study, we determined that teachers' noticing levels were higher in the course process. In this study, it was important to see how the two teachers (T1 and T5) who participated in the lesson study professional development process would lead the other teachers. Our idea was that these two teachers should focus on the student and the other teachers should shift their focus in this direction. In this way, we predicted that the facilitative effect of discussion meetings would be increased by allowing other teachers to think more about SMT. However, this did not happen exactly as we expected. Since the focus of the teachers in the first meeting was the teacher and themselves, they continued the discussions in this direction. Although T5 focused on the teacher in the first meeting, she later shifted her focus on the student, but she was unable to attract the attention of other teachers in this direction. In addition, it was observed that T5 played a facilitating role in teachers' focusing on the student and detailing their opinion on mathematical thinking. Since T1 talked more about her pedagogy at the beginning, her statements were in line with this. Later, she made comments, focusing on the mathematical thinking of certain students. However, we cannot say that she played a facilitating role like T5. The fact that T5 was more motivated to the VC was effective in her taking her role in the group.

CONCLUSIONS AND IMPLICATIONS

This study shows the improvement of professional teacher noticing in a VC where five math teachers working in the same school monitored and discussed videos of each other on different topics at different grade levels. Our study shows that VCs develop the experienced teachers' skills to notice SMT. This development was determined by examining three interrelated contexts. These are VC meetings, written opinions, and reflective reports of teachers. The findings in these three contexts support that teacher make logical connections between learning and teaching about some SMT in VCs and develop their suggestions in this direction. Therefore, these results are compatible with the literature in terms of VCs being an efficient environment for the improvement of professional noticing and interpretation of SMT (Dyer & Sherin, 2016; Jacobs et al., 2010; Sherin & van Es, 2009).

The results of this comprehensive study will lead to future research on the applicability of VCs in schools. In this special VC, video lessons of different grade levels were monitored instead of the video segments. Teachers' analysis of the video lesson provided the opportunity to follow more closely the

student thinking they focused on. However, the inclusion of two teachers in the VC who participated in the lesson study was supportive of the other teachers in developing rich discourses. Therefore, we can say that these factors increase the facilitating effects of the VC. In future studies, a VC formed by teachers participating in different professional experience programs could be designed. In addition, it is essential to conduct the study with experienced teachers in order to offer different pedagogical suggestions by establishing a relation between the SMT and the pedagogy of the teacher. In this sense, the content of VC meetings, where experienced and inexperienced teachers come together in future studies, can be analyzed. Although we revealed in our study that VC is an effective way to support the development of teacher noticing skills, we should consider that this study was limited to five teachers and lasted twelve weeks. In addition, the results of our study raise some questions. First, how do the longer process and the greater number of participants affect VC? Second, would VC be useful to help teachers teaching mathematical concepts? Finally, do teachers continue to understand and interpret SMT in classroom interactions after VC? How can VCs continue in such a way that teachers can make the desired effects on their professional development practices? Further work could be done in line with these recommendations, using more creative VC to explore teachers who recognize student thinking on certain mathematical topics with real classroom videos.

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APPENDICES

Appendix 1: Examples of Coding Idea Units Based on Teachers' Analytical Focus

Examples of Idea Units	Teachers' Analytic Focus				
	Actor	Topic	Stance	Specificity	Evidence
The teacher checked the students' prior knowledge about the subject. It reminded me of the properties of the rectangle and the square. I think this is important. Preliminary information needs to be reminded in every lesson because when students' prior knowledge is not sufficient, it is difficult to reach the desired goal.	Teacher	Pedagogy	Interpret	Specific	Video-based
Meanwhile, another student said to add the bases below and multiply by the height since the height is the same. It was a very different thought indeed. It was nice of the student to think about that.	Student	Mathematical thinking	Evaluate	Specific	Video-based
Student participation was good. It was an enjoyable lesson.	Student	Climate	Evaluate	General	Video-based
The teacher asked the students to solve the problem in a different way at the stage of checking the solution.	Teacher	Pedagogy	Describe	Specific	Video-based
I explain that squares and rhombus are not the same by drawing them in their notebooks. Although they saw that we could make decisions based on their angles, I knew they would make the same mistake again. These concepts should be constantly reminded. You have to draw it, you have to show it using materials, it doesn't happen otherwise.	Self	Pedagogy	Interpret	Specific	Non-video based
One of the students did not understand the solution when the numbers were changed and asked how they were moved. I think the student thinks that the numbers can be added in order. Such an erroneous thought may have occurred while calculating the arithmetic mean.	Student	Mathematical thinking	Interpret	Specific	Video-based
The teacher handled the relaxed behavior of the students quite well.	Teacher	Classroom management	Evaluate	General	Video-based
Curriculum density hinders activity and discovery learning.	Curriculum developers	Pedagogy	Interpret	General	Non-video based
There are such questions in the rising generation questions, it is necessary to check whether there are missing or excess data. My students got used to doing this, too, as I was checking to see if what was given was enough while reading the question.	Teacher	Pedagogy	Reflective	Specific	Non-video based

TÜRKÇE GENİŞLETİLMİŞ ÖZET

Öğretmenin öğrenci düşünmelerini fark etmesi, öğretim uzmanlığının ve öğrenci merkezli öğretimin temelini oluşturan önemli bir bileşenidir (Sherin vd., 2011). Deneyimli öğretmenler, sınıf içindeki anlamlı durumları öğretmen adaylarına göre daha iyi fark etseler de (Jacobs vd., 2010), öğrencinin matematiksel düşünmesini anlama ve yorumlama bağlamında bu becerilerini geliştirme ihtiyacı duyarlar. Bu açıdan bakıldığında, öğretmenin fark etmeyi öğrenmesi, dikkatini sınıf içi etkileşimlerin belirli özelliklerine yönlendirecek ve öğretim çalışmalarının nasıl nitelendirileceği konusunda rehberlik etmeye yardımcı olacak öğrenme araçları ile mümkündür (Sherin & van Es, 2009). Bir öğrenme aracı olarak video, öğretmen/öğretmen adaylarının neyi ve nasıl fark ettiklerini belirlemeye yönelik birçok araştırmaya öncülük etmiştir.

Mevcut çalışma, bir grup öğretmenin birbirlerinin sınıf videolarını izlemek ve analiz etmek için tartışmalar geliştirdikleri bir video kulübü bağlamında gerçekleştirilmiştir. Video kulüpler, öğretmenlerin kendi ve meslektaşlarının sınıflarından videolar izledikleri ve tartıştıkları mesleki gelişim süreçleridir. İlgili araştırmalar, video kulüplerin öğretmen/öğretmen adaylarının önemli sınıf etkileşimlerini fark etmeyi öğrenmelerine yardımcı olduğunu (van Es & Sherin, 2008) ve yorumlama becerilerinin gelişimini desteklediğini ortaya koymaktadır (Barnhart & van Es, 2020; Girit Yıldız vd., 2023). Buna karşılık araştırmalar, öğretmenlerin sadece sınıf videolarını izleyerek ve üzerinde düşünerek bu becerilerini geliştiremediklerine işaret etmektedir. Bu durum, video kulüp tasarımlarının kolaylaştırıcı faktörlerinin ön plana çıkmasını sağlamıştır. Bu yönde, öğretmenin fark etmesini desteklemek için kolaylaştırıcı liderliğindeki katılımcı merkezli tartışmalara (Barnhart & van Es, 2020) ve videoların seçimine (Amador vd., 2020; Walkoe vd., 2020) odaklanan araştırmalar yapılmıştır. Önceki araştırmalar, video kulüplerin öğretmenlerin fark etmelerini desteklediğini ortaya koysa da mevcut çalışma kolaylaştırıcı faktörlerin dikkate alındığı bir video kulüp tasarımıyla dikkat çekmektedir. Çoğu araştırmanın aksine, öğretmenlere video kulüp tartışma toplantılarında video bölümü yerine bir video dersinin tamamı izletilmiştir. Video bölümü yerine bir video dersinde meydana gelme şansı daha fazla olan ilginç matematiksel anların olması, öğretmenlerin fark etme becerilerinin gelişimi için kolaylaştırıcı bir faktör olabilir. Bununla birlikte video kulübüne dahil olan iki öğretmenin daha önceki yıllarda mesleki gelişim modellerinden biri olan ders imecesine katılmış olmaları, öğretmenlerin video kulüp tartışma toplantılarında zengin söylemler geliştirmelerine öncülük edebilir. Bu durum öğrencilerin matematiksel fikirleri hakkında diğer öğretmenlerin daha fazla düşünmelerini sağlayarak tartışma toplantılarının kolaylaştırıcı etkilerini artırabilir.

Bu bakış açısıyla, öğretmenlerin fark etme becerilerini geliştirmeyi hedefleyen bir video kulübüne katılan ortaokul matematik öğretmenlerinin, fark etme becerilerinde meydana gelen gelişimi izlemek bu çalışmanın esas amacıdır. Bu amaçla çalışma nitel araştırma desenlerinden durum çalışmasına uygun olarak tasarlanmıştır. Araştırmanın katılımcılarını Doğu Anadolu Bölgesi'nde bulunan bir devlet ortaokulunda görev yapan beş matematik öğretmeni oluşturmaktadır. Araştırmanın veri toplama araçlarını, video kulüp toplantıları, öğretmenlerin video derslerini izlerken almış oldukları video analizi yazılı notları ve toplantı sonrasında yazdıkları yansıtıcı raporlar oluşturmaktadır. Verilerin analizi, öğretmenlerin birbirlerinin sınıflarından video derslerini izlemek ve tartışmak amacıyla her hafta bir araya geldikleri 12 hafta süren video kulüplerden elde edilen verilere dayanmaktadır. Verilerin analizinde betimsel analiz tekniğini kullanılmıştır. Betimsel analizi yaparken şu aşamalar takip edilmiştir: İlk olarak betimsel analiz için bir çerçeve oluşturulmuştur. Bu aşamada van Es ve Sherin (2010) tarafından geliştirilmiş olan bir teorik çerçeveden faydalanılmıştır. Daha sonra veriler, bu teorik çerçeve kapsamında düzenlenerek tanımlanmıştır. Ayrıca öğretmenlerin yanıtlarından doğrudan alıntılara sıklıkla yer verilmiştir. Son olarak bulgular yorumlanarak ilişkilendirilmeye çalışılmıştır.

Çalışmada öğretmenlerin birden fazla boyutta fark ettikleri durumlar analiz edildiği için, öğretmenlerin her bir boyuta ne zaman ve nasıl geçiş yaptıklarının ortaya konulması önemlidir. Bu amaçla öğretmenlerin belirlenen boyutlara göre fark etme becerilerinde meydana gelen gelişim incelendiğinde, sürecin başından sonuna kadar, öğretmenlerin özne boyutunda öğrenciye odaklanma yüzdeleri artış

gösterirken, öğretmene odaklanma yüzdelerinde ise düşüşler olduğu anlaşılmaktadır (bkz. Tablo 3). Özellikle beşinci haftadan sonra öğretmenlerin öğrenci ve öğretmene odaklanmaları arasındaki farkın fazla olduğu görülmektedir. Buna bağlı olarak beşinci haftaya kadar öğretmenlerin konu boyutunda odak noktası hem pedagoji hem de matematiksel düşünme olmuştur. Beşinci haftadan sonra matematiksel düşünmeye odaklanma yüzdeleri sürekli artış göstermiştir. Sonuç olarak, özne boyutundaki değişimin konu boyutundaki değişimle bağlantılı olduğunu ve konu boyutundaki değişimin aynı zamanda öğretmenlerin benimsedikleri analitik yaklaşımları da etkilediğini söylenebilir. Yani, bu analiz aynı zamanda öğretmenlerin fark ettikleri boyutlar arasındaki geçişlerin bağlantılı olabileceğine işaret etmektedir. Değerlendirilen boyutlardaki değişim, aynı zamanda video kulüp toplantıları sırasındaki kolaylaştırıcının belirli boyutlarda odaklanmasının bir sonucu olabilir. Süreç başında öğretmenlerin fark ettikleri durumlara yönelik açıklamaları daha çok tanımlayıcı ve değerlendirici nitelikte iken sekizinci haftadan itibaren yorumlayıcı bir analitik yaklaşım benimsediklerini ve yorumlarını detaylandırarak alternatif pedagojik öneriler sundukları görülmektedir. Nitekim öğretmenlerin yansıtma yaklaşımlarını gösteren yüzdelerde süreç boyunca çok az bir artış olmuştur. Açıkçası bu bulgu çok şaşırtıcı değildir. Yansıtmanın, fark edilen durumların içselleştirilmesi ve uygulamalara aktarılması (Estapa vd., 2018) olduğu düşünülürse, bunun gerçekleşmesinin zaman alacağı öngörülmektedir.

Sonuç olarak, elde edilen bulgular video kulüplerin deneyimli öğretmenlerin öğrenci matematiksel düşünmesine dayalı fark etme becerilerini geliştirdiğini göstermektedir. Bu gelişim birbiriyle ilişkili üç bağlamda ele alınarak belirlenmiştir. Bunlar; video kulüp tartışma toplantıları, öğretmenlerin yazılı görüşleri ve yansıtıcı raporlarıdır. Bu üç bağlamda da elde edilen bulgular, öğretmenlerin video kulüplerde belirli öğrencilerin matematiksel düşünmelerine ilişkin öğrenme ve öğretme arasında mantıksal bağlantılar kurduklarını ve bu yönde önerilerini geliştirdiklerini desteklemektedir. Dolayısıyla bu sonuçlar, video kulüplerin öğretmenlerin öğrenci düşünmesini fark etme ve yorumlamalarının gelişimi için verimli bir ortam olması açısından alan yazınla uyumludur. Bu kapsamlı çalışmanın sonuçları, video kulüp mesleki gelişim süreçlerinin okullarda uygulanabilirliğine yönelik gelecekte yapılacak araştırmalara öncülük edecektir.