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| Research Article / Araştırma Makalesi |

An Action Research on the Utilization of Formative Assessment Components in Online Environments in Science Education

Fen Bilimleri Öğretiminde Çevrimiçi Ortamlarda Biçimlendirici Değerlendirme Bileşenlerinin Kullanılmasına Yönelik Bir Eylem Araştırması

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Keywords

1.Formative assessment
2. Collaborative action research
3.In-service teacher training
4. Science education
5. Science teacher

Anahtar Kelimeler

1. Biçimlendirici değerlendirme
2. İşbirlikçi eylem araştırması
3. Hizmet içi öğretmen eğitimi
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Abstract

Purpose: This research aimed to identify the utilization status of formative assessment components by teachers and analyze the process of addressing the problems encountered in these components.

Design/Methodology/Approach: The research was designed considering Stringer's (2007) model supporting the collaborative action research process. Weekly action cycles were planned with teachers during the research. Data collection tools for the study included video recordings (classroom observations), teacher interviews, researcher field notes, lesson plans, planning and reflection meetings with teachers, and meetings with the validation committee. Data analysis in this research was conducted using descriptive analysis and constant comparative analysis. Interview and observation data, along with lesson plans, were analyzed by the researcher after each action cycle, based on the 'formative assessment classroom observation form' created, to determine the extent to which each teacher used formative assessment components in their lessons. Data were also shared with the validation committee to complete evaluations related to formative assessment components for each teacher. Upon examining the development of teachers' formative assessment components, it was observed that two teachers reached expert levels in all components, while one teacher reached an expert level in all components except for peer assessment.

Findings: Factors generally influencing the use of formative assessment components by teachers, based on the findings of this study, included teachers' instructional beliefs and attitudes, collaboration and adequate support, time, experience, and standardized tests, as well as teachers' educational philosophies and their utilization of online learning environments. The findings of the study were discussed in relation to the literature, and various recommendations were provided to practitioners to contribute to the use of formative assessment in classroom practices and to researchers aiming to improve teachers' formative assessment practices.

*Highlights: F*actors generally affecting the use of formative assessment components by teachers can be stated as teachers' pedagogical beliefs and attitudes, collaboration and adequate support, time, experience, and centralized exams, teachers' educational understanding, and their use of online learning environments.

Öz

Çalışmanın amacı: Bu araştırmada, öğretmenlerin biçimlendirici değerlendirme bileşenlerini kullanma durumlarının ortaya konulması ve bu bileşenlerde ortaya çıkan problemlerin giderilmesi sürecinin analiz edilmesi amaçlanmıştır.

Materyal ve Yöntem: Bu araştırma, öğretmenlerin biçimlendirici değerlendirme uygulamalarını geliştirmeyi amaçlamakta olup, işbirlikçi eylem araştırması yöntemiyle gerçekleştirilmiştir. Araştırma süreci, işbirlikçi eylem araştırması yaklaşımını destekleyen Stringer (2007) modeline dayalı olarak tasarlanmıştır. Bu doğrultuda, öğretmenlerle haftalık eylem döngüleri planlanmıştır. Araştırmada veri toplama araçları olarak video kaydı (ders gözlemi), öğretmen görüşmeleri, araştırmacının saha notları, ders planları, öğretmenlerle yapılan planlama ve yansıtma toplantıları ile geçerlik komitesi toplantıları kullanılmıştır. Veri analizinde betimsel analiz ve sürekli karşılaştırmalı analiz yöntemlerinden yararlanılmıştır. Görüşme ve gözlem verileri ile ders planları, her eylem döngüsü sonunda araştırmacı tarafından geliştirilen "biçimlendirici değerlendirme sınıf içi gözlem formu" doğrultusunda analiz edilmiştir. Böylelikle, her bir öğretmenin dersinde biçimlendirici değerlendirme bileşenlerini kullanma durumu belirlenmeye çalışılmıştır.

Bulgular: Araştırma sonuçlarına göre, öğretmenlerin biçimlendirici değerlendirme bileşenlerindeki gelişimleri incelendiğinde, iki öğretmenin tüm bileşenlerde uzmanlık düzeyine ulaştığı, bir öğretmenin ise akran değerlendirme bileşeni hariç diğer bileşenlerde uzmanlık düzeyine ulaştığı tespit edilmiştir.

Önemli Vurgular: Çalışmadan elde edilen bulgulara göre, öğretmenlerin biçimlendirici değerlendirme bileşenlerini kullanımlarını etkileyen genel faktörler; öğretimsel inanç ve tutumları, iş birliği ve yeterli destek düzeyleri, zaman yönetimi, deneyim, merkezi sınavların etkisi, öğretim anlayışları ve çevrim içi öğrenme ortamlarını kullanma durumları olarak belirlenmiştir.

This study was produced from the first author's doctoral dissertation, and a part of the study was presented as an oral presentation at the 15th National Congress of Mathematics and Science Education, held at Kafkas University, Kars, TÜRKİYE, on 27–30 September 2023.

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INTRODUCTION

The integration of inquiry-based strategies in science education is essential for enhancing students' critical thinking skills and scientific process skills (National Research Council (NRC), 1996). Teachers who implement these strategies are characterized as open-minded, contemporary, and committed to continuous improvement, as they design learning experiences tailored to students' needs by engaging in learning alongside them (Seiley, 1999). Moreover, it is recognized that the primary task of these teachers is to stimulate and interact with students' thoughts and perspectives (Demirel, 2000; Perkins, 1999). The development of knowledge in students' minds is dependent on this interaction with their teachers (Brooks & Brooks, 1993). The sustainability of teacher-student interaction relies on the continuity of assessment activities (Wiliam, 2007). This situation highlights the necessity for assessment practices to be used not only for evaluative purposes but also as a means of enhancing learning (Black et al., 2003; Bonwell, 1991; Gotwals & Birmingham, 2016). In this context, formative assessment, which promotes student learning based on teacher-student interaction, becomes particularly relevant (Black & Wiliam, 1998).

Formative assessment provides ongoing opportunities for teachers to engage in activities that support students' learning by interacting with them (European Commission, 2011). In the framework of formative assessment, the student is positioned at the center of the teaching process and plays an active role. Throughout this process, students engage with both teachers and peers, taking ownership of their own learning. Generally, in the formative assessment process, information about student learning is gathered, analyzed, and then used to provide feedback to students or adjust instruction to help them achieve their learning goals and success criteria (Moss & Brookhart, 2009). Formative assessment inherently encompasses three core dimensions that address what is happening in the classroom at any given moment: Where do we currently stand in terms of learning? What are our learning objectives? What strategies can bridge the gap between the current state and the learning goals? (Hattie & Timperley, 2007; Wiliam & Thompson, 2007; Keeley, 2015; Moss & Brookhart, 2009).

Throughout the formative assessment process, teachers and students assess their current status, compare it with learning goals, and collaborate on strategies to achieve those goals. An analysis of research on formative assessment reveals that key components are identified to sustain this process effectively. These components include explicitly communicating learning objectives and success criteria to students, utilizing various data collection strategies to assess student learning, providing constructive feedback, incorporating self-assessment and peer assessment practices, and planning the next steps in instruction (Buck & Trauth-Nare, 2009; Hattie & Timperley, 2007; Wiliam & Thompson, 2007; Keeley, 2015; Moss & Brookhart, 2009).

For effective and high-quality science teaching to take place, it is essential that formative assessment is actively integrated into classroom learning and teaching activities (Gotwals et al., 2015). The European Commission (2011), in its report *Science Education in Europe*, also emphasized the critical role of formative assessment in achieving the objectives of science education, stating that it is beneficial in both curriculum development and learning and teaching activities. Similarly, a review of the literature highlights that many countries stress the importance of formative assessment in science teaching programs (Australian Institute for Teaching and School Leadership Limited [AITSL], 2011; European Commission, 2011; Ministry of National Education [MEB], 2018; Organisation for Economic Co-operation and Development [OECD], 2005a). In Turkey, the significance of formative assessment in achieving the objectives of science education is explicitly emphasized in the 2018 Science Curriculum, developed in response to these advancements (MEB, 2018).

An examination of the assessment principles within the Science Curriculum (2018) reveals that assessment practices should be ongoing as part of the teaching and learning process (MEB, 2018, p.7). In this context, it is stated that data informing the learning process should be collected through monitoring activities, and the obtained results should be used to enhance teaching and learning activities (MEB, 2018). This approach supports the notion that assessment processes should not be viewed as a standalone procedure but rather as an integral part of instruction (Keeley, 2015; Moss & Brookhart, 2009; Otero, 2006). Therefore, it is evident that the curriculum strongly advocates for the use of formative assessment in classroom practices.

Despite the curriculum's emphasis on formative assessment in classroom practices, studies on teachers' implementation of formative assessment components indicate that this expectation is not being fully realized (Earle, 2014; Gioka, 2009; Gotwals et al., 2015; Haug & Ødegaard, 2015; Ruiz-Primo & Furtak, 2007; Torrance & Pryor, 2001). For instance, in a study aiming to provide a snapshot of formative assessment use in classroom practices, Earle (2014) found that the "self-assessment" component was employed in only 36% of cases, while the "peer assessment" component was used in just 8% of cases. Similarly, Gioka (2009) reported that teachers' use of "feedback" to support student development was significantly lower than their use of judgmental feedback. Additionally, Ruiz-Primo and Furtak (2007), in a study examining the relationship between the effectiveness of formative assessment practices and student performance, found that teachers rarely incorporated the "gathering information about student learning" component. Other studies indicate that the questions teachers pose during classroom interactions tend to target lower-order cognitive skills (Gotwals et al., 2015; Ruiz-Primo & Furtak, 2007) and that the "sharing of learning objectives and success criteria with students" component is insufficiently implemented (Haug & Ødegaard, 2015). Based on these studies, it can be concluded that science teachers' use of formative assessment components is not at an optimal level. This challenge is also evident in online learning environments (Veugen et al., 2022; Zou et al., 2021).

With the use of online environments in instructional practices due to the global pandemic, the ability of teachers to manage online teaching processes has become crucial. In online assessment environments, the use of formative assessment components such as "self-assessment" and "peer assessment" can make the process more interactive and active (Palloff & Pratt, 2009).

Additionally, the use of assessment techniques that are easy and quick to use when collecting information about student learning in online environments can make the teaching process more efficient. For formative assessment to be used in online learning environments, teachers need to be able to use formative assessment components in online environments. Upon reviewing the literature, it is seen that teachers find it challenging to implement formative assessment practices in online learning environments and that individual characteristics such as teacher beliefs and digital literacy are effective factors in the use of formative assessment (Veugen et al., 2022). Furthermore, it is stated that the design of training programs for teachers on online formative assessment may be effective in transforming teachers' understanding and attitudes towards online formative assessment (Zou et al., 2021). However, while limited research explores how teachers employ formative assessment components in online learning environments (Veugen et al., 2022), there remains a notable gap in studies aimed at enhancing teachers' use of formative assessment components in these settings. Based on this gap in the literature, the present study investigates science teachers' implementation of formative assessment components in online learning environments and examines the strategies used to address deficiencies in their application.

This study seeks to answer the following research questions:

1. To what extent do teachers utilize formative assessment components in online learning environments?
2. What strategies are employed to address the identified deficiencies?

METHOD/MATERIALS

Research Design

This study employs the collaborative action research method with the goal of enhancing teachers' formative assessment practices. This research approach seeks to improve instructional strategies and working conditions by heightening teachers' awareness of decision-making regarding their own practices (Chatterton et al., 2007).The study is designed based on Stringer's (2007) model. Stringer (2007) highlights that the core phases of action research unfold in three sequential stages: "look," "think," and "act." In the "look" stage, relevant data are collected, and the examined situation is described broadly. During the "think" stage, the collected data are processed, interpreted, and articulated. Finally, in the "act" stage, strategic plans are developed, executed, and assessed. A diagram illustrating the activities undertaken at each phase of the collaborative action research process throughout the study is presented in Figure 1.

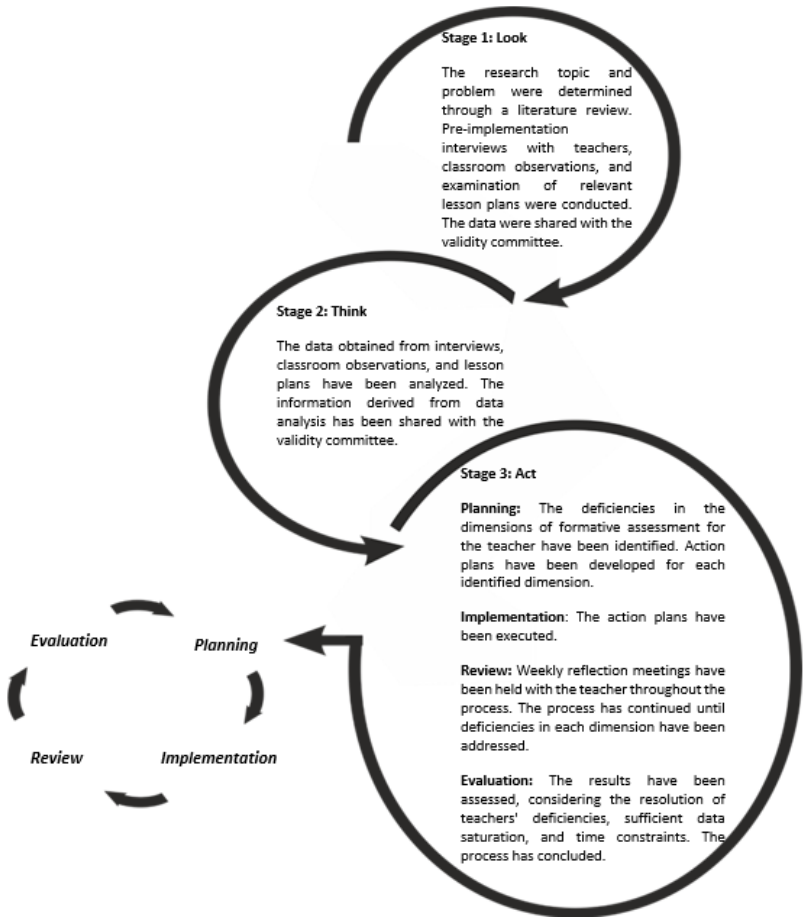

Figure 1. Workflow diagram of the study

Research Group

Three science teachers working in Kastamonu Province participated in this study. In the selection process, their utilization of formative assessment components in online learning environments, willingness to engage in the study, and capacity for collaboration were considered. These teachers were designated as Teacher 1, Teacher 2, and Teacher 3. The socio-demographic profiles of the teachers comprising the study group—including years of professional experience, grade level, educational background, gender, and age—are presented in Table 1.

Table 1. Socio-demographic characteristics of collaborative teachers

Teacher	Years of Professional Experience	Grade Level	Graduation	Gender	Age
Teacher 1	22	5th grade	Bachelor's	Female	40-45
Teacher 2	10	7th grade	Master's	Male	35-40
Teacher 3	20	7th grade	Bachelor's	Female	40-45

Teacher 1: Graduated from a state university with a degree in Physics Education and started professional teaching career in 1998, having been teaching for a total of 22 years. Pursued academic life at the undergraduate level without engaging in advanced academic studies such as master's or doctoral degrees. Attended in-service training courses 2-3 times a year. Mentioned participation in courses with content related to "Assessment and Evaluation". Expressed interest in formative assessment strategies. The class size is 35 students. The school where the teacher works is a state school affiliated with the central district of Kastamonu. The students' socioeconomic levels at the school are moderate to high. The school's success rate is above the provincial average.

Teacher 2: Graduated from a state university with a degree in Science Education and has been in the profession for 10 years. Completed a master's degree in 2019 and is currently continuing doctoral studies in the field of Science Education. The class size is 18 students. The school where the teacher works is a state school affiliated with the central district of Kastamonu. In addition to students coming from the center, there are also students transported from surrounding villages. The students' socioeconomic levels at the school are low to moderate. The school's success rate is below the provincial average.

Teacher 3: Has been teaching in state schools for 17 years. Holds a bachelor's degree in teaching and has received training in STEM and robotic coding. Mentioned working on project-based activities. The class size is 28 students. The school where the teacher works is a state school affiliated with the central district of Kastamonu. The students' socioeconomic levels at the school are high. The school's success rate is well above the provincial average.

Data Collection Tools

The research questions, data collection tools, data collection methods, and details regarding when, from whom, why, for how long, and how many times these methods and tools were used in the study are presented in Table 2.

Table 2. Data collection methods and techniques used in collaborative action research process

Research Questions	Data Collection Tools	From Whom?	Why?	When?	Duration	Quantity
1. How do teachers use formative assessment components?	Video recording (in-class observation)	Classroom environment	Prevention of data loss, General description of the situation	During classroom implementation	53 hours 20 minutes	80 recordings
	Teacher interviews	Teachers	Expression of experience	At the beginning of the process	5 hours	10 interviews
	Researcher field notes	Researcher	Evaluation of the teacher's process	Throughout the research process	Throughout the research process	Throughout the research process
	Lesson plans	Researcher and teachers	Examination of techniques used in lesson plans	Before each implementation	10 hours	20 plans
2. How was the process of addressing identified deficiencies conducted?	Video recording (in-class observation)	Classroom environment	Critical reflections, Identification of change and development, Support of findings	During classroom implementation	56 hours 25 minutes	84 recordings
	Teacher interviews	Teachers	Evaluation of the process	At the end of the process	1 hour 30 minutes	3 interviews
	Teacher planning and	Teachers	Expression of experience,	After each action cycle	10 hours 30 minutes	21 meetings

Research Questions	Data Collection Tools	From Whom?	Why?	When?	Duration	Quantity
	reflection meetings		Evaluation of the process, Critical reflections (review, planning, evaluation)			
	Meetings with the validity committee	Expert researchers	Expression of change and development	After each action cycle	10 hours 30 minutes	21 meetings
	Researcher field notes	Researcher	Evaluation of the teacher's process	Throughout the research process	Throughout the research process	Throughout the research process
	Lesson plans	Researcher and teachers	Examination of techniques used in lesson plans	Before each action cycle	10 hours 30 minutes	21 plans

Data Analysis

In this research aimed at revealing teachers' use of formative assessment components and addressing identified deficiencies, data analysis was conducted using descriptive analysis and constant comparative analysis. Table 3 presents the connections between research questions, data sources, and analytical methods.

Table 3. Connections between research questions, data sources, and analysis methods

Research Questions	Data Sources	Analysis Methods
1. How do teachers use formative assessment components?	Teacher interviews, Researcher field notes, Lesson plans, Meetings with the validity committee, Video recording (In-class observation)	Descriptive analysis
2. How was the process of addressing identified deficiencies conducted?	Teacher planning and reflection meetings, Teacher interviews, Researcher field notes, Lesson plans, Meetings with the validity committee, Video recording (In-class observation)	Descriptive analysis and constant comparative analysis

In this study, during the needs analysis and implementation phase, online classroom observations, teacher interviews, field notes, planning meetings, and validity committee discussions were examined using descriptive analysis. Throughout the process, targeted evaluations were conducted to assess teachers' instructional practices. After ensuring data saturation, constant comparative analyses were performed, and the findings were continuously analyzed.

Initially, after gathering and reviewing the data, an analytical framework was established based on the focused assessment areas. According to this framework, a formative assessment classroom observation form was developed, incorporating seven formative assessment components categorized under three dimensions, and translated into Turkish. In designing the form, items adapted from Dell and Dell (2016) and Gotwals et al. (2015) were utilized to evaluate the relevant instructional dimensions. The initial version of the form was sent to two independent experts for feedback. Based on their recommendations, the finalized version of the form was determined and used to evaluate classroom video recordings in the online environment.

After finalizing the formative assessment classroom observation form, it was completed weekly by the researcher and an expert from the validity committee. While documenting observations, the researcher and expert recorded key instructional behaviors exhibited by teachers across the specified dimensions and components, alongside their evaluative remarks. The researcher and expert engaged in collaborative discussions for each teacher to determine which performance indicators aligned with the formative assessment dimensions and components. Through this consensus-driven process, they established each teacher's weekly formative assessment performance.

Validity and Reliability Studies

In this action research, credibility, transferability, dependability, and confirmability were ensured through several strategies. A validity committee, composed of experts in formative assessment and action research, regularly reviewed the process and provided feedback. Data were collected from six different sources, enabling triangulation, and the entire process was thoroughly documented to enhance transparency and confirmability. Classroom video recordings were coded by two researchers, and inter-coder reliability was calculated as 0.90, indicating high consistency (Miles & Huberman, 1994).

FINDINGS

The findings of the study are presented in two stages: the usage status of formative assessment components by teachers and the process of addressing deficiencies in formative assessment components.

How Do Teachers Utilize Formative Assessment Components?

Table 4 provides performance indicators of three Science teachers participating in the study, indicating their usage of in-class formative assessment components during observed lessons. Analysis results identified deficiencies in the formative assessment components in the online learning environment.

Table 4. Performance Indicators of the In-Class Formative Assessment Observation Form

Formative Assessment In-Class Observation Form							
Dimensions	Sharing learning objectives: Where are we going?	Gathering information about student learning: Where are we now?				Closing the gap/Responding to students: How do we close the gap?	
Components	Sharing learning objectives and success criteria	Types of questions/Obtained information	Strategies for obtaining information	Self-assessment	Peer assessment	Feedback loops information	Instructional decisions/adjustments
Teacher 1	Beginning	Developing	Effective	Beginning	Beginning	Developing	Effective
Teacher 2	Beginning	Beginning	Developing	Beginning	Beginning	Developing	Effective
Teacher 3	Beginning	Effective	Effective	Beginning	Beginning	Developing	Effective

When examining Table 4, it is evident that teachers are at the beginning level in sharing learning objectives and success criteria, self-assessment, and peer assessment components. This suggests that teachers are not fully utilizing these components in their lessons. In the feedback loops component, teachers are at the developing level. It has been found that the feedback provided by teachers is primarily evaluative, focusing on correct answers to the problem or task. It is observed that the feedback is connected to learning objectives, and teachers use students' inquiries to offer feedback.

In the instructional decisions component, teachers are at the effective level. Therefore, teachers collect information about their students' learning throughout the lesson, aligned with learning objectives and success criteria. Teachers also identify misconceptions students have and analyze this information to draw conclusions about their students' strengths and weaknesses. However, there is a need to improve the methods of information collection used by teachers.

Teachers exhibit varied performance levels in the question types/obtained information and strategies for gathering information components. For the question types/obtained information component, the levels, frequencies, and examples of questions used by teachers in pre-implementation lessons according to Webb's depth of knowledge are provided in Table 5.

Table 5. Levels, Frequencies, and Examples of Questions Used by Teachers in Pre-Implementation Lessons According to Webb's Depth of Knowledge

Teacher	Depth of Knowledge Level	Frequency	Example
Teacher-1	Recall and Reproduction	22	All objects on Earth are attracted to each other by a force called gravity. So, do your feet touch the ground because of that force?
	Skills and Concepts	8	Can you think of situations around you where you can see the effect of gravity?
	Strategic Thinking and Reasoning	6	If there were no force, could you sit down? .... What do you think about this?
Teacher-2	Recall and Reproduction	25	If I say an apple weighs 10 kg, would that be incorrect?
	Strategic Thinking and Reasoning	5	How would life be if there was no gravity?
Teacher-3	Recall and Reproduction	10	Can you give examples of secretions produced by the Golgi apparatus?
	Skills and Concepts	12	Why do vacuoles in plant cells grow as they age?

Strategic Thinking and Reasoning	13	If a cell can sustain life with just ribosomes, why are there more organelles in eukaryotic cells? Teacher-3 also questioned their students on why they reached a particular answer.

When the questions asked by teachers to students in the online learning environment were analyzed, it was observed that in the component of question types/obtained information, Teacher-1 was at a developing level, Teacher-2 was at a beginning level, and Teacher-3 was at an effective level. It was observed that Teacher-2 mostly asked single-response, low-depth questions to students. Teacher-1's questions to students were generally low-level, but they also used questions aimed at a higher depth of knowledge. Teacher-3 asked mixed questions ranging from low to high depth of knowledge to students. Teacher-3 also questioned their students on why they reached a particular answer.

When examining the pre-implementation strategies used by teachers to gather information, it was observed that Teacher-1 and Teacher-3 were at an effective level, while Teacher-2 was at a developing level (VCM-1). According to the decision made by the validity committee, at this level, it was observed that Teacher-1 and Teacher-3 employed effective inquiry strategies in the classroom that provided evidence for most of the learning students achieved. For example, Teacher-1, while addressing the learning goal of "measuring the force with a dynamometer" in the 5th-grade Science lesson, unit 3, "measurement of force and friction," asked students questions related to the effects of gravity in daily life and stimulated deeper thinking by posing these questions. It was observed that more than half of the class expressed a desire to participate in the discussion.

"Teacher: Can you think of situations around you where you can see the effect of gravity?

Student: Teacher, sometimes they measure in villages, Teacher.

Teacher: Can't you see the effect of gravity right now?

Student: I'm experiencing it, Teacher.

Teacher: All objects on Earth are attracted to each other by a force called gravity. So, do your feet touch the ground because of that force?

Student: I'm sitting right now.

Teacher: Could you sit down if there was no force? ... What do you think about this?"

Here, the teacher asked the student about situations where gravity could be related to daily life. The teacher deepened the inquiry process based on the student's response. The teacher generally encouraged students to think based on the strengths and weaknesses of student responses relative to the learning objective. The limitation of the teacher was only using the question-answer method. The decision made by the validity committee is to "increase the techniques used by the teacher to obtain data related to student learning and to implement them." The situation regarding this component is similar for Teacher-3 as well.

When examining Teacher-2's strategies for gathering information in the online learning environment, it was observed that they were at a developing level (VCM-1). According to the decision made by the validity committee, Teacher-2 generally did not encourage students to reflect on the strengths and weaknesses of student responses relative to the learning objective. For example, while addressing the achievement of "naming gravitational force acting on mass as weight" in the 7th-grade Science lesson, unit 3 "force and energy," Teacher-2 engaged in question-answer sessions related to the effects of gravity in daily life.

"Teacher: Why do we use these rocket fuels? (Teacher waits for a while, but no response comes from the class) To overcome gravity?

Student: Yes, sir, that's right. We use them to overcome gravity force.

Teacher: How would life be if there was no gravity?

Student: Everything would be flying in the air.

Teacher: So would our life be negatively affected? Positively?

Student: Negatively.

Teacher: Wouldn't there be any positive aspect at all?

Student: Sir, we could jump out of the window during an earthquake."

Here, the teacher provided the correct answers to the questions themselves and did not give students the time needed to find the correct answer (RFN). The questions asked by the teacher directed the students but did not encourage them to think deeply. The decision made by the validity committee is that "the limitation of the teacher is not only using the question-answer method but also not involving the student enough in the learning process. The teacher should diversify the techniques used to obtain data related to student learning and use them to include all students in the class."

How Were the Identified Deficiencies Addressed?

In the process of addressing the gaps in the formative assessment components in the online learning environment, a total of 7 action cycles were conducted with Teacher-1 and Teacher-2, and 5 action cycles with Teacher-3. Each action cycle was planned for 4 class hours of weekly Science lessons. Table 6 provides the formative assessment components included in each action cycle of the teachers and the levels at which these formative assessment components were used by the teacher in these action cycles.

Table 6. Dimensions and Components Included in Teachers' Action Cycles

Dimensions		Sharing learning objectives: Where are we going?	Gathering information about student learning: Where are we now?				Closing the gap/Responding to students: How do we close the gap?	
Components		Sharing learning objectives and success criteria	Types of questions/Obtained information	Strategies for obtaining information	Self-assessment	Peer assessment	Feedback loops information	Instructional decisions/adjustments
T1	Cycle 1	Developing	-	Effective	-	-	-	-
	Cycle 2	Developing	Developing	Effective	-	-	Developing	-
	Cycle 3	Effective	Developing	Effective	Developing	-	Developing	Effective
	Cycle 4	Expert	Effective	Effective	Developing	-	Effective	Effective
	Cycle 5	Expert	Effective	Expert	Effective	Developing	Effective	Expert
	Cycle 6	Expert	Expert	Expert	Effective	Effective	Expert	Expert
	Cycle 7	Expert	Expert"	Expert	Expert	Expert	Expert	Expert
T2	Cycle 1	Developing	Developing	Developing	-	-	-	-
	Cycle 2	Developing	Developing	Developing	-	-	Developing	-
	Cycle 3	Effective	Developing	Effective	Developing	-	Developing	Effective
	Cycle 4	Effective	Effective	Effective	Developing	Developing	Effective	Effective
	Cycle 5	Expert	Effective	Effective	Effective	Developing	Effective	Effective
	Cycle 6	Expert	Expert	Expert	Effective	Effective	Expert	Expert
	Cycle 7	Expert	Expert	Expert	Expert	Expert	Expert	Expert
T3	Cycle 1	Developing	-	Effective	-	-	Developing	-
	Cycle 2	Effective	-	Effective	-	-	Effective	-
	Cycle 3	Expert	Effective	Expert	Effective	-	Effective	Effective
	Cycle 4	Expert	Expert	Expert	Expert	-	Effective	Expert
	Cycle 5	Expert	Expert	Expert	Expert	Developing	Expert	Expert

When examining Table 6, it is observed that in the action cycles, the components of sharing learning objectives and success criteria, as well as obtaining information strategies, are included for each teacher from Cycle 1 onwards. Since it is necessary to include learning objectives and success criteria for each achievement at the initial stage, and considering that the teachers are at the beginning level in this component, it has been included in every cycle for each teacher. In terms of obtaining information strategies, since the strategies that can be used in online learning environments may differ from face-to-face learning environments and in order to prioritize the issues that may arise during implementations, this component has been included in all cycles designed for each teacher. Self-assessment and instructional decisions/regulations components have been included for each teacher from Cycle 3 onwards. The validity committee deemed it appropriate for the self-assessment component to be included in the process only after the information gathering strategies component has become fully usable by the teacher during the implementation process. Thus, including various self-assessment techniques in the action cycles has been facilitated for the implementation of the self-assessment component. The instructional decisions/regulations component, on the other hand, has been deemed appropriate to be implemented before moving on to the next achievement. For the question types/obtained information and feedback loop components, it has been determined which cycles should be included based on the teachers' pre-implementation performance indicators. The peer assessment component has been the last component to be included in the action cycles for each teacher. This decision by the validity committee was made to ensure both the teachers' mastery of the process and the students' learning of the techniques they will use to evaluate each other. Additionally, Teacher-3 only used this component in one cycle during the implementation because they believed that this component could adversely affect the quality of teaching due to their past experiences.

From this point on, the development in each critical formative assessment component for each teacher is provided. The progression in sharing learning objectives and success criteria for Teacher-1, question types/obtained information for Teacher-2, and peer assessment for Teacher-3 is presented.

Teacher-1

Teacher-1 is at the initial level for sharing learning objectives and success criteria component in the online learning environment. During the preparation phase, the teacher engaged in discussions with the researcher on how to create and share learning objectives and success criteria with students. As the action cycles began, Teacher-1 included this component in the introduction part of the lesson.

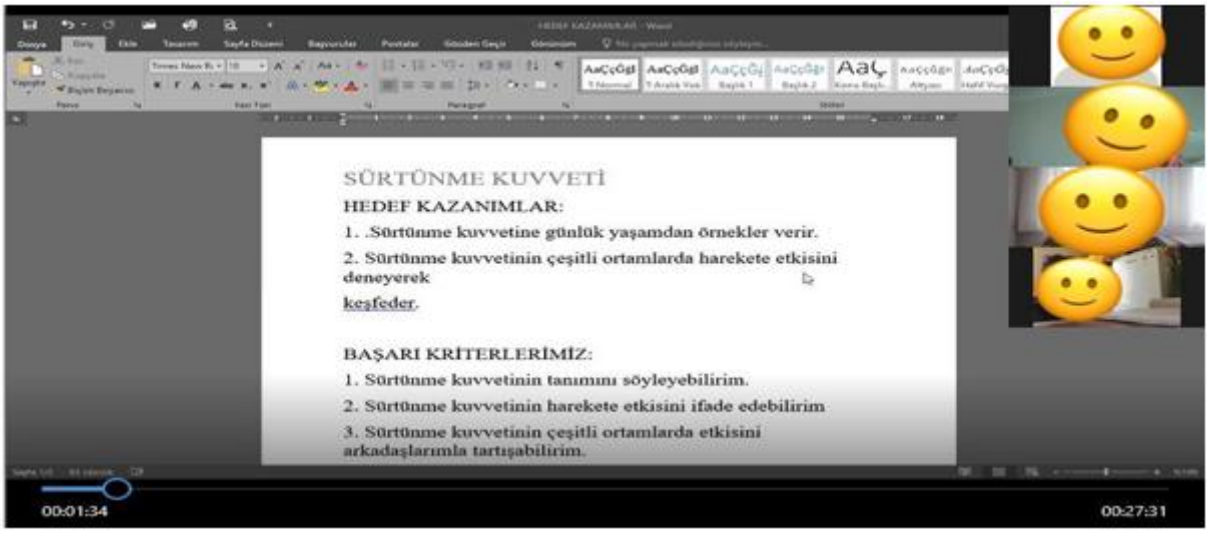

Figure 2. An example of Teacher-1 sharing learning objectives and success criteria during the lesson

Teacher-1 shared the learning objective for the topic of "frictional force" verbally in Cycle 1, as shown in Figure 1, and attempted to collaboratively determine the success criteria with the students by asking, "How do we determine if we have achieved the learning objectives?" However, the students were unable to participate. Consequently, Teacher-1 independently determined the learning objectives and success criteria in Cycle 1 and shared them with the students. The teacher shared some key concepts related to the topic with the students and asked them what they knew about these concepts. The teacher took a guiding role during this process. Providing a specific time for students to write down the success criteria in their notebooks, the teacher later shared the success criterion as "a tangible indicator indicating that we have achieved the learning objectives" (CVR-Cycle 1). Additionally, Teacher-1 shared with the students what the success criteria were and emphasized that the purpose of the lesson was to accomplish these criteria. After giving students three minutes to write down the success criteria in their notebooks, the teacher asked them to review them to understand what they meant. A student's question during this process was as follows: "So, is our goal in this lesson to achieve these criteria?" The teacher confirmed that this was correct (CVR-Cycle 1). Some students had difficulty understanding what the success criteria were at first, possibly because the teacher was introducing this concept into their lessons for the first time, causing some apprehension (RFN-Cycle 1).

After writing down the success criteria in their notebooks, the teacher asked the students to review them, saying, "After writing them down in your notebooks, I want you to review the success criteria. Let's read them again together and see if we have achieved these criteria by the end of the four lessons. At the end of the four lessons, have we been able to fulfill these criteria? Let's look at them together." Students' involvement in the process of creating success criteria began to be observed for Teacher-1 after Cycle 3. Similar processes were observed in subsequent cycles. In the post-implementation interview, Teacher-1 expressed their views on the relevant component:

"First of all, students knowing what they will learn, which topics they will learn in advance, and being more consciously involved in the process made them participate more and they inevitably asked questions about the topics we covered." (Post-I).

Teacher-1 stated that when they included the sharing of learning objectives and success criteria component in their lesson, students took on a more conscious responsibility for what they were going to learn and were able to express the parts they did not understand. At the end of the process, it was decided that Teacher-1 had reached the expert level in the component of sharing learning objectives and success criteria (VCM-3).

Teacher-2

Before the implementation, it was observed that Teacher-2 was at the initial level in the component of question types/obtained information in the online learning environment (VCM-1). Studies were conducted to address the deficiencies of teachers in this component with the prepared action cycles. Training on question types and cognitive levels was provided to address the deficiencies.

According to the decision of the validity committee, the first step for Teacher-2 is for their students to participate in classroom interaction (VCM-1). Because students mostly responded to questions with "yes" or "no." Therefore, alongside the cognitive levels of the questions, student interactions became important during this process (VCM-1). An example dialogue between Teacher-2 and one of their students is provided below (Cycle 4-CVR):

"Teacher: When riding a bicycle, we push the pedal. Why does the bicycle stop after we stop pedaling for a while?

Student: Frictional force reduced the kinetic energy, and it eventually stopped.

Teacher: For example, why does a person descending with a parachute descend slowly?

Student: Because it experiences air resistance. If there were no air resistance, it would fall straight down and crash to the ground rapidly.

Teacher: What if we used an umbrella instead of a parachute? (Continued with another student.)

Student: The umbrella cannot take in much air, so the resistance is low, but the parachute takes in more air, so it descends more slowly.

Teacher: Air resistance causes objects to slow down. A person descending with a parachute makes a safe landing thanks to air resistance reducing their kinetic energy. So, how do we increase air resistance? (Continued with another student.)

Student: We need wider surfaces to increase it.

Teacher: What do we do to decrease it?

Student: We need narrower surfaces, teacher."

In this dialogue, it can be seen that the teacher attempted to maintain classroom interaction, and the students participated in this process. The responses of the students evolved from "yes" and "no" to meaningful sentences. The teacher noted this during the planning and reflection meeting as follows (PRM-4):

"In fact, students also enjoy this process. Participation in the lessons increased with formative assessment. It catches my attention."

This process continued with increasing student participation until Cycle 7 (VCM-2). The cognitive levels of the questions asked by the teacher rose from the recall and reproduction stage to the strategic thinking and judgment stage. This change was observed distinctly after Cycle 4. Examples of questions asked by the teacher are given below:

"What is gravitational force? How does gravitational force change on Earth and other planets?" (CVR-Cycle 4).

"In the 1920s, 30s, and 40s, a method like this was used: high-energy rays were directed at the atom. As a result, the protons, electrons, and neutrons in the atom cannot withstand these rays and break apart. Can atoms naturally break apart like this?" (CVR-Cycle 5).

"The first image shows a green and large representation, while the second image shows a purple and slightly smaller one. Why do you think that is?" (CVR-Cycle 6).

"Here, toothpicks are used to combine the atoms. What does this mean?" (CVR-Cycle 7).

Taking into account the cognitive levels of the questions and classroom interaction, it was determined that the deficiencies of the teacher in this component were addressed, and they reached the expert level (VCM-3).

Teacher-3

Regarding the peer assessment component, Teacher-3 expressed during the pre-implementation interview that they had prior experience with this but believed that their students would unnecessarily criticize each other in class, making the process uncontrollable (Pre-I). Therefore, they did not want to allocate much time to this component in the action cycles (RFN). They only worked on this component in Cycle 5. Initially, Teacher-3 shared the steps of the peer assessment ladder with their students and reached a consensus with them on how they would assess each other before starting the process. In this cycle, Teacher-3 created various criteria and asked the students to assess each other's materials related to mitotic division (CVR-Cycle 5). An example of Teacher-3's work on the peer assessment component is provided in Figure 2.

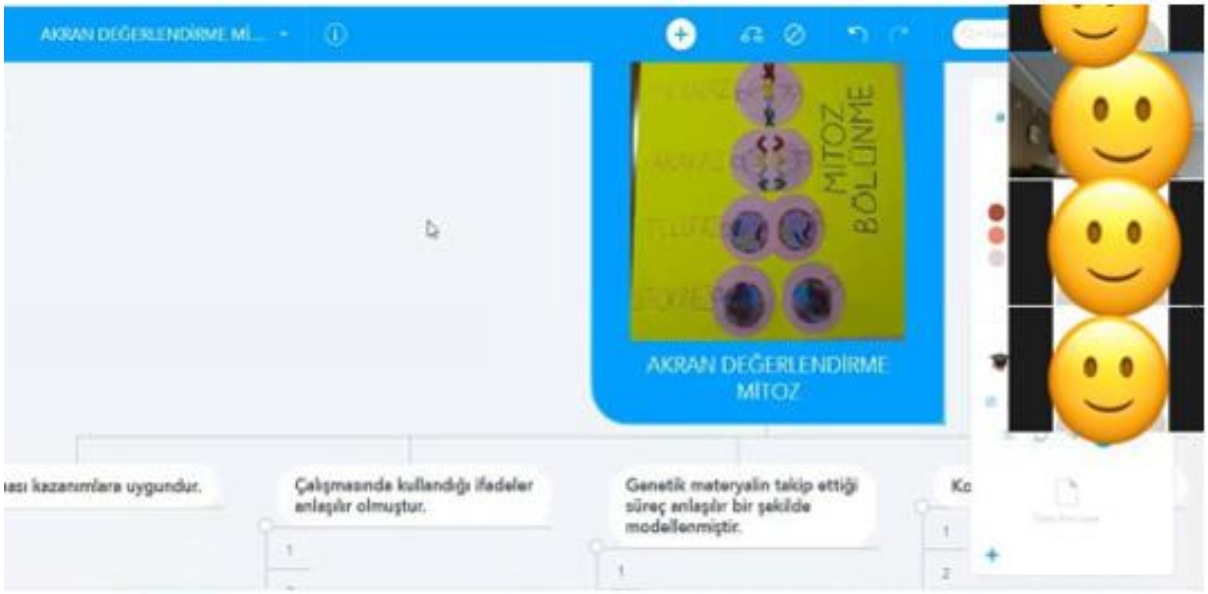

Figure 3. Example of teacher-3's peer assessment activity

When examining Figure 3, it can be observed that Teacher-3 shared the material to be evaluated by the students and the criteria they would use to assess each other. Particularly during the peer assessment process among successful students, difficulties were encountered. Students struggled to accept the opinions of their peers evaluating them. Teacher-3 had to intervene constantly throughout the process (RFN-Cycle 5). During the process, Teacher-3 found it challenging to maintain control in the classroom and stated that they did not consider using this technique again (Post-I). Teacher-3 evaluated this process negatively. During the peer assessment experience, students were stressed, finding it difficult to accept criticisms of their own work. At the end of the process, it is believed that Teacher-3 reached the developing level in the peer assessment component (VCM-3).

Actions Taken to Address Identified Shortcomings

The process of addressing the identified shortcomings in the formative assessment components of science teachers in online learning environments has been detailed for each teacher. Actions taken with teachers for each component, the average number of cycles required, and their progress are provided in Table 7.

Table 7. Process of addressing identified shortcomings

Component	Progress	Average Cycle Count	Actions Taken
Sharing learning objectives and success criteria	Beginner to Expert	4	Determination of learning objectives and success criteria Linking instructional practices with learning objectives and success criteria Involving students in the process of forming learning objectives and success criteria
Question types/obtained knowledge	Beginner to Expert	4	Determining the cognitive levels of questions and including questions with high depth of knowledge in the instructional process Questioning how students reach the answer to the relevant problem "how" and "why" Tasks given to students requiring more strategic and procedural decision-making (short film, video, game, research report)
Strategies for obtaining information	Developing-Expert	4	Utilizing effective inquiry strategies that demonstrate all students learn systematically Active use of pre-prepared questions in the teaching process Consistently clarifying student responses and refining student comments Questioning students for more detailed responses Increasing student involvement in thinking about the problem
Self-assessment	Beginner to Expert	4	Asking students to evaluate their own learning Ensuring students fully understand what to do Structuring the process according to specific criteria to support students
Peer assessment	Beginner to Expert	3	Asking students to evaluate a peer's work and provide feedback to improve its quality Ensuring students fully understand what to do and structuring the process to support students in completing their task Ensuring that peer assessment has a positive impact on the quality of student work
Feedback loops	Developing-Expert	4	Providing students with explanatory feedback on the completion process of tasks (used strategies) and on the task itself Ensuring that feedback is sufficient for students to know what to do next Providing feedback on learning objectives and success criteria Enabling students' questions to provide rich feedback Providing opportunities for students to use feedback meaningfully
Instructional decisions/arrangements	Effective-Expert	3	Using multiple data collection methods to identify students' understanding/misunderstandings or to make inferences about students' strengths and weaknesses Continuously analyzing evidence related to student learning Utilizing the derived inferences and student work or responses to continuously shape instructional decisions.

DISCUSSION AND CONCLUSION

In this section, the findings regarding the use of formative assessment components by teachers before the implementation and the process of addressing identified deficiencies are discussed. The changes and developments in teachers' use of formative assessment components are examined in detail.

The process of using formative assessment in classroom activities began with the sharing of learning objectives and success criteria. It was observed that the teachers participating in the study did not share learning objectives and success criteria with their students in their pre-implementation lessons. In studies examining the use of formative assessment components in classroom practices, limited research has been found on the use of learning objectives and success criteria. One such study by Gotwals et al. (2015) examined the formative assessment practices of mathematics and science teachers who participated in a professional development program on formative assessment using video recordings. In this study, despite receiving training in formative assessment, teachers stated that they had low use of learning objectives in their lessons. Similarly, Haug and Ødegaard (2015), in their study investigating how formative assessment develops conceptual understanding in teaching basic science concepts to primary school teachers, expressed that teachers did not set learning objectives in their lessons before participating

in the professional development program. Similarly, a study by Torrance and Pryor (2001), aimed at researching and improving formative classroom assessment in primary schools, concluded that teachers did not clearly share learning objectives with students. The findings of this study are similar to those of previous research.

In this study, it was found that the questions teachers used in the pre-implementation phase were generally low in cognitive depth. Previous research has also shown that science teachers do not ask questions that involve deep knowledge (Gotwals et al., 2015; İnaltun, 2019). In the evaluation conducted among teachers, three different levels of performance were identified in terms of question types/knowledge components. The teacher who demonstrated the highest performance was determined to have a student group with high inquiry skills, and the school's success was above the district average. This situation indicates that the expected success of students could be high. On the other hand, it was found that the teacher with the lowest performance worked in a school where the success was below the district average, and the expected success of students could be low. As also indicated by Tomanek et al. (2008), student characteristics and success expectations affect science teachers' formative questioning practices. In this study, it was determined that the teacher who demonstrated the lowest level of performance in terms of question types/knowledge components had students with low academic achievements and social communication skills. Low classroom interaction may cause students to provide simple answers to questions, which may lead the teacher to prefer questions at a low cognitive level. Additionally, the current study shows that diversifying data collection tools related to student learning increases student interactions and raises the cognitive levels of questions asked by the teacher. It has been stated that pedagogical content knowledge also affects question types. It has been observed that as the cognitive level of the questions asked by teachers increases, students become aware of their own learning. It has also been determined that giving students wait time after directing questions increases student participation (Harrison, 2013). In this context, it can be concluded that emphasizing pedagogical knowledge is important for teachers to improve their questions and classroom interactions.

In this study, it was determined that teachers generally preferred questioning techniques to focus on student learning in the "knowledge acquisition strategies" component in the pre-implementation phase. This finding is parallel to the findings of similar studies in the literature (Earle, 2014; Bulut 2010). Especially, a study by Earle (2014), which examined the approaches adopted by English schools, revealed that questioning was the most commonly used knowledge acquisition strategy for formative assessment purposes. Another factor to consider in teachers' questioning practices is the purposes of the questions and where they are used during the lesson. In the study, it was observed that teachers generally preferred this technique to assess students' knowledge at the beginning of the lesson, to attract students' interest and attention during the process, and to evaluate students at the end of the lesson. A similar study by Kubat (2018) also examined how teachers use the question-answer technique in the teaching-learning process and reached similar results. A prominent feature of the study is that it was conducted in online learning environments. In the current study, it was observed that teachers who transitioned to online learning environments unprepared due to the global pandemic had difficulty integrating knowledge acquisition strategies that could be used in these environments into their lessons. Önder's (2022) study revealed that the most challenging aspect for teachers during the COVID-19 pandemic was integrating technology into their lessons. This is seen as a supporting factor for the findings of the current study. Additionally, it was emphasized that shortening the duration of online lessons may lead teachers to have difficulty in using alternative assessment methods. This indicates a challenge for teachers in using and integrating technology into their lessons.

In this study, formative assessment techniques that can be used in online learning environments were recommended to teachers during the pre-implementation preparation phase, and how these techniques would be used in lesson plans was determined. This process is generally evaluated positively by teachers. Especially, the implementation of the 'think-pair-share' activity via the 'breakout rooms' feature on the 'Zoom' application enabled students to engage in intra-group and inter-group discussions. However, it was noteworthy that a teacher with low classroom interaction used this technique reluctantly. It was observed that another teacher, despite having low computer usage and technical problem-solving skills, was more enthusiastic. This highlights the importance of support that teachers receive during the process and collaboration with the researcher. It can be said that as teachers receive support and interact with the researcher, their confidence increases, and they carry out formative assessment practices more enthusiastically. Similarly, Gilson's (2009) study indicates that teachers value professional support and collaboration. Through this support, it was observed that teachers' confidence increased, and they conducted formative assessment practices more enthusiastically. A project study conducted by Harrison (2013) also supports similar results. It has been stated that collaboration between researchers and teachers provides formative feedback to teachers, and this feedback helps teachers make sense of and improve these practices. These findings parallel the results of the current study and indicate that when teachers are in constant communication and collaboration, they plan and implement formative assessment practices more effectively.

In this research, no self-assessment activities were encountered in the pre-implementation lesson observations of the three teachers, therefore it was determined that teachers were at the initial level in the self-assessment component. This finding is consistent with the findings of similar studies in the literature (İnaltun, 2019; Gotwals et al., 2015). In these studies, it was also found that teachers generally do not use self-assessment activities. However, in the current study, it was shown that teachers' reasons for not including self-assessment activities in their lessons were the inadequacy of lesson time and the difficulties they faced in implementing these activities in online learning environments. Additionally, it is a result of this study that students do not trust their own assessments in the self-assessment process and are accustomed to teacher-centered assessments. However, as the process progresses, it was observed that students become more confident in this process.

In similar studies in the literature (Gashi-Shatri & Zabeli, 2018; Harris & Brown, 2013; Yang et al., 2021), it has been emphasized that teachers need support in implementing self-assessment activities during the application process, and that time is crucial for students to understand this process. Additionally, DeNome (2015) has noted that factors such as school and environmental context, student academic achievement, and parents' socioeconomic status are influential in the self-assessment process. The findings of the current study are in line with the literature. Consequently, it has been stated in the current study that when teachers incorporate self-assessment activities along with success criteria, student engagement increases and this process enhances students' learning awareness.

In this study, it was found that teachers did not use the "peer assessment" component before the application, which is similar to the findings of other studies in the literature (Earle, 2014; Gotwals et al., 2015). The reasons for this could be attributed to teachers' lack of knowledge about using this component in online teaching and time constraints. In the current study, one of the participating teachers mentioned that peer assessment is the most important process of formative assessment. The teacher emphasized the importance of students accepting peer criticisms during this process. Additionally, in line with other studies in the literature (Anker-Hansen & Andrée, 2019; Gömleksiz & Ayhan, 2011), it was stated in the current study that peer assessment encourages critical feedback exchange among students and provides guidance among peers. Furthermore, in the current study, a teacher expressed reluctance to integrate this method into lessons due to a negative experience with peer assessment. This concern may be associated with the idea that students criticizing each other could be socially uncomfortable. Students' lack of trust in peer feedback and their tension during the process indicate doubts about reliability and validity. These findings highlight complex factors affecting teachers' and students' participation in peer assessment processes, such as teachers' previous experiences and students' social interactions and performance anxiety.

When examining teachers' formative assessment practices, it was observed that all three teachers were at the "effective" level in the "instructional decisions" component before the application. At this level, teachers used the information collected regarding student learning to shape instruction. This finding differs from the findings of a study conducted by Haug and Ødegaard (2015). In their study aiming to investigate how elementary school teachers support conceptual understanding within the formative assessment framework, it was found that teachers let the curriculum rather than student understanding decide when to move on to the next topic. The study also found that teachers lacked sufficient pedagogical content knowledge. Using data on student learning to shape instruction and taking action for the next step requires a certain level of pedagogical content knowledge (Bell, 2000). In this regard, in the current study, it can be said that collaborative work and support provided to teachers were effective. Preparatory work with teachers, training provided, and weekly planning and reflection meetings may have increased teachers' pedagogical content knowledge regarding formative assessment. In the current study, teachers needed to diversify the data collection methods used to gather information about student learning in order to reach the "expert" level. Diversifying data collection strategies may have also led to changes in the types of questions teachers used. This could have supported the development of the instructional decisions component. Gotwals et al. (2015) found a moderate to strong relationship among teachers' use of formative assessment components in their study. The study found that question types, feedback loops, and instructional decisions influenced each other. The findings of the current study are consistent with the findings of similar studies.

In this study, aimed at revealing the determination of teachers' use of formative assessment components and addressing the process of addressing identified deficiencies, the detailed discussion of the pre- and post-application change process of formative assessment components by teachers has been provided up to this point. In this process, various factors influencing the implementation of formative assessment have also been identified. Due to Covid-19, the current study being conducted in online environments has been expressed by teachers as the factor that most affected the process. Teachers have indicated various problems related to the use of formative assessment in online environments. These problems include lower student attendance in online environments compared to face-to-face settings, lack of technical equipment (internet, computer, tablet, etc.) required for students to attend classes online, and teachers' lack of experience in online education. In this regard, it is observed that the requirements in online learning environments are greater than those in face-to-face environments (Ingram et al., 2010; Kearsley & Blomeyer, 2004). Since interaction between teachers and students is more limited in online education environments compared to face-to-face educational settings, it becomes more crucial. Continuity of teacher-student interaction emphasizes the importance of feedback loops. Similarly, in a study by Popa et al. (2020), when the results of a study investigating the attitudes, perceptions, and understandings of university faculty members and students during online learning and teaching experiences during Covid-19 were examined, teacher-student interaction, timely feedback, and modifying or improving the pedagogical design of the course based on the outcomes of feedback were found to be the factors contributing to success in online learning environments. Hence, ensuring continuous student engagement in online learning environments is also important. In order to increase student participation, teachers need to be experienced in using strategies to ensure that students are active in online learning environments. The findings of the current study have revealed that teachers were inexperienced in online teaching practices before the implementation. Similarly, in a study conducted by Rehn et al. (2018) to identify the skills required by teachers providing online education, it was concluded that teachers were inadequate in terms of encouraging student interactions and the strategies they used in class. The findings in the literature are consistent with the current study. The reason for teachers' inexperience in online learning environments may be the lack of previous need to use this platform. As the strategies used to obtain information about student learning through formative assessment practices in online environments were shared with teachers and as teachers used these strategies, it was observed that teachers' control in online learning environments increased. Additionally, as teachers used self-assessment and peer assessment techniques in online learning environments, an increase in

student participation was observed. This finding is consistent with the findings of similar studies in the literature (Gikandi & Morrow, 2016; Sudakova et al., 2022; Veugen et al., 2022).

Based on the findings obtained from the study, factors generally affecting the use of formative assessment components by teachers can be stated as teachers' pedagogical beliefs and attitudes, collaboration and adequate support, time, experience, and centralized exams, teachers' educational understanding, and their use of online learning environments. When looking at the development of teachers' formative assessment components, it can be said that two teachers reached the expert level in all components and one teacher reached the expert level in all components except the peer assessment component (at the developing level).

RECOMMENDATIONS

In studies aimed at improving teachers' formative assessment practices, researchers are recommended to work collaboratively with teachers and actively participate in the process. The duration of the study lasted for one semester of the academic year. In studies to be conducted in this field, the duration can be extended. In the study, planning and reflection meetings with teachers were conducted by the researcher. For ease of implementation, in studies with a similar design to this study, appropriate planning can be made in advance, and teachers, researchers, and experts in the validation committee can hold meetings together. The professional experiences of the participating teachers in the study are 10 years and above. Comparisons can be made between the roles and implications of teachers who are new to the profession and those with 10 years and above of experience. The study was conducted with 5th and 7th-grade science teachers. Research can be conducted for other grades and subjects not studied. In the research results, it was found that implementing peer assessment in the classroom was more challenging compared to other components. Factors affecting the implementation of the peer assessment component in the classroom can be examined by conducting studies with both teachers and students. The study being conducted in online learning environments was generally perceived as a disadvantage by the participating teachers. A design for an experimental study can be created to examine the effect of online learning environments on teachers' use of formative assessment components in both face-to-face and online learning environments. Additionally, for teachers to acquire knowledge about formative assessment and to have the opportunity to implement it in their classrooms, the Ministry of National Education can include formative assessment practices in in-service training courses.

Declaration of Conflicting Interests

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

Author 1 developed the research plan and theoretical framework under the guidance of Author 2. Author 2 provided continuous mentorship, offering critical feedback and making revisions throughout all stages of the study. Both authors collaboratively interpreted the findings and co-wrote the discussion and conclusion sections of the manuscript.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Before recruitment could take place, ethics approval was obtained from the Kastamonu University (Protocol Number:2021/14).

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