Education and Science

Vol 46 (2021) No 205 335-357

The Role of Science Teachers' Awareness in their Classroom Practice of Formative Assessment *

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Abstract

The aim of this study is to determine the awareness of science teachers of formative assessment and to examine how formative assessment awareness is reflected in teachers' classroom practices. For this purpose, the exploratory mixed method was used in the study. For the first part of the study, the quantitative dimension was composed of 33 teachers, and the second part of the qualitative aspect consisted of 4 science teachers. As a data collection tool, a formative evaluation interview form consisting of 7 open-ended questions developed by the researchers and in-class observation form focusing on teachers' practices were used. The data obtained were analyzed by content analysis, and themes and codes were created. For the analysis of this data collection tool, a theme-code list was formed based on the data obtained in the research. As a result of the analyses, the teachers were divided into three levels: naive, eclectic and conscious. The majority of teachers who participated in the study were at the eclectic level. Teachers at this level have fundamental knowledge about the importance and use of formative assessment; however, it was found that these teachers do not adequately reflect the formative assessment in their practice. It was also observed that there was a parallel between teachers' awareness of formative assessment and their classroom practices. Considering the results obtained in this study, it is concluded that increasing the teachers' awareness regarding formative assessment can directly affect the shaping of their classroom practices.

Keywords

Formative assessment
Assessment practices
Awareness
Science teaching
Classroom practice

Article Info

Received: 08.03.2019
Accepted: 06.03.2020
Online Published: 06.18.2020

DOI: 10.15390/EB.2020.8934

* This article was derived from KÜ-BAP01/2017-45 numbered BAP project entitled "Investigation of Science Teachers' Awareness and Practices on Formative Assessment."

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Introduction

As progress continues in many different areas, it has also paved the way for change in education systems that do not meet the needs of their time. There has been extensive reform in the field of education by moving from traditional teaching, where the teacher is the controlling figure and the students are passive receivers of education, to the constructive approach in which students are responsible for their learning under the teacher's guidance (Shepard, 2000). In the transition process, focusing on how can a student learn better rather than how much he learns has led to a change in assessment, from measuring what students know to assess what they learn in the process (Treagust, Jacobowitz, Gallagher, & Parker, 2001; Wang, Kao, & Lin, 2010). In this context, formative assessment based on teacher-student interaction, which facilitates learning and more accessible structuring of knowledge, has gained importance (Reeve, 2013).

Formative assessment is the evaluation of student knowledge and learning to guide students and teachers (Bell & Cowie, 2000; Black & William, 1998; Sadler, 1989). In other words, the purpose of formative assessment is to provide feedback to teachers and students. Using this feedback, teachers formulate strategies for creating more effective teaching while reviewing their classroom practices (Linquanti, 2014; Tomlinson, 2007). Students, who are in charge of their learning, develop skills such as reflecting, assessing, learning and fulfilling needs (Bell & Cowie, 2000; Shepard, 2009).

Based on the definition, formative assessment is a process involving more than a measurement tool (Nichols, Meyers, & Burling, 2009). Formative assessment can be applied in three different ways in the classroom. On-the-fly evaluation is the first of the formative evaluation types, and is the result of instant feedback to the student during class discussions. The purpose of this type of assessment is to correct students' misinformation based on the answers they give to the questions or on non-verbal communication such as facial and body gestures (Bell & Cowie, 2001). The planned assessment is the second type of formative assessment. In the planned assessment, teachers use various assessment tools to reach the student's prior knowledge. In light of this prior knowledge, the instruction is planned and implemented in order to correct the students' misconceptions or to complete the missing information (Ruiz-Primo & Furtak, 2007). The third type is a curriculum-based assessment, which is integrated into the program. It is a form of assessment based on the students' difficulties or misconceptions emphasized in the curriculum and organizing the teaching process accordingly (Shavelson et al., 2008). Although the formative assessment includes different forms of practice, the basis of formative assessment is to enquire what a student knows about a subject; determine the gap between the goal to be achieved and what the student knows about the subject; and to fill this gap with the help of the teacher (National Research Council [NRC], 2001).

Previous studies have examined the use of formative assessment in educational environments from many different perspectives. For example, research has shown that formative assessment has a vital role in the success of the student (Madison-Harris, Muoneke, & Times, 2012; Van den Berg, Harskamp, & Suhre, 2016; Vogelzang & Admiraal, 2017). In particular, studies are showing that the success of students who have difficulty in learning has increased through the use of formative assessment method (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Madison-Harris et al., 2012). In addition to increasing student achievement, studies show improvement in students' self-efficacy along with an increase in their interest and motivation (Brookhart, 2008; Sadler, 1989; Shavelson et al., 2008). Other studies show that the student develops self-regulation, reasoning and planning skills and contributes to the elimination of conceptual misconceptions (Black, Harrison, Lee, Marshall, & Wiliam, 2002; Hattie & Timperley, 2007). Formative assessment is also said to contribute to critical thinking and discussion skills (Nicol & Macfarlane-Dick, 2006). Considering the studies in the literature, the formative assessment can be said to be an integral part of effective teaching (Trauth-Nare & Buck, 2011).

The effectiveness of formative assessment having been observed in the field of education, it has started to be applied in science education as well. It is emphasized that formative assessment comes to the foreground in order to understand the scientific process, including how to obtain knowledge rather than memorize scientific information and to learn the art of scientific inquiry that leads to meaningful learning (NRC, 1996). Misconceptions that may arise from students' tendency to explain scientific facts in science education with non-scientific information (Hardy, Jonen, Möller, & Stern, 2006; Vosniadou, 2008) are prevented by formative assessment (Kingston & Nash, 2011). In short, it is thought that formative assessment strategies will help students to develop a scientifically more adequate understanding (Bell & Cowie, 2001).

The sub-dimensions of formative assessment - the use of appropriate methods to identify students' current knowledge and the adjustment of the instruction in the direction of students' difficulties - led to studies in science education. Methods used to reveal students' prior knowledge have been the subject of many studies (Black & Wiliam, 2009; Shelton, Smith, Wiebe, Behrle, Sirkin, & Lester, 2016). Studies have covered questions, and brainstorming (Cowie & Bell, 1999); student books (Aschbacher & Alonzo, 2006; Shelton et al., 2016); written documents and discussion (Furtak & Ruiz-Primo, 2008); concept map (Won, Krabbe, Ley, Treagust, & Fisher, 2017); and reflective diaries (Wallin & Adawi, 2018). On the other hand, Coffey, Hammer, Levin, and Grant (2011) state that it is more important to examine the practices carried out in the classroom than focus on methods. In the studies conducted in this direction, mostly the effect of teachers' pedagogical content knowledge as the formative assessment is examined. For example, Jones and Moreland (2005) reported that teachers with weak pedagogical content knowledge did not interact with students too much and did not provide adequate feedback to improve learning. Anderson, Zuiker, Taasoobshirazi, and Hickey (2007) observed that teachers who lack the pedagogical content knowledge can become more efficient teachers by improving their discourse skills.

In addition to knowledge and skills, the motivation of teachers should be taken into account in order to apply formative assessment effectively (Ayala et al., 2008). It is said that teachers lacking motivation will perceive this evaluation as a burden rather than a part of the teaching process (Heritage, 2007). Therefore, the critical role of formative assessment in terms of both teaching and learning must be understood by the teachers; and development of a positive attitude and belief in the formative assessment will be beneficial for its implementation (Campbell & Evans, 2000; Tierney, 2006). It is emphasized that awareness, another variable of motivation, will play an essential role in this process. The lack of awareness of formative assessment in teachers is thought to cause them not to effectively implement it in classroom practices (Bell & Cowie, 2000). In order to prevent this situation, it is foreseen that the importance of formative assessment to the teachers and the provision of the necessary training will increase their awareness level and performance (Dixon, Hawe, & Parr, 2011). On the other hand, Cowie and Bell (1999) have found that teachers use formative assessment strategies in their classes but are not aware of it. In this respect, it is essential to find the relationship between teachers' awareness levels and in-class performances. This situation can be considered as an indicator that the relations between the theoretical knowledge of the teachers and their classroom practices are not established correctly and are not examined sufficiently. In particular, it is seen that formative assessment is mostly not preferred by teachers and cannot be used successfully in classroom practices (Bayat & Şentürk, 2015). This shows that teachers' awareness and their reflections are not handled with a holistic approach. Therefore, it is important to determine the relationship between teachers' awareness levels and classroom performances and to consider both theoretical and practical aspects of formative assessment with a holistic approach.

Formative Assessment in the Turkish Education System

Since 2005, the Turkish Ministry of National Education has prepared and put into practice curricula based on the constructivist education philosophy in all disciplines. Although formative assessment, which is a requirement of constructivist teaching in the curriculum prepared for science teaching, is not named as such, it has been stated that "alternative assessment strategies and evaluation approaches are given weight in assessment rather than traditional methods of assessment" (Ministry of National Education [MoNE], 2005, p. 11). In 2013, the program of science teaching was rearranged, and sub-dimensions of formative assessment were addressed. In the section on measurement and evaluation of this program, about formative assessment, it is stated: "… An assessment approach has been adopted in order to ensure that students are monitored, directed and their problems eliminated by identifying learning difficulties, and continuous feedback is provided to support meaningful and permanent learning" (MoNE, 2013, p. IV). It is noted that the science education curriculum, which was revised once again in 2018, does not explicitly emphasize formative assessment. However, it is noted that a single measurement tool will not be used because of a process requiring the participation of teachers and students and because each student is different (MoNE, 2018). As can be seen, formative assessment is not explicitly referred to in any of the three of the science education curricula, but the necessity of teachers to use these methods is implicit. Besides, although it is covered in the curriculum, it is not known how much the teachers know about formative assessment and how far they apply it. Bayat and Şentürk (2015) discussed situations related to the use of formative assessment in their studies based on the opinions of high school teachers about alternative measurement and assessment techniques, although not directly within the scope of formative assessment. There are few studies on this subject, and those studies aimed to investigate the measurement and evaluation methods used by teachers (Birinci-Konur & Konur, 2011) or to get teachers' opinions on this issue (e.g., Bayat & Şentürk, 2015). At the same time, as Cowie and Bell (1999) state, there can be a difference between the awareness levels and in-class performances, so that classroom formative assessment practices of the teachers are observed and the connection between awareness status and practices in the classroom is also examined. Considering the awareness levels and classroom practices with a holistic understanding, it is thought that teachers will provide a multi-dimensional examination of the situation related to the use of formative assessment in the classroom. In this way, it will guide both researchers and practitioners about models that can be developed for the availability of formative assessment practices. In light of this information, in this study, the awareness of science teachers of formative assessment was investigated. This study seeks answers to the following research questions:

- What are science teachers' awareness levels regarding formative assessment?
- How are their awareness of formative assessment reflected in the classroom practice?

Method

Research design and process

In this study, mixed method approach was used. The mixed method provides a detailed and comprehensive explanation of a phenomenon by using a combination of quantitative and qualitative research methods (Mills & Gay, 2016). In other words, it helps deeper analysis of research problems (Creswell, 2014). Although the current study is mostly related to qualitative research, the methods of the quantitative approach are needed to determine the cases to be used in the qualitative section. Therefore, the study was conducted based on explanatory design. The descriptive image of the research model was given in Figure 1.

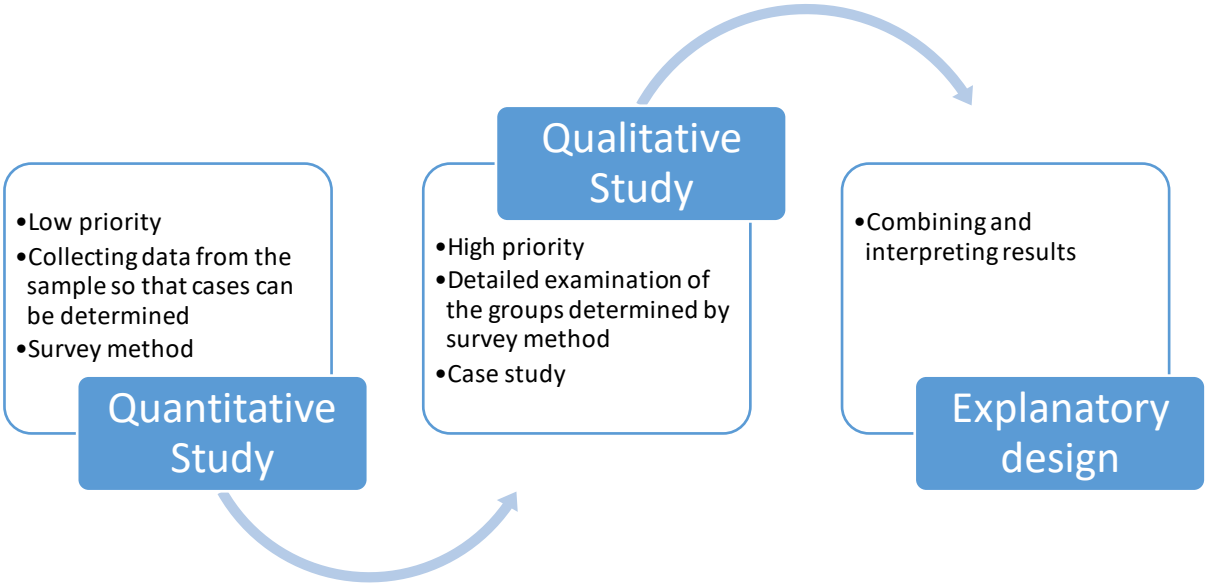

Figure 1. The research model used in the study

In explanatory design, data are first collected by using quantitative methods. Then, qualitative research method is used to clarify quantitative data. (Creswell, 2012). In line with this design, in the first stage of the study, survey method, one of the quantitative research types, was used. The survey method involves collecting data about a group of people's ideas, knowledge, attitudes, or beliefs about a case or situation (Fraenkel, Wallen, & Huyn, 2012). The first research question of the study was to investigate science teachers' the level of awareness concerning formative assessment. In this direction, by using survey method, the interview form which had seven open-ended questions was conducted to the study group of 33 science teachers. According to the analysis, it was determined that the participants were divided into 3 different awareness levels in terms of formative assessment.

The second research question of the study was to reveal the reflections of science teachers' awareness on formative assessment to their classroom practices. This situation necessitated detailed observation of the teachers' practices in the classroom. Thus, case study was carried out as the qualitative dimension of the explanatory design. Case studies provides in-depth understanding about the phenomenon examined (Creswell, 2007) Analyzing the phenomenon in its current context or environment increases the importance of the case study (Yin, 2009). Instrumental case study was used in the study. This type of case studies involves collecting data by selecting a limited case to focus on the chosen topic or problem (Stake, 1995). Within this scope, it was aimed to make observations by selecting the teachers belonging to different awareness levels which were grouped according to awareness level in the first stage of the study. On a voluntary basis, only 4 teachers out of the 33 teachers allowed researchers to observe for the classroom. Two teachers could be observed for only one level of awareness, while this number was limited to one teacher at other levels of awareness. For the

observations, two researchers entered the teacher's classroom to observe the lessons personally; they recorded observational data on formative assessment opportunities and how teachers used formative assessment in the classroom. The records of the observation data were kept separately by both researchers; the data obtained from the study were then compared, and the observation data of the course rearranged. Each teacher was observed in four different science classes in one week. A total of 16 lessons (a lesson lasts 45 minutes) were observed. These observational data were analyzed comparatively with a rubric including indicators in awareness levels developed by the researchers and, as a result of this analysis, the reflections of formative assessment in class practices were described and discussed.

Study group

The present study was carried out in Kastamonu province, located in Turkey's West Black Sea region. 40 science teachers working in state or private schools in the central district of Kastamonu were attained, and 33 teachers accepted to take part in this research. Thirteen of the 33 teachers were male and 20 females. The teachers in the study group teach science courses from Grade 5 to Grade 8.

For the first research question of the study, data were collected from all the teachers in the study group. With these data, criteria for awareness level of formative assessment and awareness of participants were determined. For the second research question, the participants were chosen among 33 teachers by using purposive sampling method (Patton, 1987). The selected participants were determined based on two criteria. First, it was aimed to have teachers belonging to different levels of awareness. In this way, it was thought that it would allow comparison of how awareness levels were reflected in classroom practice. The other criterion was related to be volunteering for participation in the study. The observation of the researchers in the classroom depends on the consent of the teachers. When two criteria were taken into consideration, 4 teachers, 1 from naive level, 2 from eclectic level and 1 from conscious level, decided to participate in the study. The data obtained from the observation include the practices of these four teachers. Three of the four teachers were male and one female. Participants were given nicknames to ensure the clarity of the data obtained and the storage of their credentials. The nicknames İlker, Ahmet, Ayşe and Can were used in the stages where examples and explanations about teachers' classes were to be given.

All of the teachers who were observed in their classes are graduates in Science Teacher Education Program. Their professional experience and academic careers differ. For example, İlker has eight years of professional experience. He teaches science courses from Grade 5 to Grade 7. İlker works in a crowded central school in terms of both the number of students and teachers. He has completed his MA degree in Science Education and is studying for his doctorate. Can works in the same school as İlker and has 16 years of experience. Ahmet, who has four years of teaching experience and teaches all grades in middle school. He is studying for his Master's degree in Science Education, currently writing his thesis. Ayşe with seven years of teaching experience teaches Grades 5 and 6, and her school is a middle-sized one which is distant from the city center.

Data collection tools

In this study, firstly an interview form consisting of seven open-ended questions was used. This form generally collects data about teachers' formative assessment practices, their understanding, and the recognition of formative assessment opportunities in given case situations and their importance in terms of their courses. This form was prepared by the researchers and formed after taking an expert opinion. The selected experts consisted of people with scientific studies and competence in the fields of education, and measurement and evaluation. The last version of the interview form was obtained at the end of two round meetings between the researchers and the experts. Then, the interview form was applied to the study group which included 33 teachers. For the analysis of data in the forms, a rubric including themes and indicator lists was developed considering the answers of the participants

obtained. This rubric was used as a measurement tool to determine the formative assessment of teachers in the research process. In this respect, the research is data-driven (Strasser, 2012) and has revealed the awareness of teachers in this area through the awareness patterns that emerge from the data in the research process. These themes in the rubric are also called "awareness level." The terms "theme" and "awareness level" will be used interchangeably. In the formation of these naive, eclectic and conscious themes, the findings of the studies conducted in different fields in the literature were considered. Especially in the nature of science (NOS) literature (e.g., Doğan & Abd-El-Khalick, 2008), a similar categorization is used for the consistency of the participants' views on the epistemology of science, the social and historical aspects of science, the reflection of contemporary perspectives. . The naive theme, which is one of these themes created from a similar point of view, is used for inconsistent and inaccurate participants' views on formative assessment. Conscious/informed is a theme used to describe teachers who have accurate and consistent information about formative assessment and can explain how they are used in their classes. The eclectic theme is used for teachers who have knowledge of formative assessment but cannot accurately reflect their experience to classroom practice and display a consistent structure.

Data analysis process

For the first research question of the study, awareness levels of 33 teachers were determined by using the theme and indicator lists in the rubric. In this process, data collected from interview forms were scored by more than one rater and compared. Pearson correlation coefficient, comparison of means, matching percentage and generalizability theory methods are used in open-ended items to ensure the inter-rater reliability (Güler & Taşdelen-Teker, 2015). Since the data obtained are on the classification scale, it is recommended to use the percentage of agreement (Güler & Taşdelen-Teker, 2015). Therefore, the percentages of agreement between 3 different raters independently were calculated. The percentage of inter-rater agreement was calculated as 77%, and a percentage of agreement over 75% is considered sufficient to make the evaluation results reliable (Goodwin, 2001; Şencan, 2005). For the elements other than the percentage of agreement, the participants were re-coded by the raters, by a collective decision, to decide the level of participants' awareness. The data analysis process was completed by taking these final evaluations into consideration of the participants under the themes obtained.

For second research question of the study, four out of 33 teachers representing awareness levels were selected, and their in-class practices observed. For these observations, a binary combination was formed from the three encoders that performed the analysis, and each class observation was therefore carried out by two encoders. In this process, the rubric developed within the study was used as a measurement tool to determine the level of formative assessment practice level in the classroom. The data obtained from the first stage, and those obtained from the class observations were subjected to comparative analysis, and the findings were established.

Validity and reliability of the study

Different techniques were used in the quantitative and qualitative methods to ensure the validity and reliability of the study. Firstly, during survey study, the interview form was obtained by consultation with the experts' opinion. This can lead the researchers to reach validation of the instrument. In the following process, it was decided to apply the interview form to the participants by a specific researcher. In this way, the conditions that would affect the quality of the data connected to the data collector have been tried to be minimized. Another technique to strengthen validity of data was related to the application of this interview form (Fraenkel et al., 2012). The researcher went to schools where each teachers worked and asked them to complete it. Within the scope of the reliability of the data obtained from the survey study, 3 independent raters took part in the analysis of the collected data. Thus, it was seen that a consistent result was tried to be achieved.

In the qualitative dimension of the study, instead of the validity and reliability, there are some concepts-credibility, transferability, dependability, confirmability- which are appropriate to the nature of the qualitative study. In the current study, some techniques were used to reach these concepts. Firstly, in order to provide credibility, the researchers adopted an objective approach by trying to critically approach every stage of the process. Another important concept is transferability (Yıldırım & Şimşek, 2011). The research process and findings were explained in detail to transfer qualitative study results to similar situations. Dependability concept stands out for the reliability of qualitative data (Lincoln & Guba, 1985). The qualitative data in this study were provided by three researchers observing the study group in pairs at the same time, and discussing and comparing the observation notes to reach a conclusion. As stated in the data analysis section, when the percentage of inter-rater agreement (77% and 75%) were considered, it was seen that the data obtained were reliable. Finally, the confirmability of the data is another important concept emphasized in qualitative studies (Erlandson, Harris, Skipper, & Allen, 1993). In this study, the use of the quotations of the participants in the disclosure of qualitative data helped to minimize the prejudices of the researchers and to strengthen the findings

Results

In this section, the rubric used in determining the awareness levels of science teachers of formative assessment and evaluation approaches, and how these awareness levels are reflected in the teachers 'classroom practices, are given in separate sections.

Awareness levels of formative assessment

Table 1 shows the list of themes and codes created as a result of the transcription of the instrument which includes teachers' responses to seven open-ended questions concerning the understanding of formative assessment and its implementation in classroom practice. The classification of awareness levels in Table 1 is based on the data obtained from the participants, which were generated during the study period. In this respect, this classification is used both as a finding obtained in the study and as a criterion for determining the awareness of teachers.

Table 1. Formative Assessment Awareness Levels and Indicators

Theme/Level	**Indicators**	**Examples**	**Distribution of participants**	
			n	**%**
N/A	(No data can be obtained relating to formative assessment)	-	**2**	**6,06**
NAIVE (Having inadequate knowledge about the importance and use of formative assessment.)	• Have insufficient knowledge of and skills in formative assessment. • To explain the formative assessment process using other approaches of measurement and evaluation. • Not being able to distinguish formative assessment application tools. • Failure to know or relate correctly to measurement and	• Step to the next level. • Distinguishing the students who know from those who do not know. • The teacher's inability to use an effective process (for an understanding of a subject for the final exam). • To be able to establish a good dialogue with the students and to learn how to achieve a higher level of learning (place of formative assessment in science).	**6**	**18,18**

	evaluation approaches in the science curriculum. • Believe that the evaluation is only done at the end of the unit or period. • Calling on reinforcement activities or materials as formative assessments.			
ECLECTIC (Having fundamental knowledge of formative assessment and its use but not to adequately implement formative assessment in practice.)	• Have some knowledge and skills about formative assessment, yet some contradictory information exists. • Know formative assessment is necessary to carry out effective science teaching, but do not have sufficient knowledge of its use in science classes. • Have information only about the evaluation dimension of formative assessment and to apply. • • Speaking of the importance of formative assessment, but clearly expressing that it cannot be implemented in the classroom.	• I measure in-class performance on a scale. • "An evaluation examination could be held after ..." • Evaluate the process. • I am doing written exams.	**19**	**57,58**

CONSCIOUS (Having sufficient knowledge of the importance of formative assessment and applying formative assessment in own courses.)	• Know formative assessment in measurement and evaluation, aware of its importance and role and apply it in class. • Have accurate information about formative assessment and use this knowledge in class. • Aware of the usability of assessment at each stage of the course, • Aware of the evaluation of student learning frequently and regularly in an education period and using new ways and methods to address existing deficiencies. • Use of measurement and evaluation (formative assessment) to support learning. • Use of formative assessment to support learning by ignoring grade-giving anxiety. • Formative assessment is also self-assessment of the teacher and reshaping the next learning stage.	• I use the time at the beginning of the course to support learning with • Evaluation should some more complex issues that take time to learn. • Evaluation of the unit gradually; evaluations should be made after each stage not be left to the end of the term. • It is crucial for the determination of misconceptions in the process of education. • We see that it is more difficult for the student to move to other topics without having mastered a present topic first. • Formative assessment should use a question-answer method and monitoring tests. • Timely intervention, when needed is useful for students.	**6**	**18,18**

The awareness levels of the formative assessment are grouped under three different themes: naive, eclectic and conscious. The naive theme was used to identify individuals as persons with insufficient knowledge of the importance and use of formative assessment. When we look at the indicators under this theme, we see that the teachers explain the measurement and evaluation process using the existing approaches outside the formative assessment; they cannot distinguish formative assessment application tools; and favor policies like evaluating at the end of the term. For example; Teacher 1 participant explains the situation of the student deficiencies given in the open-ended questions at the end of the term with 'the inability of the teacher to use an effective process'. The same participant expresses the formative assessment as "distinguishing between who know and who do not". In another example, the T10 participant explains the importance of formative assessment in terms of science education: ”to establish a good dialogue with the students and to improve learning”.

Teachers grouped under the eclectic theme have some knowledge of the importance and use of formative assessment, but it has been determined that these teachers do not adequately reflect formative assessment in their practices. The presence of conflicting knowledge and practices of these teachers is also one of the remarkable indicators under this theme. According to the indicators in this section, teachers do not have sufficient knowledge about the use of formative assessment in science classes while stating that it is necessary to carry out effective science teaching. In other words, they are not able to use formative assessment in their class, nor are they putting into practice any knowledge of the assessment dimension of formative assessment. For example; The teacher coded under T2 under this theme defined the formative assessment as 'evaluating the process.' However, the same participant reveals that, in the formative evaluation practices, di an assessment exam could be conducted after the subject 'rather than the formatting dimension. The eclectic theme includes theoretical knowledge as well as some formative assessment and evaluation practices, but mistakes or contradictions in the practices prevent the participants from taking part in the conscious theme. For example, T19 defined the formative assessment as' identifying and correcting students' missing information… '. It was seen that the same teacher used only formative assessment practice in the classroom as' I do writing…, and did not suggest any other method for formative assessment.

The conscious theme defines individuals as teachers who have sufficient knowledge of the importance and use of formative assessment and evaluation, and who use it following current approaches in their courses. Table 1 shows that the indicators under this theme are more quantitative than those of the other two themes. We see that the participants in the conscious theme give more detailed answers to the questions and explain their applications in more detail. This can be shown as a reason for increasing the number of indicators. The critical element in the indicators under this theme is to support learning without the concern of grading. In addition to this, there are indicators about the time and frequency of formative assessment and evaluation. For example, S11 participant stated formative assessment as 'At the beginning of the course, I use it at the end of the course/unit to support learning through assessments on some more complex issues that take time to learn.' These indicators, in Table 1, show awareness of the usability of formative assessment and evaluation at every stage of the course and that they can have practical application in the classroom. Furthermore, the indicators are under the theme of conscious related to being aware of the evaluation of student learning frequently and regularly in the period of education and using new ways and methods to eliminate the existing deficiencies. Finally, under this theme, the formative assessment also included an indication of the teacher’s self-assessment and reshaping of the next learning stage.

Based on the data collected to determine the awareness of the formative assessment and evaluation approach, this theme and indicator scale gives participants three different levels of examination. The N/A level was included in the study because some participant responses did not contain any data in terms of formative assessment, but this was still significant in the study. With this in mind, the findings of the participants about the content level are set out in the next section.

Awareness levels of participants in terms of formative assessment

As a result of the analyses conducted, the awareness levels of the teachers in the participant group in terms of formative assessment and evaluation approaches have fallen into four categories. The distribution of teachers by these categories is shown in Table 1.

When Table 1 is examined, it will be seen that 57.58% of teachers are included in the eclectic category in terms of awareness levels. The numbers of participants in the naive and conscious categories are equal and constitute approximately 18% of the group in the two respective categories. It was noted that two out of the 33 participants were included in the N/A category from their responses.

The majority of the participants at the eclectic level were found to have information about the importance of formative assessment and its implementation by the science teachers in the study group, but not to adequately reflect formative assessment in their practices. These findings are based on data obtained from teachers' responses to the awareness level scale. Questions related to class practices on this scale include teachers' self-assessments and their reflective opinions on this issue. The reflection of these levels of awareness into classroom applications is given in the next section.

Reflection of awareness levels in classroom applications

Some studies in the field of education show that teachers' theoretical knowledge is not always reflected in the classroom environment. For example, Morrison and Lederman (2003) found that teachers' level of awareness of formative assessment in science classes and their classroom practices were not parallel. While teachers gave appropriate answers to questions about contemporary approaches about the science lessons outside the classroom, these approaches were not observed in classroom practices.

In the current study, teachers' awareness of formative assessment as well as how this awareness is reflected in the classroom applications were examined. In order to reach data about this issue, an open-ended data collection tool and classroom observations were used. In this context, considering the distribution rates of the participants given in Table 1, four teachers, in one naive, one conscious and two eclectic were chosen to be observed for four hours each. The findings were given below under the subtitles.

Assessment and evaluation practices of naive teachers

Teachers at this group are individuals with an inadequate perspective in terms of formative assessment and evaluation approaches, as shown by the indicators in Table 1. Among the indicators, it is stated that teachers in this group cannot differentiate between formative assessment application tools; that they mistakenly refer to reinforcement activities or materials as formative assessment; and that they explain the formative assessment process using other approaches in assessment and evaluation.

In the observations, we observed that the teacher uses some measurement and evaluation methods and processes, but there are no methods used for formative assessment. In particular, it was determined that on-the-fly evaluations were attempted but not implemented correctly due to deficiencies in the formatting section. The classroom practices related to assessment and evaluation can be summarized as follows:

- Checking of the assignment given in the previous lesson
- Feedback by saying 'correct' or 'false' to the student
- Not clarifying unclear subjects/topics

- Failure to give feedback to students who have answered incorrectly or did not answer
- Not waiting for an answer from the students and giving the correct answer to a question straight away
- Not redesigning teaching process

The observed teacher starts the new topic with the unit evaluation questions given in the previous lesson. In the example where the teacher asks for the reasoning behind the student answers:

> *The teacher asks the students "Why are the shadows bigger than the objects?", receives some answers from the students and finally answers "Rays are sent to wide ends as they are nearer the light source."* (Observer 2)

It is seen that at the beginning of the lesson, the teacher had an opportunity for formative assessment. However, the teacher gives the correct answer to the question without determining shortcoming in students' mind and using re-teaching. In the later phase of the lesson, when the teacher asks students and gives feedback as "correct" or "wrong" the teacher misses opportunities to reshape the answers given by the students.

In the question-answer method used throughout the course, it was determined that the teacher was asking questions, and students were in the position of answering questions. If the answer was correct, it was observed that the next question was passed, but if the answer was wrong, the question was asked of another student. It was observed that no feedback was given to the students who had the wrong answers or had misconceptions. For example:

> *The teacher asks, "What do the world, the moon and the sun look like? Draw them in your notebook." He gives further instruction to his students by asking them to raise a finger if they finish drawing. Following this instruction, the students raise their fingers, and the teacher checks their drawings. However, those who did not raise their fingers or who are uninterested do not get feedback from the teacher. (O1-O2)*

One of the most critical findings encountered during the course is that the teacher gives the correct answers directly instead of correcting the student's answers, and therefore not taking the opportunity to re-teach. For example:

> *The teacher asks the class, "Which among transparent, semi-transparent and non-transparent objects have shadows?" Some of the students answer that non-transparent objects have shadows, while others say semi-transparent and non-transparent objects have shadows. The teacher gives the correct answer by stating that semi-transparent and non-transparent objects have shadows and moves on to another topic. There is no re-teaching process based on the misunderstanding of the semi-transparent concept. (O1)*

Assessment and evaluation practices of eclectic teachers

Teachers at this level admit that formative assessment is necessary to carry out science teaching, but are classified as those who do not have sufficient knowledge about its use in the classroom. In other words, they emphasize the importance of formative assessment, but they are unable to implement formative assessment effectively in the classroom. This is supported by in-class observation data. For example, it was observed that teachers focused on on-the-fly evaluations from types of assessment in classroom practices but could not use them consistently. Classroom applications of the observed teachers in terms of formative assessment are as follows:

- Reviewing previous subject matter at the beginning of the lesson to refresh students' minds and correct misinformation

- Attempting to correct missing and incorrect information using different methods for treating wrong answers in the question-answer part. Moving on to the next question directly after the right answers
- Questioning the unclear parts of the topic regardless of the content
- Evaluation studies at the end of the lesson

Teachers in the eclectic group were found to be practicing formative assessment in the introduction to the lesson by reviewing previous subject matter and checking what had been learned. Ahmet's actions in the introduction to the lesson, for example, can be summarized as follows:

> *Three students are invited to the board. The teacher asks them to draw the earth, the sun and the moon on the board. Then the teacher asks the class if anyone disagrees about the drawings. One of the students says there is something wrong with them. After some responses, the teacher summarizes the responses: "The moon and the sun look the same size. Why did not consider their sizes in your drawing?"*

In the given classroom situation, it is seen that the teacher starts the lesson with a short activity to measure the students' learning. In this drawing activity, instead of expressing the wrong drawings directly, it is turned into a whole group discussion to see the general level of learning in the class. Misconceptions are highlighted by taking into account the answers. However, the teachers think that it is sufficient to give the correct answer without using a different teaching process to prevent false learning. Conversely, Ayşe applies formative assessment practice at the beginning of their courses:

> *Ayşe asks a question to assess prior learning: "What is there in a simple electric circuit?" Students give answers by stating the extra components such as the switch. Ayşe then asks what the indispensable parts of an electric circuit are. Receiving the same answer, Ayşe draws an electric circuit on the board and states that it is similar to the human body, the bulb being the head, the batteries being the torso and cables being limbs. (O1)*

With the question-answer activity, Ayşe identifies missing information or false learning from the wrong answers given by the students and draws a simple electric circuit in order to correct it and to re-establish a teaching process by using an analogy.

We observed that the most common method used by teachers to assess learning is question-answer. In the naive level, teachers give feedback by merely saying "correct" or "wrong" to the answers from the students. Eclectic teachers, on the other hand, attempt to correct the missing/false parts of knowledge by using different methods. For example:

> *Ahmet asks a question that points out the size-distance equation: "Even though we know the sun and the moon are so big, why do they seem so small?" When students can point out the size-distance equations, the teacher then asks for similar examples. When students cannot give answers, the teacher asks them to check out the cars that can be seen from the classroom window between their two fingers; The students look at the cars – one close and the other some distance away – by moving their hands back and forth. The teacher then asks if anyone has any questions. (O1-O2)*

We observed that the teacher-directed a question about the subject and made an activity for formative assessment according to the answers. Then the teacher asked if the students had further questions, to assess the need for formative assessment. In a similar question-answer process, it is observed that Ayşe uses a different teaching practice from the one she had used before. For example:

> *Ayşe asks, "What are the dependent, independent and control variables in the relationship between heating time and water temperature increase?" A student gives the wrong answer regarding the dependent variable. The teacher tries to help the student find the answer using a metaphor. (O1-O2)*

In some cases, it was seen that they did not check the students who did not understand these questions or who needed support. When the correct answer came, they moved to the next concept or question. Ayşe's classroom activity illustrates this situation;

> *The teacher finishes lecturing; she has prepared a set of questions. She divides the class into groups and sets up a competition. Each group earns 10 points for a correct answer. Groups give their answers by raising their fingers. However, some students disagree with the answers given by their fellow group members. The teacher does not intervene but directs some questions towards finding the answer. After each correct answer, a new question is asked. The teacher explains only one question because none of the groups is able to answer.*

Assessment and evaluation practices of conscious teachers

Conscious teachers are the ones who know about formative assessment and evaluation and can apply them correctly in their classrooms. What particularly distinguishes the teachers in this group from other teachers is their awareness of the practicability of assessment at each stage of the course and its reflection in each lesson. This is an indication that the teacher is mostly focused on planned formative assessment. According to the data obtained from six teachers in this section, one teacher being monitored during four lessons, the flow and classroom practices of the course in terms of formative assessment are summarized below:

- Checking prior knowledge and prior learning
- Checking whether students have questions
- Enquiring about specific parts of the content-related understanding
- Moving on to the next topic only after the current topic has been understood thoroughly
- Use of the end-of-unit assessment test in class and re-review of correct answers
- Use of the re-teaching process to eliminate insufficient learning

In conscious teachers, checking of prior knowledge is similar to that of eclectic teachers. In this group, the teachers make a transition to the new topic only after they have made the check-ups of prior learning. For example:

> *The teacher asks for examples of transparent, semi-transparent and non-transparent materials. The examples given are discussed. The teacher clarifies anything that is unclear and asks questions such as "Do you understand the drawing of the shadow understood?" and "Do you understand the light source coming closer?" (O1-O2)*

In this example, it appears that the teacher checks prior knowledge and tries to collect data by asking content-related questions to determine unclear areas and whether there is a need for new teaching. After these discussions at the beginning of the lesson:

> *The teacher asks "Are there any questions so far?" and continues, "If you've understood everything so far, you'll also understand the next topic," and she moves on to the next topic, size-distance equations. (O1)*

In another example, the teacher seems to question the unclear parts specifically associated with the content and then moves on to the next topic after all the points are made manifest.

> *The teacher gets both verbal and applied answers by asking, "What happens if the curtain comes closer to the object?" At the end of the discussion, the teacher states "We have learned what we need to get an umbra, did you understand?" to collect data for formative assessment and continues by saying "Then in order to get an umbra, we need…?" to let the students finish her sentence. (O1-O2)*

Following the question-answer process used for formative assessment and evaluation, the end-of-unit assessment test is used by the teacher at the end of the courses. These tests are answered by the students in the classroom. For example, the teacher distributes the subject screening test to the students:

> *Each student answers questions, and the teacher underlines the crucial points to be considered even if the questions were answered correctly. After the explanations about the question, the teacher asks if there are any questions. (O2)*

In another example, the teacher uses formative assessment strategies at the end of a topic in a similar manner to the previous example:

> *The teacher gives answers to the first ten questions at the end of the unit assessment test, and the rest of the questions are left for the next week on the condition that the students review at home what they learned and note anything they did not understand about the topic. In the next lesson, the students are to raise the questions they have in mind after reviewing and ask for clarification if necessary. (O1)*

It was determined that science teachers carry out different classroom practices depending on their awareness level. We observed that teachers in the same group (e.g., naive) have similar classroom practices and activities While naive teachers hardly ever practiced formative assessment methods, the eclectic teachers implemented formative assessment in their classrooms but lacked adequate and conventional approaches. On the other hand, conscious teachers know the formative assessment methods can use these approaches in the classrooms.

Discussion, Conclusion and Recommendation

The aim of this study is to reveal the awareness of science teachers about formative assessment and their reflections on classroom practices. By developing the rubric based on teachers' thoughts, classroom practices and motivations, the awareness levels of teachers about formative assessment were examined.

In light of the findings obtained in the study, it has been revealed that the awareness of science teachers of the formative assessment and evaluation approach can be grouped at three different levels: "naive", "eclectic" and "conscious". These three levels represent a low to high increase in awareness of formative assessment. For example, while naive teachers have inadequate knowledge and application of formative assessment, conscious teachers have a highly modern educational perspective at both theoretical and practical levels. As for the eclectic teachers, it is concluded that they have theoretical knowledge about the subject, but there are contradictions between what they express and what they do in practice. In addition to revealing the pedagogical status of teachers, these differences are seen as an element that can affect the use of formative assessment in the classroom in the curricula and current education approaches (Bell & Cowie, 2000).

When the teachers participating in the study examined in accordance with the rubric, it was seen that very few of them were at the desired level on the theoretical and practical aspect of formative assessment. This means teachers do not practice formative assessment in the classroom correctly and according to the points emphasized in science education programs. For example, naïve or eclectic teachers were more likely to correct the problem with on-the-fly feedback, which is used merely to correct a mistake (Bell & Cowie, 2001). Teachers' assessment using on-the-fly questions make the assessment an evaluation process rather than a learning process (Nichols et al., 2009). Morrison and Lederman (2003), in their study, found that all teachers used low-level reminder questions to explore students' knowledge level. On the other hand, more experienced teachers ask questions leading to in-class discussions which encourage students to express their thoughts. In other words, the teachers' awareness levels and the classroom practices they use at this awareness level affect students' learning processes positively or negatively.

Another finding of the study was that teachers' awareness levels directly affected the formative assessment practices used in the classroom. More explicitly, almost no formative assessment was observed in the classroom of the naive teacher, whereas conscious teachers used formative assessment strategies successfully. Bell and Cowie (2000) argued that the reason why teachers do not use formative assessment strategies in their class is that they had low level awareness about formative assessment techniques and strategies. In this study, it was also observed that there is a correlation between the level of awareness of teachers and the assessment and evaluation approaches they use in class. When teachers with low-level awareness and not using formative assessment strategies are considered to affect the quality of education, it is necessary to develop more effective teaching strategies to include formative assessment in the teaching process (Tomlinson, 2007). Accordingly, to include formative assessment correctly and widely in the teaching process, the awareness levels of teachers can be developed. Similarly, it was emphasized that examining in-class practices was important for determining the level of formative assessment, at which stage it is used and how the process is conducted (Coffey et al., 2011). This situation is thought to be useful in terms of guiding both researchers and teachers in determining the level and shape of the theoretical knowledge. In studies conducted previously, it was found that formative assessment strategies were not used systematically in classroom teaching, that their essential features were not taken into consideration (Morrison & Lederman, 2003), and that some teachers used formative assessment strategies in the classroom without actually realizing it (Cowie & Bell, 1999).

One of the remarkable results is that teachers' formative assessment approaches, which they use in parallel with their awareness levels, affect the nature of the discussions within the classroom and the way students express themselves. For example, naive teachers eliminates the reasoning, scientific discussion and argumentation that should take place in the classroom, the conscious teachers offers the students an opportunity to express themselves, to have scientific discussions and to correct the points on which a fellow student is wrong. This situation is not only related to increasing the success of the student, it positively affects the self-efficacy, interest, and motivation of the students (Brookhart, 2008; Sadler, 1989) and contributes to self-regulation, reasoning, planning skills and elimination of misconceptions (Black et al., 2002; Hattie & Timperley, 2007). Given the benefits of applying it in the classroom, the inefficient use of formative assessment in the classroom will deprive students of the opportunity of developing subjects.

The basic idea of formative assessment is to enquire what a student knows about a topic and determine the gap between the goal to be achieved and prior knowledge, and to fill this gap with the help of the teacher (NRC, 2001). Although it is seen as necessary for teachers to spot students' misconceptions and incorrect learning and find appropriate methods to guide them towards a more meaningful education, it was observed that the teachers in the naive and eclectic groups are failing to meet the requirements of formative assessment. It was emphasized that formative assessment should have more space in the education system and it should be made not only evaluation but also a part of learning (Yalaki, 2015). In this respect, it was seen that teachers in the present study did not carry out contemporary assessment approaches in their classrooms. Curriculum-based assessment, which is one of type of formative assessment might be integrated into the programs to develop teachers' awareness and motivation (Shavelson et al., 2008). Thus, formative assessment is considered to be part of in-class practices.

It was clearly demonstrated by the findings of this study that the awareness is directly reflected in the classroom. Therefore, in order to use formative assessment effectively in the classroom, the awareness of practitioners needs to be increased. It is an essential step proposed for the development of formative assessment practices. However, it is thought that consciousness can be improved by increasing the experience of formative assessment as well as teachers' knowledge level. It is seen that increasing the level of knowledge about formative assessment alone is not sufficient in the study. Yalaki (2015) emphasized that formative assessment strategies required a particular adaptation by both students and teachers and could be improved by practice. The fact that teachers have the opportunity to experience these methods will increase their awareness and theirs usability. From this point of view, it is considered that it is important to include formative assessment practices besides theoretical knowledge in pre-service and in-service teacher trainings. For example, continuing professional development programs (CPD) should be supported by evaluating the classroom practices of teachers. In this context, according to Pearson, Scott, and Sugden (2011), instead of short-term professional development programs with only theoretical knowledge, continuing professional development programs addressing both the theoretical and practical aspects are more useful in increasing the knowledge and skills of the participants. Besides, Walsh (2006) suggests that teachers make self-evaluation and use reflective practices in such professional development programs. In summary, it is recommended to plan continuing professional development programs with practice and feedback in order to raise awareness of the in-service teachers about formative assessment. For pre-service teachers, it is recommended to extend the courses in which theoretical and practical applications of formative assessment are given together. In this way, it is thought that pre-service teachers can effectively use formative assessment practices when integrated into the education system. It is believed that awareness and support for classroom practices will be supported.

When the results obtained in this study and the points highlighted in the literature have been taken into consideration, it will be necessary to examine teachers' awareness of increasing application in the classroom. Studies generally are conducted to investigate the methods of assessment and evaluation used by teachers (Birinci-Konur & Konur, 2011), fewer of them are focusing on how teachers implement formative assessment strategies. With this in mind, there is also a need for a more focused study which examines the classroom practices so that the teachers are guided towards a more effective learning-teaching process. It is recommended that the researchers who will work in this field will examine the classroom applications in detail and that they will help the students to understand the classroom in a better way both by the practitioners and the researchers. In this way, it is recommended for field researchers to carry out studies that will contribute to the content of continuing professional development programs that can improve the practices of trainers. It is thought that the scope of awareness and indicators that are framed within the range of this research can be tested and enhanced by using different researchers in future studies.

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