Investigating high school science teachers' readiness for implementing formative assessment practices

Khalid A. Kariri [1*] , William W. Cobern [2] , Adam A. Al Sultan [1]

[1] Imam Abdulrahman Bin Faisal University, Dammam, SAUDI ARABIA
[2] Western Michigan University, Kalamazoo, MI, USA

Abstract
Formative assessment is used to link teaching and learning in the classroom. It provides feedback on ways to improve student performance by matching educational goals with instructional practices. The purpose of this study was to investigate Saudi science teachers' readiness to implement formative assessment. The participants included 11 male high school science teachers. This study involved a qualitative, phenomenological research design. Science teachers were shown examples of teachers using formative assessment techniques in the form of vignettes and were asked if they have used or will use such techniques in their classrooms. The findings provide information on the readiness of science teachers to adopt formative assessment. Results show that only three had used formative assessment, indicating that teachers need more preparation for using formative assessment. The findings of this study are helpful for Arabic language countries and countries that tend to have rigid curricula.

Keywords: formative assessment, science teachers, readiness, high school

INTRODUCTION

Assessment is a process that links teaching and learning. Although assessment can take various forms, many educators consider assessment to be the process that is used to evaluate what has been learned in a lesson or a series of lessons. According to Wiliam (2010), assessment "is a central and perhaps even a defining feature of effective instruction: Assessment is the only way that we can know whether what has been taught has been learned" (p. 18). Formative assessment is a process for assessing the progress of a student while learning is taking place, not afterward. According to Hattie (2012), formative assessment supports specific student needs, thus improving student achievement of learning objectives. Although there is much evidence that supports the effectiveness of formative assessment, there are areas where more research is needed (Alotaibi, 2019). One area pertains to high school science teachers. Relatively few scholars have investigated the views of high school science teachers on formative assessment, their practice of formative assessment, or the challenges of formative assessment as a cyclical process in the science classroom. Additionally, studies are needed

from more diverse educational cultures to introduce different perspectives and expectations regarding formative assessment (Adie et al., 2018). Saudi Arabia is a good example of a country where there has been little research on formative assessment. Additionally, little research has been carried out on high school science teachers' readiness to implement formative assessment (Alrasheedi & Alahmad, 2022). Readiness for change is a comprehensive attitude that is influenced by content, process, and context. Readiness means that the individual is cognitively and affectively inclined to accept, embrace, and adopt a particular plan to purposefully change a current situation (Holt et al., 2007). As such, the purpose of this study is to investigate Saudi science teachers' readiness to implement formative assessment practices.

THEORETICAL FRAMEWORK & LITERATURE REVIEW

Formative Assessment and Summative Assessment

Black and Wiliam (2009) distinguished between formative and summative assessment by asserting that

Contribution to the literature

- The study contributes to the empirical literature on science teachers specifically in Saudi Arabia, but more generally in Arabic-speaking countries. These are areas, where empirical science education research is relatively new.
- The study contributes to the literature on the formative assessment by specifically focusing on high school science teacher readiness.
- The study contributes to the literature an innovative protocol for interviewing teachers about formative assessment that is in the form of vignettes to collect data from teachers who may not understand the practice of formative assessment very well.

formative assessment attempts to utilize assessment techniques to record in-process teaching and learning adjustments for both teacher and student: in other words, to see what the students are learning (formative) rather than what they learned (summative). As such, formative assessment is embedded within instruction involving both teacher and learner. The teacher works toward eliciting evidence that leads to instructional decision-making.

Summative assessment is often associated with final exams or standardized testing; summative assessment refers to what has been learned at the end of a class. As such, summative assessment happens too far down the learning path for teachers to adjust instruction and make learning process interventions (Garrison & Erlinghaus, 2013).

Overall, the key difference between formative and summative assessment has to do with the term "in-process". Formative assessment happens before or during the lesson. Summative assessment is a culminating activity. Summative assessment, in the form of standardized tests, for example, cannot be used to modify lessons or teaching in ways that can better prepare students or better understand their needs. Moreover, formative assessment is intended to improve student performance by improving motivation and closing the gap between what the students know now and what they are expected to grow to understand. Formative assessment concentrates on student learning, increasing confidence, and shaping self-efficacy, so that students' interest in learning improves (Yin et al., 2008). According to Black and Wiliam (2009), formative assessment has five major components:

> "share learning intentions and criteria for success; engineer effective classroom discussions and other learning tasks that elicit evidence of student understanding; provide feedback that moves learners forward; activate students as instructional resources for one another; and activate students as the owners of their own learning" (p. 8).

Black and Wiliam's (2009) components serve to clarify the complexity of the educational practice of formative assessment. Overall, formative assessment refers to a processes for identifying misconceptions, struggles, and learning gaps. It seeks to address those problems through steps taken by teachers in classroom instruction.

The Theory of Formative Assessment

The primary theoretical framework for this study is *formative assessment theory*, which indicates that formative assessment is an essential component in a classroom and one that moves the classroom focus from teacher-centered to student-centered (Brookhart, 2013; Webb & Jones, 2009). This framework is described by Bell and Cowie (2001) and Black and Wiliam (2009). Bell and Cowie (2001) described two types of formative assessment, which are *planne*d and *interactive*.

Planned formative assessment is about collecting information from the entire class reflecting progress toward learning objectives. As such, planned formative assessment is often employed to identify areas where students struggle and then to design instruction accordingly. The teacher plans before instruction using three phases: elicit, interpret, and act. In the eliciting phase, the teacher aims to gain information from the students using specific assessment tasks to determine class learning progress. The teacher documents students' responses, often semi-formally, and reflects on them for later action. For example, a teacher may employ quick tests before each lesson during a unit. Then, the teacher needs to interpret the information. In this phase, the teacher's interpretation of the elicited information is often subject criterion-referenced. The teachers seek to know if their students understood the subject as intended. Additionally, the teacher's ability to interpret the information they collect involves using their content knowledge, general and content pedagogical knowledge, curriculum knowledge, knowledge of educational contexts, and a knowledge of educational aims and goals. In other words, the teacher's prior experience (i.e., knowledge bases [Shulman, 1987]) helps evaluate what information students need to progress and thus results in an action. Therefore, the final phase of planned formative assessment is the acting phase. Here, the teacher can utilize the elicited and interpreted information to enhance the students' learning. The teacher must have flexibility in their action plans and

willingness to modify their instruction to meet students' needs.

Interactive formative assessment naturally occurs during student-teacher instructional interactions. Interactive formative assessment also has three cyclical phases: notice, recognize, and respond. In the noticing phase, the teacher notices what the students understand during practical activities by circulating among students and glancing at students' progress. As such, the information gained in this phase is ephemeral and not recorded. This phase is a faster mechanism compared with the more formal eliciting phase of the planned formative assessment. Therefore, the teacher needs to be mindfully attentive and aware because the nature of the information gained from the students is both hard to notice and may not be obtainable later. In the recognizing phase, the teacher seeks to identify the importance of the information gathered from the students, which involves the teacher's ability to recognize the implications of that information. This requires the teacher to know how the information fits into the curriculum and to be aware of potential misconceptions. Finally, the teacher responds to what has been noticed and recognized. In the responding phase, the teacher utilizes the information gathered from the two previous phases and generates an explanation or demonstration for the whole class. The teacher thus provides immediate feedback to students.

The teacher must be able to see beyond the curriculum, lesson plans, and test preparation to get to the root of what students are thinking other than the right or wrong answers (Bell & Cowie, 2011). As such, when teachers spend time assessing student thinking and making necessary adjustments, the quality of their instruction is directly correlated with the effectiveness of their instruction, which is the main goal of formative assessment. Using formative assessment, teachers provide students with an opportunity to demonstrate their understanding during the learning process. A teacher then analyzes the student data to determine if further work on conceptual understanding is needed. When gaps in understanding are discovered, a teacher will then modify instruction. An additional planned assessment may then be provided to determine student growth in understanding. Researchers have found that students and their teachers, working as a team, can provide information necessary to successfully move student learning forward. When formative assessment is used appropriately in the classroom, several things can happen: student learning improves (Black & Wiliam, 2009; Popham, 2011); teachers have greater understanding of their students' needs (Bell & Cowie, 2001); teachers can keep better track of the learning as it evolves (Hattie, 2012); and teachers and students can embark on a personal journey of discovery and learning together (Hattie, 2009). Indeed, formative assessment can have a powerful impact on student motivation when
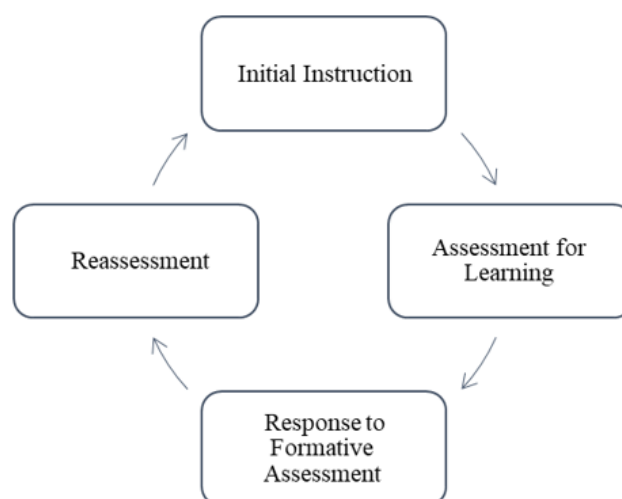

Figure 1. A model of formative assessment practices (Source: Authors' own elaboration)

the barriers of performance-based assessments and the comparisons of student abilities are reduced (Cauley & McMillan, 2010).

Model of Formative Assessment Practices

Each of the aforementioned contributions offers insightful thoughts, experiences, and practices of formative assessment and informs the design of this study to investigate secondary school Saudi science teachers' readiness to implement formative assessment practices. As such, the research of the current study proposes a model of formative assessment practices to address the study's objectives (**Figure 1**).

Figure 1 illustrates the proposed formative assessment model with its four-phase cycle: *initial instruction*, *assessment for learning*, *response to formative assessment*, and *reassessment*. At the beginning of a class, a teacher prepares the lesson and selects a teaching strategy (i.e., initial instruction). To achieve the maximum benefits of formative assessment practices, the teacher adopts a student-centered initial instruction. The next phase is assessment for learning, where the teacher provides students with an opportunity to demonstrate their understanding during the learning process. The teacher uses one or more assessment methods to verify how well the students have achieved the lesson's learning objectives. The following phase is the response to formative assessment, where the teacher analyzes the student data to determine if further instructional activities are needed. If the formative assessment indicates that the students have not adequately learned the lesson objectives, then the teacher plans for "reteaching" using different teaching strategies. The final phase is reassessment, where the teacher provides an additional planned assessment to determine student growth in understanding. If the students still have a shortcoming in understanding and achieving the learning objectives, the teacher repeats the four steps of formative assessment.

Formative Assessment in Saudi Arabia

In Saudi Arabia, there is a lack of literature about the use of formative assessment. Formative assessment has been discussed in a number of studies (Al-Alhareth & Al Dighrir, 2014; Al-Sadaawi, 2007; Al-Sadan, 2000; Qassim, 2008); however, these studies dealt mainly with general assessment, not specifically formative assessment. Nor were they specifically about science classrooms. The exception is Alanazi (2017), who tested the effectiveness of an in-service teacher development program designed to promote the use of formative assessment. Following the training program, Alanazi (2017) found that teachers who attended the program used more formative assessment in their classrooms than did a similar group of teachers who had not received the training. More recently, Alrasheedi and Alahmad (2022) indicated that high school science teachers rarely implement formative assessment practices in their classrooms and often focus on traditional assessment forms, such as end-of-term examinations, in-class chapter tests, and formal essays.

Previous research has established that teachers have a positive attitude toward using formative assessment; however, they are less confident implementing formative assessment practices in their classrooms (Cauley & McMillan, 2010; Young & Jackman, 2014). According to Kariri et al. (2018), Saudi science teachers use pre-assessments, assessments during a lesson, and post-assessments but not formative assessment. Their assessments included discussions, handouts, verbal questions, and tests. Based on interviews, Kariri et al. (2018) found that teachers rely on lesson goals set by the Saudi Ministry of Education as included in a teacher's guidebook. Although the teachers commented positively about formative assessment, they did not in fact make use of it in their classrooms. None of the teachers interviewed retaught lessons or changed methods to ensure that students had learned what they needed. The teachers interviewed clearly felt pressure owing to a new curriculum, large class sizes, and time constraints. There seemed to be little understanding of the need to adjust instruction after formative assessment to address gaps in student learning. Saudi Arabia is a good example of a country where there has been little research on formative assessment, yet there is a significant need for formative assessment. But are these teachers ready for formative assessment?

Research Questions

To investigate male high school science teachers' readiness to implement formative assessment practices, three primary questions with related sub-questions guided this study:

1. What do Saudi high school science teachers' responses to the various phases of formative assessment?

   a. What are Saudi high school science teachers' thoughts about initial instruction, that is, how to begin a lesson?

   b. What are Saudi high school science teachers' thoughts about using an "assessment for learning" approach in their classrooms?

   c. What are Saudi science teachers' thoughts about using a "response to formative assessment" approach in their classrooms?

   d. What are Saudi high school science teachers' thoughts about using a "reassessment" approach in their classrooms?

2. What do Saudi high school science teachers say would hinder their implementation of formative assessment?

3. What support do Saudi high school science teachers say they would need to implement formative assessment?

MATERIALS AND METHODS

Research Design

This study involved a qualitative, phenomenological research design to address the research questions, focusing on the experiences of a particular group of individuals and their understanding, views, and reflections regarding a phenomenon (Creswell & Poth, 2014). The phenomenological research design provides an in-depth description of an individual's experiences and allows the researchers to explore their understanding, interpretations, and meaning-making of those experiences (Patton, 2015). The phenomenon in this study was formative assessment, specifically Saudi secondary science teachers' readiness to implement formative assessment practices.

Participants

A convenience sample of 11 male high school science teachers from different schools in the Eastern Province of Saudi Arabia participated in this study. Throughout this report, pseudonyms are used to protect the anonymity of the participants. See **Table 1** for the participants' demographic data. Because of cultural norms in Saudi Arabia, as male researchers we could only recruit male participants. Female teachers would have been included if there were a female researcher, but unfortunately, there was not.

The participants included four physics teachers, three biology teachers, and four chemistry teachers. They had between five and 10 years of experience. A bachelor's degree was the highest education level attained by the participants, and all had attended at least one but no more than three professional development events on assessment.

Table 1. The participants' demographic data

Teachers' names (pseudonyms)	Science major	Highest level of education	Years of teaching experience	Number of attended professional development events on assessment
Mohammed	Physics	Bachelor	7	2
Salem	Physics	Bachelor	8	2
Omar	Physics	Bachelor	7	2
Amer	Physics	Bachelor	10	3
Hamad	Biology	Bachelor	8	2
Abdullah	Biology	Bachelor	10	3
Ahmed	Biology	Bachelor	6	1
Ibrahim	Chemistry	Bachelor	9	3
Faris	Chemistry	Bachelor	10	3
Fahad	Chemistry	Bachelor	5	1
Bader	Chemistry	Bachelor	9	2

Data Source and Procedures

The researchers developed an interview protocol to collect data from the participants. Rather than simply asking the participants what they thought about formative assessment, the researchers showed them examples of authentic formative assessment in the form of vignettes (based on Keeley et al., 2005) and asked them to respond to several interview questions. For the purpose of this study, we defined teacher readiness as having positive responses when presented with an authentic formative assessment vignette; and, moreover, having ideas of their own as to how they would implement formative assessment and why they would do it. On the other hand, teachers who have little to say or if what they say is negative or hesitant about formative assessment, then our conclusion is that they are not ready to implement assessment.

The formative assessment vignette was divided into four phases associated with the formative assessment model: *initial instruction*; *assessment for learning*; *response to formative assessment*; and *reassessment* (**Figure 1**). In the interview protocol, we presented a participant the first phase of the vignette, which is initial instruction, and then asked questions about this phase. In the next step, we showed the participant the assessment for the learning phase of the vignette and then asked questions about it. Third, we showed the participant the third phase of the vignette, which is the response to formative assessment, and then asked questions about that phase. Finally, we showed the participant the reassessment phase of the vignette and then they answered questions about that phase. Also, we asked probing questions of the participants following each phase. To illustrate, the participants saw the parts of a vignette one at a time. See the Appendix for the protocol.

The first author interviewed the participants, and their responses were audio-recorded, then the data were transcribed verbatim. In order to reduce the influence of the researcher's beliefs and perceptions during the data collection, open-ended questions were used, and participants led the discussions. To ensure code accuracy and reduce selection bias, the first and third authors who

speak Arabic independently coded the transcripts. We used an inductive process for open coding (Corbin & Strauss, 2015). A codebook was developed based on iterative examinations of the current study's purpose and questions. The codes were associated with the research goal and questions. The interview scripts were analyzed using MaxQDA, which is computer software used for qualitative data analysis. MaxQDA helps analyze the interview scripts by organizing the themes and codes. Researchers can analyze qualitative data such as interview scripts by organizing the themes and codes, and they are able to determine the results by organizing the themes and codes. Summary statements were also used to construct responses to the research goal and questions. The inter-rater reliability was estimated by comparing coding. Reliability was calculated at a 0.95 level of consistency. Finally, the results were translated into English and verified by the second author.

RESULTS

First Research Question: What Do Saudi Science Teachers' Responses to the Various Phases of Formative Assessment?

First sub-question

The first research question was addressed through four sub questions. The interview protocol began with the teacher reading *the initial instruction phase* of the vignette (**Appendix A**). In the vignette, the teacher taught a lesson on animal characteristics with two specific learning objectives using a lecture method. To show his students the differences between animals and other organisms, he used pictures and verbal explanations. The participant read this section and then was asked about their own instruction. Four of the 11 teachers preferred a lecture method for their initial teaching. The four teachers who preferred a lecture method for the initial instruction gave time constraint as the reason. For example, Ahmed said,

> "Sure, this method is essential to me, and I always use it because class time is very limited, and I

often cannot finish lessons on time using other teaching methods" (transcript line 42).

Omar commented similarly,

"I use this teaching method, especially since the curriculum is a lot, or time is limited, so I use it to shorten the time" (transcript line 35-37).

The remaining seven teachers indicated they did not prefer lecturing. They thought it was not a good method for their classes and expressed several concerns about using the lecture method in their classrooms. These teachers were more *student-centered*. For example, referring to the vignette, Salem said,

"The method of teaching used is the lecture, which I do not like, and there are better ways like using a picture or video to raise the attention of students and then ask questions and hear from the students instead of starting the teaching directly in the explanation of the manner of the lecture" (transcript line 37-41).

Fahad said,

"This method is not appropriate because it does not focus on the students. The teacher [in the vignette] used the lecture, and that is a wrong choice. He should focus on student learning and not on the teacher's actions. I do not use the lecture method because I want the learning to be focused on student engagement" (transcript line 47-50).

Bader said,

"The method does not achieve the goals because the student must discover the information, but the teacher [in the vignette] here gave them the information, and this is contrary to active learning, the method now used in Saudi Arabia; active learning, that is, the student looking and learning and exploring, the teacher using the method of indoctrination is primitive and old" (transcript line 32-34).

In summary, these teachers objected to the lecture method because it places the focus of instruction on the teacher instead of the students. Regarding the answer to the first sub-question, the majority of the teachers think that initial instruction should focus on the student.

Second sub-question

The second interview question represents *the assessment for learning phase* of the vignette and addresses the second sub-question. Before the teachers read the assessment for the learning phase of the vignette (**Appendix A**), they were asked what they felt should

happen after the initial instructional phase. All of the teachers said that some form of assessment should come after the *initial instruction* phase. Five of the teachers suggested the assessment practice of *oral questioning* to assess the students. For example, Mohammed said,

"After the explanation, the teacher must ask the students some questions, and through the questions [the teacher in the vignette] knows if the scientific concept is reached" (transcript line 57-58).

Abdullah said,

"After explaining the lesson, I start by making sure that the information has reached the students with so-called feedback, so making sure that the information has reached the students. Sometimes I ask students questions. Sometimes, students in each group are given the opportunity to ask questions to another group and so on" (transcript line 46-47).

Ibrahim said,

"So as to make sure the student's understanding, give them oral questions or discussion and can be distributed in the form of groups" (transcript line 53-55).

The remaining six teachers suggested the assessment practice that is *worksheets*. For example, Ahmed said,

"It is assumed that after each point, there is an assessment, and then the teacher [in the vignette] assess the students in general on the whole lesson" (transcript line 45-46).

Salem said,

"After the explanation, the final assessment of the lesson can be done by means of oral questions or questions in the book, which are directly answered by students individually or by groups" (transcript line 47-48).

Faris said,

"The next step asks students to give examples of the same solubility issue and how solids dissolve in liquid. Often after the explanation, I use a worksheet about the terms or vocabulary or concept" (transcript line 37-40).

Fahad said,

"I always use worksheets that include images and examples to distribute to my students. It is important to make sure that the lesson's goals are achieved" (transcript line 55-58).

In summary, when asked what should follow the initial instruction phase, all respondents said that either assessment or the use of oral questions or worksheets should come next. Regarding the answer to the second sub-question, all of the teachers think that assessment for learning should be implemented.

Third sub-question

The third interview question represents the *response to formative assessment phase* of the vignette (**Appendix A**) and is the third sub-question of the first main question. In this phase, the teacher in the vignette reviewed his students' answers to the assessment and found the students had had trouble. In the next class, he decided to focus on these student difficulties by dividing students into groups and reteaching them by new worksheets and activities. The teacher uses guided questions to identify misconceptions or misunderstandings. Finally, the teacher leads a whole-class discussion and uses guidance questions to address any confusions.

After the teachers read this phase of the vignette, they were asked if they could see themselves doing what the teacher had practiced in the vignette. All the teachers spoke positively about the formative assessment used by the vignette teacher and said they preferred to apply this method in their own classrooms, although they did not use the term "formative assessment." Six of the teachers said they always used such an approach. For example, Mohammed said,

> "Yes, always use it in my teaching" (transcript line 98).

Fahad said,

> "Always use it in every lesson and every time and give students freedom so that I make sure that the goal is achieved or not achieved" (transcript line 113-114).

Faris said,

> "Yes, apply it and try to let the student get the information. And I do not give them the information so that [the teacher in the vignette] concludes the information such as using brainstorming" (transcript line 85-86).

The other five teachers said that they sometimes used such an approach. These participants worried that there might not be enough time to present the material again or spoke about the large number of students in the classroom. For example, Ahmed said,

> "Yes I sometimes apply this method in my teaching if time is allowed. This method needs a long time" (transcript line 78).

Amer said,

> "I will apply it if there is enough time" (transcript line 87).

Salem said,

> "If the lesson helps me to apply it. Most of the time, I apply it in short lessons" (transcript line 88-89).

Omar said,

> "Of course, I apply it, but the percentage of my application of this method depends on the proportion of students who do not understand" (transcript line 91-92).

Regarding the answer to the third sub-question, all participants expressed their support of the method the teacher used in the vignette without actually using the term formative assessment.

Fourth sub-question

The fourth interview question represents the *reassessment* phase of the vignette and the fourth sub-question of the first main question. Based on the formative assessment model of the current study, the participants were asked what they thought the teachers in the vignette should do next after the *response to formative assessment.* It is important to indicate that in the reassessment phase the teacher (in the vignette) provides an additional planned assessment to determine student growth in understanding and the extent of achieving the lesson's learning objectives. Based on the previous phase in the vignette, which is the response to formative assessment, the teacher in the vignette retaught his students with further instruction. In the following phase, which is the reassessment, the teacher provides an additional planned assessment to determine student growth in understanding.

Specifically, in the vignette (**Appendix A**), after the teacher retaught his students using different teaching strategies with further instructional activity, he assessed his students using an additional planned assessment that is a worksheet similar to the one he used before, but this one included more pictures and descriptions of confusing concepts. The interviewees read the reassessment phase and were asked their opinion of what the teacher should do after the response to the formative assessment phase of the vignette. Only three teachers thought the method would give the opportunity to measure students' understanding and achievement of the learning objective after reteaching them and giving them additional instructional activity, and that the teacher in the vignette would reassess his students to make sure the students understood the points of the lesson. For example, Omar said,

"I think that after the teacher [in the vignette] reteach his students and gave them a new activity to overcome the difficulties that students had, he should reassess them to make sure of their understanding" (transcript line 117-119).

Fahad said,

"The teacher retaught his students the point, which they had trouble with, by using another way of teaching and activity, so now I think he should make sure students understand by assessing them" (transcript line 124-125).

The other eight participants' responses showed no indication of an additional planned assessment (i.e., reassessment) after the teacher retaught his students in response to the formative assessment phase. The eight participants' responses were brief, and two misconceptions stood out in their responses. The first misconception was themed *summative assessment*. Surprisingly, five of the participants argued that a summative assessment was suitable after the response to the formative assessment phase to conclude the lesson and in some responses to mark the student's final performance grade on the concepts of the lesson. For example, Mohammed said,

"I expect [the teacher in the vignette] should make a summative assessment, such as an exam or a test" (transcript line 140).

Similarly, Omar said,

"I think that the teacher [in the vignette] should test his students' knowledge to make sure of their understanding by distributing a final comprehensive test" (transcript line 130-131).

Amer also added,

"He [the teacher in the vignette] should give them a final assessment to make sure the information is reached" (transcript line 118).

Fahad also stated,

"I think the teacher [in the vignette] should make sure students understand by assessing them using a final test" (transcript line 137).

Other participants emphasized that homework would be appropriate at this point to grade the students' final performance. For example, Ahmed said,

"He [the teacher in the vignette] would make sure that students understand the lesson, and it is possible that the teacher should give students homework to evaluate their final performance" (transcript line 117).

Ibrahim said,

"I think homework would be the next step, and in the next class the teacher should have marked the students' homework" (transcript line 122).

Furthermore, the second misconception concerned the next lesson. Interestingly, three of the teachers stated that the teacher's procedures in the vignette were enough to move to the next lesson. For example, Salem said,

"If this step is applied in a good way, I expect the information to reach the student, and the students understand the lesson. No other steps are needed. [The teacher in the vignette] goes to the next lesson" (transcript line 114).

Regarding the answer to the fourth sub-question, three teachers believed that the method, which was used by the teacher in the vignette, gave students the opportunity to infer and reach their own understanding, and that they would reassess their students to ensure they understood the points of the lesson. The responses of the eight teachers did not indicate an additional assessment planned, and they made two misconceptions: they used summative assessment rather than formative assessment, and they moved to the next lesson after responding to the formative assessment phase.

Second Research Question: What Do Saudi Science Teachers Say Would Hinder Their Implementation of Formative Assessment?

As mentioned by the interviewees, there are four difficulties or obstacles to using formative assessment. According to 10 of 11 teachers, the lack of time was what hindered them from using formative assessment. For example, Abdullah said,

"This method takes a long time" (transcript line 115).

Salem said,

"But we have a time problem so that the curriculum is long in the secondary school. The problem is the time because I have a curriculum. At the same time, I need to explain it very efficiently" (transcript line 92-93).

Omar said,

"The disadvantages. I see that the biggest negative is the time when the teacher finds it difficult to find time to diversify in teaching or re-explain in another way. I discovered that the time has been limited to the teacher in the method of evaluation

formative and difficult to return in another way" (transcript line 97-99).

Furthermore, two of 11 teachers thought the large number of students in the classroom was a major obstacle to the use of formative assessment. For example, Abdullah said,

"The large number of students hinders my using of this strategy" (transcript line 171),

and Hamad said,

"But sometimes in the case of a large number of students may cause the length of the explanation period" (transcript line 179).

Moreover, the length of the curriculum was mentioned by two of 11 teachers as one of the obstacles. For example, Abdullah said,

"First curriculum. The number of lessons is too many and the information is very large" (transcript line 172).

Salem said,

"But we have a time problem so that the curriculum is long in the secondary school. The problem is the time because I have a curriculum. At the same time, I need to explain it very efficiently" (transcript line 148-149).

Finally, only one teacher (Fahad) of the sample thought that it was possible that formative assessment was boring to some of the students who understood the concepts from the first stage. He indicated,

"One disadvantage of this method may be becoming boring to the students who understood the information from the first time, so when we return to teach the same point, it will be boring to them" (transcript line 103).

Regarding the answer to the second research question, the interviewees mentioned that the following four obstacles prevented them from using formative assessment: lack of time, the large number of students, the length of the curriculum, and boredom.

Third Research Question: What Support Do Saudi Science Teachers Say They Would Need to Implement Formative Assessment?

In response to the aforementioned difficulties or obstacles teachers face using formative assessment, two solutions were mentioned by the teachers. First, 7 of 11teachers thought that organizing time is a solution to overcome the obstacles of using formative assessment. For example, Ahmed said,

"The teacher must develop himself so that [the teacher in the vignette] can organize time in the classroom" (transcript line 132).

The second solution mentioned by seven teachers concerned working collectively as student groups. Abdullah said,

"I overcome this problem by working collectively by dividing students into groups as well as organizing time and using the clock so that each part of the lesson has a specific time" (transcript line 174-175).

Ibrahim said,

"For me to overcome the time problem, I use distinguished students in each group. I put the leader of the group in who is distinguished to help me correct the wrong ideas of the students in the group, instead of what I ordered on every group or every student" (transcript line 175-176).

Ahmed said,

"Solutions. Divide the lesson into parts and distribute the parts to student groups and assess each group" (transcript line 134).

Thus, the teachers mentioned that formative assessment causes teachers to face some difficulties or obstacles that they need to overcome, so they offered two solutions: organizing class time and working collectively as student groups.

Finally, the teachers were asked follow-up questions about the supports they would need to implement formative assessment strategy in their classrooms. Teachers taking workshops to improve using the formative assessment approach was a suggestion by nine of 11 teachers. For example, Abdullah said,

"One of the best ways I see it is to exchange experience between teachers and training courses. There are reciprocal visits between teachers to share experiences and make use of teachers" (transcript line 192-194).

Mohammed said,

"Training courses for teachers by preparing them better to use this method. The courses develop the teacher and help him to master this method" (transcript line 183-184).

Second, seven of 11 teachers suggested the possibility of teacher observations by visiting colleagues who have experience in the use of formative assessment. For example, Abdullah said,

"One of the best ways, as I see it, is to exchange experience between teachers and training courses.

There are reciprocal visits between teachers to share experiences and make use of teachers" (transcript line 192-194).

Amer said,

"Visiting colleges that teach the application of formative assessment could improve teachers' use of this method" (transcript line 149-151).

Regarding the answer to the third research question, the interviewees mentioned that they need support to use formative assessment in their classrooms including workshops and visiting colleagues who have experience in the use of formative assessment.

DISCUSSION

The purpose of this study was to investigate Saudi science teachers' readiness to implement formative assessment practices. Guided by the study's theoretical framework, our formative assessment model includes four phases: initial instruction, assessment for learning, response to formative assessment, and reassessment. To collect data from the teachers, we interviewed them using vignettes about authentic formative assessment practices. As such, the vignettes provided structure for the interview protocol.

With regard to the initial instruction phase, the study's results showed that the majority of the teachers did not prefer the lecture method in their teaching and supported the use of student-centered approaches. These findings are somewhat expected because each teacher has the Saudi Ministry of Education's learner-centered teacher guidebook for each of the science domains (i.e., biology, physics, and chemistry). The teacher guidebook proposes strategies and methods of teaching that help teachers create a student-centered learning environment. Additionally, each lesson in the guidebook provides teachers with approaches to diversify the learning according to the needs of different students. The teacher guidebook also educates teachers on how to help students with learning difficulties and provide answers to all questions and queries presented in the student's book. Our findings further support the idea that quality teacher guidebooks can have a profound effect on teachers' pedagogical and content-related competence, as well as fostering student-centered approaches (Masrifah et al., 2019).

In the assessment for learning phase, the study's results showed that all the teachers used a method of assessment after the initial instruction, and approximately half of the teachers carried out an oral questioning approach while others employed worksheets. The teachers highlighted the importance of using an assessment to make sure the lesson goals are achieved by students. However, the type of the assessment was still undefined by the teachers in this phase of the vignette, which would be clearer in the next phases. The teacher's guidebook includes instructions on how to ensure that students achieve the goals, as well as suggested questions to ask students orally or by using worksheets after each point and at the end of the lesson. However, teachers were unable to talk about various types of assessment, perhaps because the teacher guidebook does not provide much help.

Moving to the third phase, the response to formative assessment, all teachers praised the formative assessment used by the teacher and said they preferred to use it in their classrooms even though the term formative assessment had not been mentioned in this phase. Almost half the teachers expressed concern that there might not be enough time to present the material again or talked about the large number of students in the classroom. This finding is expected because studies have shown that teachers face challenges when they apply assessment. Alt (2018), for example, found that teachers often name class size and limited instructional time as impediments to innovative techniques such as formative assessment.

In the last phase of the vignette, reassessment, just three interviewees believed that the method, as used by the teacher in the vignette, gave students the opportunity to infer and reach their own understanding, and that they would prefer to reassess students. Meanwhile, the majority of teachers did not indicate they would apply reassessment. Also, it is clear from the examples given by the teachers that they had two misconceptions: they used summative assessment instead of formative assessment, and they moved to the next lesson after responding to the formative assessment phase. These findings show that when the teachers were presented with authentic formative assessment examples in the form of vignettes, only three of them were able to recognize that these were indeed examples of formative assessment, while the majority had no idea of the concept or its application. Even though they responded positively to the method, their example did indicate that they had misconceptions about formative assessment. Teachers need supporting mechanisms to help them to understand and implement formative assessment in their classes. For example,

1. After the assessment of learning part, Mohammed was asked his opinion about what the teacher in the vignette next sounds like an assessment for learning response would do because Mohammed indicates that going to the next point depends on whether or not the students learned the current point. However, after the response to formative assessment, Mohammed was asked about his opinion about the next step, he thinks the teacher in the vignette should make a summative assessment such as tests or a short quiz. Also, in the reassessment portion of the vignette, Mohammed focuses on reviewing the lesson

objectives. He does not focus on the student but more on the material. He is focusing on summative assessment, rather than formative assessment or assessment for learning.

2. Amer's opinion about what the teacher in the vignette would do after the assessment for the learning step sounds like a summative assessment. In this part, he did not indicate that he would reteach his students or change his teaching method if his students did not understand. When Amer asked about applying this strategy (response to formative assessment), he mentioned that he would apply it if there were enough time, so time constraints determine his applicability of the assessment for learning. In the concluding questions, Amer's comments indicate that he re-teaches, but he is not describing assessment for learning.

3. When Abdullah was asked about the next step that the teacher in the vignette would do after both the assessment for learning and the response to formative assessment parts, Abdullah's comments sound like the teacher addresses student weaknesses by giving them "extra homework," but extra homework is not re-teaching and certainly not assessment for learning or response to formative assessment. In the conclusion questions, when Abdullah was asked about formative assessment, he thinks this method is a very excellent, and he mentioned that he sometimes uses this method by asking a student who understands the lesson to re-explain in his way to other students who did not understand.

4. When Ahmed was asked about the next step after the assessment for learning part, Ahmed's opinion does not indicate that re-teaching is a possibility. He only suggested reviewing the "right answers." Ahmed mentioned that he would check the answers of the students and then goes on to explain again the points that students did not understand. However, Ahmed did not indicate that he would change his teaching strategy, and he thinks this method needs a long time, and he would apply it in his teaching if time were allowed.

5. Bader thought the difficulty in applying this method is the lack of an appropriate place to apply this method, such as a large and equipped science lab. Bader mentioned that he would repeat the lesson to students who do not understand. However, he did not indicate that he would change the teaching strategy, but only repeat the lesson.

In the last part of the interview, the teachers gave their opinion on the obstacles and difficulties that could hinder implementation of the formative assessment. The teachers mentioned four difficulties hindering application of the assessment, including length of the curriculum, limited time, large class sizes, and boredom. The teachers suggested solutions and support to overcome these obstacles. There were two solutions mentioned by teachers: organizing time and working collectively in student groups. Also, they were willing to learn some techniques that would support their use of formative assessment, such as workshops and visiting colleagues who are experts in using this strategy. These findings clearly show that Saudi science teachers need to learn about formative assessment and how to apply it in the classroom. According to Nilsson (2013), to understand the value of formative assessment in the classroom, new teachers must have experienced instruction that used formative assessment. As a result, Nilsson (2013) added obvious forms of formative assessment to her own interactions with student teachers, and the student teachers became more critical about what they knew about science, about children, and about their own understanding of teaching after observing these techniques.

CONCLUSION

The goal of this study was to ascertain the readiness of Saudi science teachers to implement formative assessment practices in their classrooms by showing them examples of authentic formative assessment in the form of vignettes and being asked several interview questions about the vignettes. We associated teachers' responses to authentic formative assessment vignettes with their readiness to implement formative assessment.

The major finding from this study is that the teachers interviewed are not ready to apply formative assessment in their Saudi Arabian classrooms. The researchers found that only three of the 11 teachers interviewed had used formative assessment, indicating that teachers are unprepared to use formative assessment. Although they know the term formative assessment, and they seem to grasp what the term "formative assessment" implies, their answers about the vignette and their examples show that they do not understand formative assessment. Most of them have misconceptions about how formative assessment is applied and believe that it is simply reteaching by using the same strategy or using summative assessment. Furthermore, when these teachers saw the vignette, their comments indicated that they would have difficulties in applying formative assessment. There is a discrepancy between the above results and formative assessment. According to Black and Wiliam (2009), using formative assessment, teachers identify students' misconceptions, struggles, and learning gaps. Through formative assessment, teachers strive to close these learning gaps. This is not what the teachers in this study seemed prepared to do.

The authors suggest some practical advice to science teachers in Arabic language countries and countries that use a strict curriculum to help them overcome the difficulties that they face in applying formative assessment practices. These steps include organizing time, lesson management, and working collectively with student groups. First, learning more about using formative assessment could improve science teachers' ability to effectively formulate assessment strategies, as well as to overcome the problems they may face when trying to apply this technique. Second, according to Banilower et al. (2008), effective science instruction involves the teacher eliciting students' prior knowledge so they will be able to compare their ideas with those presented in class. Therefore, a science teacher should use pre-assessment to elicit students' prior knowledge to understand what the students know about the lesson, as well as the misconceptions that students have, which will help the teacher to apply formative assessment by using the appropriate teaching method and assessment. Also, the teacher could monitor the development of learning progress during the class. At the same time, this strategy helps to save time and to deal with a lengthy curriculum because the teacher has information about what the students already know. Additionally, pre-assessment strategies help teachers learn what they need to know about the students before the class begins, so they can appropriately organize the lesson objectives, classroom time, and lesson plans.

One major strength of this study was the use of vignettes, or examples of authentic formative assessment, to help guide the interview process. Additionally, the teachers were able to relate the vignettes to topics that they were actually teaching and compare the methods used in the vignette with their own experience using the example.

A limitation that could be remedied in future studies would be the use of data beyond the self-reported interview data used here. It would have been helpful to have observed actual teaching sessions in the classrooms of all the teachers interviewed, particularly in the classrooms of the teachers who said they used formative assessment in their classrooms. A shortcoming in our study is the lack of a female researcher to interview female science teachers in action. Gender segregation is the rule in Saudi schools.

Future research will be threefold. First, we will do classroom observation to understand if and how formative assessment is being used in science classrooms. Some teachers indicated that they were familiar with these methods and used them in their classrooms. We will connect with these teachers and do classroom observations with them. We will also engage in discussions with groups of teachers and brainstorm ways that formative assessment could be implemented in their classrooms. Dini et al. (2020) created an approach to modeling formative assessment that could be a

process to help science teachers make choices in classroom interactions that can move their students' understanding forward to achieve curriculum goals. They highlighted three understandings: the centrality of noticing and interpreting student understanding; the teacher's actions and what they elicit based on what they notice and interpret; and how the teacher advances the learning based on these observations and understandings. They defined and directed these three purposes: noticing and interpreting, eliciting information, and advancing learning. This method, while simple in context, can be extremely useful in helping teachers take the information they have elicited from their students and advance those ideas to achieve the curriculum goals. Second, it will also be important to speak with the educators who designed the current curriculum and discuss with them changes in the curriculum that would include more formative and less summative assessment techniques. This could be followed with workshops to train teachers in the techniques that they are lacking. Finally, it is important to find a cooperating female researcher who could conduct a similar study among female science teachers in Saudi Arabia. This will put an additional perspective on the study and broaden its impact significantly.

REFERENCES

Adie, L. E., Willis, J., & Van der Kleij, F. M. (2018). Diverse perspectives on student agency in classroom assessment. *The Australian Educational Researcher, 45*, 1-12. https://doi.org/10.1007/s13384-018-0262-2

Al-Alhareth, Y., & Al Dighrir, I. (2014). The assessment process of pupils' learning in Saudi education system: A literature review. *American Journal of Educational Research, 2*(10), 883-891. https://doi.org/10.12691/education-2-10-6

Alanazi, F. H. (2017). Effectiveness of the proposed training formative assessment program and its impact on teaching style improvements of Saudi science teachers in Saudi Arabia. *Journal of Turkish Science Education, 14*(1), 35-56.

Alotaibi, K. A. (2019). Teachers' perceptions on factors influence adoption of formative assessment. *Journal*

of Education and Learning, 8(1), 74-86. https://doi.org/10.5539/jel.v8n1p74

Alrasheedi, N., & Alahmad N. (2022). The practicing level of formative evaluation among high school science teachers and its methods in teaching science from the point of view of the teachers themselves. *Journal of Educational and Psychological Sciences, 6*(10), 78-108. https://doi.org/10.26389/AJSRP. N020921

Al-Sadaawi, A. S. (2007). *An investigation of performance-based assessment in science in Saudi primary schools* [Doctoral dissertation, Victoria University].

Al-Sadan, I. A. (2000). Educational assessment in Saudi Arabian schools. *Assessment in Education: Principles, Policy & Practice, 7*(1), 143-155. https://doi.org/10. 1080/713613320

Alt, D. (2018). Teachers' practices in science learning environments and their use of formative and summative assessment tasks. *Learning Environments Research, 21*, 387-406. https://doi.org /10.1007/s10984-018-9259-z

Banilower, E., Cohen, K., Pasley, J., & Weiss, I. (2008). *Effective science instruction: What does research tell us?* RMC Research Corporation, Center on Instruction.

Bell, B., & Cowie, B. (2001). The characteristics of formative assessment in science education. *Science Education, 85*(5), 536-553. https://doi.org/10.1002/ sce.1022

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*, 5-31. https://doi.org/10.4135/9781446250808.n13

Brookhart, S. M. (2013). *How to create and use rubrics for formative assessment and grading*. ASCD. https://doi.org/10.4135/9781452218649.n15

Cauley, K. M., & McMillan, J. H. (2010). Formative assessment techniques to support student motivation and achievement. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 83*(1), 1-6. https://doi.org/10.1080/0009865090326 7784

Corbin, J., & Strauss, A. (2015). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. SAGE. https://doi.org/10.4135/ 9781452230153.n1

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design*: *Choosing among five approaches*. SAGE.

Dini, V., Sevian, H., Caushi, K., & Picon, R. O. (2020). Characterizing the formative assessment enactment of experienced science teachers. *Science Teacher Education, 104*(2), 1-36. https://doi.org/10. 1002/sce.21559

Garrison, C., & Erlinghaus, M. (2013). *Formative and summative assessments in the classroom* [Paper presentation]. The 2013 Association for Middle Level Education Annual Conference.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* Routledge.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. Routledge. https://doi.org/10. 4324/9780203181522-6

Holt, D. T., Armenakis, A. A., Harris, S. G., & Feild, H. S. (2007). Toward a comprehensive definition of readiness for change: A review of research and instrumentation. In W. A. Pasmore, & R. W. Woodman (Eds.), *Research in organizational change and development* (pp. 289-336). Emerald Group Publishing Limited. https://doi.org/10.1016/ s0897-3016(06)16009-7

Kariri, K., Cobern, W. W., & Bentz, A. (2018). Investigating the use of formative assessment among male Saudi Arabian high school science teachers. *International Journal of Environmental and Science Education*, *13*(1), 889-901.

Keeley, Eberle, F., & Farrin, L. (2005). *Uncovering student ideas in science: 25 formative assessment probes*. NSTA Press. https://doi.org/10.2505/9780873552554

Masrifah, M., Setiawan, A., Sinaga, P., & Setiawan, W. (2019). The content quality of teacher's pedagogical and professional competence standards of senior high school physics teacher guidebooks. *Journal of Physics: Conference Series, 1157*, 032037. https://doi.org/10.1088/1742-6596/1157/3/0320 37

Nilsson, P. (2013). What do we know and where do we go? Formative assessment in developing student teachers' professional learning of teaching science. *Teachers and Teaching, 19*(2), 188-201. https://doi.org/10.1080/13540602.2013.741838

Patton, M. (2015). *Qualitative research & evaluation methods: Integrating theory and practice*. SAGE.

Popham, W. J. (2011). *Transformative assessment in action: An inside look at applying the process.* ASCD.

Qassim, J. A. S. (2008). *Teachers' perceptions of current assessment practices in public secondary schools in the state of Qatar* [Doctoral dissertation, University of Hull].

Shulman, L. (1987). *Knowledge and teaching: Foundations of the new reforms*. Harvard Educational. https://doi.org/10.17763/haer.57.1.j463w79r5645 5411

Webb, M., & Jones, J. (2009). Exploring tensions in developing assessment for learning. *Assessment in Education: Principles, Policy & Practice, 16*(2), 165-184. https://doi.org/10.1080/09695940903075925

Wiliam, D. (2010). The role of formative assessment in effective learning environments. In H. Dumont, D. Istance, & F. Benavides (Eds.), *The nature of learning: Using research to inspire practice* (pp. 135-155). OECD Publishing. https://doi.org/10.1787/97892640864 87-8-en

Yin, Y., Shavelson, R. J., Ayala, C. C., Ruiz-Primo, M. A., Brandon, P. R., Furtak, E. M., & Young, D. B. (2008). On the impact of formative assessment on student motivation, achievement, and conceptual change. *Applied Measurement in Education, 21*(4), 335-359. https://doi.org/10.1080/08957340802347845

Young, J., & Jackman, M. (2014). Formative assessment in the Grenadian lower secondary school: teachers' perceptions, attitudes, and practices. *Assessment in Education: Principles, Policy & Practice, 21*(4), 398-411. https://doi.org/10.1080/0969594X.2014. 919248

APPENDIX A-INTERVIEW PROTOCOL

Vignette 1: "Is It an Animal?"

The interview opens with the subject reading the following text. The text describes *initial instruction* in this vignette.

> Mr. Ahmed is a biology teacher for first-year high school students. He taught a lesson on animal characteristics. The learning objectives for this lesson are (1) the students will identify the characteristics of animals that make them different from other biological kingdoms and (2) the student will be able to identify if a given picture of an organism, with a written description, is an animal, based on its characteristics. Mr. Ahmed chose to lecture on the characteristics of animals and the differences between animals and other organisms. He used pictures and verbal explanations of animals and other organisms to show his students the differences between them.

Once the teacher has carefully read the preceding text, the interview proceeds with the following questions:

1. **Q1:** Is this method of teaching something you used in your teaching?
   - If yes, why? Do you think this is the best method? Explain why.
   - If no, why not? Please, explain to me what method you could use?
2. **Q2:** Based on how Mr. Ahmed introduced the material, what do you think he should do next? Explain why.

Once the preceding interview questions have been answered, the interview proceeds to the next reading text. The subject reads the following text about *assessment for learning*:

> After his lecture, Mr. Ahmed decided to give each of his students a handout that included pictures and descriptions of organisms and the question, "Is it an animal?" The handout also required the students to state why they decided on their answer. Students handed the worksheet in when they finished.

Once the teacher has read the preceding text about the practice of *assessment for learning*, the interview proceeds to the next reading text about *response to formative assessment*:

> After class, Mr. Ahmed checked his students' answers to the assessment and discovered that students had trouble identifying corals as animals, even though the descriptions listed several characteristics that made it clear corals are animals. He realized that students were relying only on what corals looked like in the pictures, not on the given characteristics of animals. So, Mr. Ahmed decided to focus on this trouble that students were having.

> For the next day's class, Mr. Ahmed divided the students into groups and gave them handouts that included only descriptions of corals' characteristics to look at with no pictures. He asked the student groups to discuss if corals are animals or not based on their characteristics with an explanation of the answer.

> Mr. Ahmed walks around the classroom, listening to the groups' justifications. Mr. Ahmed uses guided questioning to determine any incorrect ideas or misconceptions. When Mr. Ahmed identifies that each group of students has completed the discussion, he leads a whole class discussion. At this point, he allows the students to use the animal characteristics to justify their discussion about identifying corals as animals, using guidance questions to address any confusions.

Once the teacher has carefully read the aforementioned text, the interview proceeds with the following interview question:

3. **Q3.** Would this be something you could see yourself doing in a classroom?

Once the preceding interview question has been answered, they are asked the following question about *reassessment practice*:

4. **Q4:** What do you think Mr. Ahmed should do next?

Once the preceding interview question has been answered, the interview proceeds to the next reading text about *reassessment practice:*

> Mr. Ahmed hands out a worksheet similar to the one he had used the day before, but this one includes more pictures and descriptions of confusing animals, such as corals. The students have to individually do the work again, and then hand it in.

Once the aforementioned interview questions have been answered, the interviewer mentions to the subject the formative assessment concept and explains to him the formative assessment practices used in the vignette. Then, the

interview proceeds to the following questions: Looking back to the vignette, this method is called formative assessment.

5. Q5: If you would like to apply such instruction in your classroom, are there any difficulties or obstacles?
   - If yes:
     - What do you think would be the difficulties or obstacles of using such instruction? Explain.
     - What do you see as hindering you from using such instruction? Explain.
     - In your opinion, how you could you overcome these difficulties or obstacles?
     - What could encourage the Saudi teachers to use formative assessment approach in their classrooms?

Probes:
- How does what the instructor did compare to your idea?
- In your opinion, what is the purpose of what the instructor did?
- Tell me what you think about this approach.
- Given this vignette, would you adopt formative assessment in your teaching?
  - If yes:

To what extent would you be willing to apply formative assessment in your classroom? How often?

https://www.ejmste.com