

Investigating the Use of Formative Assessment among Male Saudi Arabian High School Science Teachers

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ABSTRACT

Formative assessment is a key pedagogical tool that allows teachers to make instructional assessments in real time for the improvement of student learning. It gives students the opportunity to provide evidence of their learning. Saudi science teachers rely mostly on end-of-unit summative assessment and not formative assessment, and the literature contains little research about Saudi teachers' use of formative assessment in science classrooms. Seeking to address this absence in the literature and using a convenience sample of male Saudi high school science teacher interviewees, this study investigated male Saudi Arabian high school science teachers' understanding of formative assessment, their attitudes toward the practice, and how they utilize formative assessment in their classrooms, if at all. The results showed that male Saudi Arabian teachers had little practice implementing the concept of formative assessment because they felt great pressure to use government-directed curriculum in their very large classrooms while negotiating time and content constraints. Beyond pedagogical and classroom constraints, the power and control structure of the Saudi education system offered additional interaction dimensions that teachers had to navigate as they sought to understand and address their students' learning needs.

Keywords: formative assessment, utilize formative assessment, attitudes toward formative assessment

INTRODUCTION

Formative assessment is a pedagogical process that can occur throughout a class or course. Hattie (2012) speaks of formative evaluation as an activity that is used as an assessment of learning progress before or during the learning process itself. It is an instructional approach that supports specific student needs with the goal of improving student learning of objectives (Theall & Franklin, 2010).

The concept of formative assessment hinges on the term "assessment" and its place in instruction. Wiliam (2010) insists that 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). Other authors use the term "assessment for learning" instead of formative assessment because they feel the term "formative" is open to interpretation (Broadfoot et al., 1999). Black, Harrison, Lee, Marshall, and Wiliam (2004) distinguish between the differing forms of assessment thus:

Assessment for learning is any assessment for which the first priority in its design and practice is to serve the purpose of promoting students' learning. It thus differs from

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assessment designed primarily to serve the purposes of accountability, or of ranking, or of certifying competence. An assessment activity can help learning if it provides information that teachers and their students can use as feedback in assessing themselves and one another and in modifying the teaching and learning activities in which they are engaged. Such assessment becomes “formative assessment” when the evidence is actually used to adapt the teaching work to meet learning needs. (p. 10)

For Black and Wiliam (2009), the goal of formative assessment is for students to be engaged in their own learning to the extent that there is a learning discourse between peers. What makes an assessment “formative” is not the design of a test, technique, or self-evaluation, per se, but the way it is used—i.e., to inform in-process teaching and learning modifications. Black and Wiliam (1998) believe that the key word in the understanding of assessment is *feedback*.

Wiliam (2010) provides statistics regarding the effect sizes of learning gains in classrooms that use formative assessment. However, he is quick to add that the closer the assessment is to the “enactment of the curriculum” (p. 22), the greater the impact and the effect size. Wiliam also asserts that the use of formative assessment may be more cost effective and have a greater effect than other forms of assessment.

While some Saudi Arabian education diploma programs include instruction on formative assessment, formative assessment is not part of a uniform teacher education curriculum. Moreover, there is little research into Saudi science teachers’ use of formative assessment or even their knowledge and understanding of formative assessment and its benefits. Seeking to redress this research gap, the study reported in this paper explored science teachers’ attitudes toward formative assessment, their use of formative assessment, and their self-reported challenges when attempting to integrate formative assessment into their science classrooms. Findings from this study can potentially help teacher educators improve their work with both preservice and inservice science teachers and inform future research efforts for improving teacher use of formative assessment in science classrooms. Furthermore, these results may be applicable to countries of the Gulf Cooperation Council: Saudi Arabia, Kuwait, Bahrain, Oman, Qatar, and the United Arab Emirates. These countries share the same language, environment, culture, and faith and have similar science curricula.

LITERATURE REVIEW

The Theory of Formative Assessment

Formative assessment is an educational process that links teaching and learning. It is the tool that allows students to provide evidence of their learning while at the same time giving teachers the feedback they need to assess current student learning before and during the class session (Wiliam, 2014). Formative assessment helps students and teachers by providing feedback on how to improve student performance with respect to instructional goals, that is, to close the gap between what the learner already knows and the instructional objectives. This is the articulated theory that serves as the framework for the study being conducted.

Formative assessment can be distinguished from summative assessment as defined by Hattie (2012). Formative assessment occurs before or during the learning process, while summative assessment evaluates what students know or have learned at the end of teaching. When used properly, formative assessment is an important part of the learning process (Black et al., 2003).

There are two actions that occur during formative assessment. First, the learner must come to understand that there is a gap between the curriculum goals and what the learner already knows and understands (Black & Wiliam, 2009). In other words, the first action is related to the student. The other action is related to the teacher. Much of formative assessment is about the teacher grasping and understanding what the student knows or has learned. Black and Wiliam (2009) call this “interpretive listening” (p. 13). Interpretive listening means that the teacher tries to understand what is going on in the student’s mind relative to what the student is supposed to be learning. Interpretive listening requires very careful listening on the part of the teacher. Through interpretive listening, the teacher can also help the learner identify the gaps in his/her understanding.

In addition to hearing what a student has to say, through interpretive listening, the teacher also seeks to understand the student’s cognitive structure with respect to instructional objectives. Ideally, every teacher should use interpretive listening, i.e., formative assessment, techniques to ascertain student understanding at both the individual and class levels. Through the students’ reporting of their current understanding, the

teacher will be able to reteach, reapply, or modify instruction in anticipation of moving ahead with the curriculum's learning goals (Black & Wiliam, 2009).

When assessing the ways that teachers achieve their learning goals, Abell and Lederman (2007) discuss the steps that the teacher must take as he/she uses formative assessment models to engage students in vital formative assessments that elicit appropriate feedback responses at a classroom level and not just at an individual student level. Thus, the teacher's task is to move the students forward to meeting the curriculum's learning goals (Black & Wiliam, 2009). The use of formative assessment is particularly important for teachers in science classrooms.

Evidence of Formative Assessment in Science Classrooms

Banilower, Cohen, Pasley, and Weiss (2008) summarized several studies on effective science instruction. They discussed the features of effective science instruction and suggested that in order for instruction to be effective, the teacher must elicit the student's prior knowledge so that the student can compare their ideas with those presented in class. The effectiveness of the instruction is directly correlated with the amount of time spent assessing student thinking and adjusting the instruction accordingly, which is the purpose of formative assessment (Black & Wiliam, 2009).

An important use of formative assessment strategies is for developing students' conceptual understanding of science, rather than their understanding of the details of science (Aday & Shayer, 1990). Bell and Cowie (2001) believe that teachers must have a grasp of student thinking beyond right or wrong answers. Teachers need to develop a creative, flexible mind that is able to look beyond curriculum, lesson plans, and test preparation. Here is an example of teaching for conceptual development aided by formative assessment that was offered by Bell and Cowie (2001). Step-by-step details of a lesson on separating mixtures illustrated exactly how the teacher used formative assessment to see what her young students already knew in order to move to the next level of understanding. The teacher began by asking the students how they would separate out red jelly beans from a jar of multicolored jelly beans. The students found this to be easy; they knew jelly beans and they knew red. The children were then presented with a list of separation challenges. The first challenge was to separate kidney beans from broad beans. The children were confused, and the teacher wanted to know why. When probed, the children admitted that they didn't know what a kidney bean was. The teacher's basic assumption was challenged on the very first try, and she stepped back in the assignment to discuss the shape of the beans and how shape could be one way that items could be separated. The teacher then went through the separation challenge list with the children to make sure they understood the components of each challenge. At that point, the lesson resumed unimpeded.

Teachers' Difficulties Using Formative Assessment

Much research, however, suggests that using formative assessment does not come naturally for teachers, particularly new teachers. Nilsson (2013), for example, found that teacher education students feel awkward using formative assessment and formative interaction in their classrooms. While she observed intern teachers, Nilsson found that her students became so involved in their own teaching that they forget to emphasize student learning. Nilsson realized that in order for new teachers to understand how to use formative assessment in their classrooms, they needed to have experienced instruction where formative assessment was used. Therefore, she added obvious formative assessment techniques to her own classroom interactions. Once the students observed these formative assessment techniques, the prospective teachers began to look critically at what they knew about science, about children, and about their own understanding of teaching. Nilsson (2013) sought to answer the following research question: "How does formative assessment support teachers' professional learning of teaching science?" (p. 189). As the students developed their lessons, they kept in mind the pedagogical content as well as the formative assessment goals. By keeping formative assessment at the forefront of their minds, the students were able to create complete lesson plans using several instructional questions: what is the intent of the instruction, why is it important for students to know this, and what are the difficulties associated with teaching this idea. By asking strategic questions as well as developing teaching procedures for ascertaining students' understandings or confusion, teachers can more effectively move forward with instruction.

Bramwell-Lawlor and Rainford (2016) also found that teachers can have difficulties implementing formative assessment. These authors used a mixed-method assessment strategy to appraise traditional summative assessment and formative assessment in a Jamaican science classroom. In general, the authors discovered that while biology teachers spoke favorably about the use of formative assessment methods, they

also expressed the limitations of these practices in a high-stakes examination environment. One intriguing concept expressed by the teachers was the idea of control. Even though teachers knew intellectually that formative assessment required a shift toward students' control of their own learning, teachers were reluctant to release their own control.

The research of Bramwell-Lawler and Rainford (2016) and Nilsson (2013) expressed the idea that the types of formative assessment developed by Black and Wiliam (2009) are difficult to incorporate in a very structured school setting. There is very little administrative support for formative strategies such as grading with comments only, allowing materials to be handed in more than once, and engaging students in peer learning and peer assessment. Administrative response seemed to focus most on summative techniques such as test scores and grades. Congruent with these frustrations, there seemed to be a relative lack of understanding of the role that formative assessment could play in the summative assessment goals that the teachers set. In brief, most researchers note that teachers who would like to use formative assessment are constrained by time management issues, standardized testing, and the vagaries of instructional theory influencing how they utilize formative assessment—or even if they use formative assessment—in their classrooms (Bramwell-Lawler & Rainford, 2016).

Coffey, Hammer, Levin and Grant (2011) found that teachers tend to seek correct answers to the review questions that they ask. These authors point out that “there is little discussion about the substance of student thinking; there is a tacit presumption of ‘content’ as a body of correct information, centered on terminology and selected in advance as lesson objectives; and assessment is discussed in terms of particular strategies, techniques, and procedures, distinct from other teaching and learning activities” (p. 1114). A student often struggles to answer questions “correctly.” In other words, the student looks for the answer that will please the teacher because if he/she doesn't have the “correct” answer, the teacher will call on someone else.

Coffey et al. asserted that if ideas are accepted by students based simply on the teacher's authority, “rather than because they see them supported over other ideas by evidence and reasoning, then they are at odds with the practices of science” (p. 1128). Formative assessment, in the minds of these researchers, resides in closely attending to student thinking and the meaningful discussions that move ideas forward. Assessment should be “understood and presented as nothing other than genuine engagement with ideas, which includes being responsive to them and using them to inform next moves” (Coffey, et al., p. 1129). For assessment to be authentic, there needs to be an alignment between teacher, curriculum goals, and student understanding.

The formative assessment alignment between teacher, curriculum goals and student involvement is a concept that teachers know should occur yet struggle to develop strategies in their own classrooms to accomplish those goals. As Nilsson (2013) has noted, using the example of formative assessment in preservice teacher education makes a difference in a classroom teacher's understanding and ability to incorporate formative assessment classrooms. Nilsson's methodology makes formative assessment an everyday classroom strategy.

Cauley and McMillan (2010) believe that formative assessment has a powerful impact on student motivation when the amount of performance-based evaluations and comparisons of student abilities are reduced. When teachers promote performance goals, they tend to make student evaluations public, compare achievement between students and reward students who outperform others. With formative assessment, on the other hand, teachers who are looking for mastery and goal orientation give students opportunities to improve, treat mistakes as part of the learning, vary their evaluation patterns, and make grading a private matter. Cauley and McMillan believe that when formative assessment is used appropriately, students become empowered to work toward individual goals, actively participate in their own education, and are provided with positive feedback that encourages growth and learning. Stiggins (2006) agrees with their analysis: “If assessments are to support improvements in student learning, their results must inform students how to do better next time” (p. 4).

Understanding of Formative Assessment in Saudi Arabia

Formative assessment is a term that is discussed frequently in teacher education courses in the United States and other Western countries. Formative assessment strategies are often included in the teacher education curriculum. In Saudi Arabia, on the other hand, the strategy is neither taught nor discussed. It is therefore not surprising that there is a lack of Saudi Arabian literature related to formative assessment and its use in Saudi Arabian school settings. At least two doctoral dissertations (Al-Sadaawi, 2007; Qassim, 2008) and two articles (Al-Sadan, 2000; Al-Alhareth & Al Dighrir) have mentioned formative assessment. However,

all four of these studies deal primarily with assessment processes in general and do not deal specifically with formative assessment. A Saudi Arabian study by Al-Wassia, Hamed, Al-Wassia, Alafari, and Jamuoom (2015) specifically addresses formative assessment. These researchers are professors of the Faculty of Medicine at King Abdulaziz University in Jeddah, Saudi Arabia. Their study on formative assessment in classroom instruction is one of the first based in a Saudi Arabian classroom, albeit a medical school classroom. However, the implications of their study can be applied in most educational settings in Saudi Arabia. Using a mixed-method, cross-sectional, exploratory study, these researchers worked in both quantitative and qualitative ways to assess both student and teacher understandings of formative assessment.

The goal of the Al-Wassia et al. (2015) study was to assess how formative assessment was perceived by faculty and students and identify the cultural challenges as well as general challenges that have kept formative assessment from being adopted in the “clinical phase of the undergraduate medical curriculum in King Abdulaziz University” (p. S10). This study search used terms such as *formative assessment* or *assessment for learning* and *Saudi Arabia*, but the search showed no results. These authors claimed that this result means not that formative assessment was not being used but rather that there had been little research into its use. As they probed deeper, they found that the primary strategy for university faculty members was summative assessment. The authors suggested several reasons why faculty members frequently do not use formative assessment. They spoke of time constraints, the need to “teach to the test” (p. S10), and the need to meet performance goals rather than learning goals. Unique, perhaps, to Middle Eastern universities, and more specifically to Saudi Arabian universities, are challenges resulting from very large classes, a lack of interactivity, and students’ fear of speaking up. There are also sociocultural challenges specific to the Saudi culture, including the hierarchy of power, in which the teacher is omnipotent, students are afraid to debate with their teachers, and teachers resent questioning and debate.

Al-Wassia et al. (2015) concluded that there was a fundamental lack of understanding in the concept of formative assessment and the role that it plays in enhancing learning. Of more importance, however, were the cultural values at play in Saudi society. The researchers noticed what they called “four challenges categories” (p. S14): political/strategic, economical/resources, social/religious, and technical/developmental. Because these challenges are interrelated, the researchers believed that there needed to be a holistic approach to implementing formative assessment in both the medical school and in other academic settings.

The impact of the study by Al-Wassia et al. (2015) is significant because although there is a crucial need to train faculty in formative assessment, there is a general lack of understanding of its necessity or usefulness. The authors say that both students and teachers “sense the inadequate pedagogical content knowledge of the teachers who are unable to *know how students learn*” (p. S13).

The researchers also spoke of establishing an atmosphere of trust because formative assessment and other interactive teaching and learning strategies do necessitate a measure of trust. This researcher’s own interviews concur that trust is often lacking in the Saudi classroom. However, interactive trust needs to be established long before students appear in the university classroom; it needs to begin in elementary school. One of the results of this study was that mental anxiety was one of the students’ major concerns reported both in the focus groups and on the questionnaire. This anxiety is likely due to the extreme pressure to score high grades without the ability to interact with the professor in a way by which true learning can occur.

The lack of a clear understanding of the use of formative assessment in Saudi Arabian classrooms as well as a dearth of research into its use leads to the current study and the resultant interviews with Saudi classroom teachers.

Research Goal

The goal of this study was to investigate what high school science teachers in Saudi Arabia understand about formative assessment, their attitudes toward the practice, and how they practice formative assessment in their classrooms, if at all. The specific research questions were as follows:

1. What are the critical components of a science lesson according to a sample of high school science teachers in Saudi Arabia? (This question was asked not to answer pedagogical questions about science lessons, but to determine whether assessment was mentioned in the teachers’ explanations.)
2. What are the assessment practices of a sample of high school science teachers in Saudi Arabia?
3. What do the sampled high school science teachers in Saudi Arabia know about formative assessment?

4. What are the sampled science teachers' attitudes toward formative assessment?
5. Do the sampled high school science teachers in Saudi Arabia employ formative assessment?

METHODS

Research Design

The study used a qualitative, phenomenological research design. According to Creswell (2013), phenomenology is “an emphasis on a phenomenon to be explained, phrased in terms of a single concept or idea, such as educational idea of ‘professional growth’” (p. 78). For this study, the phenomenon was formative assessment, specifically Saudi Arabian science teachers' knowledge of formative assessment, experience with formative assessment, attitude toward formative assessment, and opinions about the use of formative assessment. Data were collected using a convenience sample and interviews with volunteer participants.

Subjects/Sampling Methods

The Saudi education system is centralized so that the Ministry of Education provides a standardized curriculum for all schools in the country. Students in high school range in age from 15 to 18 years. The schools are gender segregated. High school in Saudi Arabia last three years. The second and third years divide students along two paths: literary and scientific.

Science courses taught as discipline specific include biology, physics, chemistry, and geology. In the first year of high school, 2 hours a week are spent on biology, physics, and chemistry. In the second and third years, students in the science path are taught for 4 hours a week for each course in biology, physics, and chemistry. Geology is taught for one hour a week in all years of high school.

We contacted 30 male high school science teachers in the Eastern Region of Saudi Arabia using social media (i.e., email, WhatsApp or similar messaging media) to request their participation in this study for the purpose recruiting ten participants. The lead researcher is male and because of cultural norms in Saudi Arabia the study could only recruit male participants. The contact was in Arabic because it is the native language of the subjects and the lead researcher. Nine teachers responded to the social media request and agreed to participate, and interview appointments were set. The tenure of these high school science teachers ranged from seven to eighteen years. Interviews ranging from 15 to 40 minutes, were conducted by phone, and were recorded. Data were compiled from the recorded phone interviews.

The following is a list of participants in the study. Pseudonyms were used for all participants.

	Pseudonym	Teaching tenure	Subject
1	Abdullah	9	Physics
2	Mohammed	7	Physics
3	Sami	10	Physics
4	Naif	7	Chemistry
5	Ali	8	Biology
6	Fahad	15	Chemistry
7	Mosa	18	Biology
8	Hamad	9	Physics
9	Salim	9	Biology

Interview Protocol

The interview protocol involved questions (see **Appendix A**) designed to obtain information to answer the research questions. The interview protocol was validated by identifying interview questions and verifying them with experienced colleagues. Because the interviews were conducted in Arabic, the colleagues were fluent in Arabic.

Data Analysis

The interviews were recorded and then transcribed. Pseudonyms for each participant are used throughout the study. To avoid changed meaning during translation from Arabic to English of the interview scripts and to maintain credibility and validity, the lead researcher analyzed the interview script in Arabic to create codes

and themes. Two Arabic-speaking colleagues assisted with the analysis of the interview scripts. Finally, the lead researcher translated the results to English.

- The transcripts were coded using a set of etic codes related to the research areas of interest.
- To insure the appropriateness of coding, two other persons independently coded a sample of transcripts, and the results were compared for inter-rater reliability. Coding adjustments were made as needed.
- The codes were associated with the research areas of interest.
- The codes under each research area of interest were used to inform summary statements pertaining to each area.
- MaxQDA computer software was used for qualitative data analysis. MaxQDA helps analyze the interview scripts by organizing the codes to determine the results.
- Finally, summary statements were used for constructing responses to each of the research areas of interest.

RESULTS AND DISCUSSION

Results indicated that the strategies that science teachers use include preassessment, assessment during the lesson, and post-assessment. The assessment practices that science teachers use include discussions, handouts, verbal questions, and tests. When probed, the teachers gave a variety of answers regarding their use of formative assessment. The results from the interviews and discussion resulting from the interviews are organized below according to the research questions which follow. After each research question, responses are recorded. Pseudonyms are used in all cases.

Q1. What are the Critical Components of a Science Lesson According to a Sample of High School Science Teachers in Saudi Arabia?

- When you plan a science lesson, what are the critical components of the lesson that you think should be present? Please explain.
- Please describe what a typical lesson that you teach looks like from beginning to end.

The teachers expressed several ideas regarding the critical components of a science lesson:

- The Ministry of Education in Saudi Arabia prepares lesson goals and provides them to the teacher through teacher and student guide books for each course. The high school science teachers in Saudi Arabia focus on these lessons goals. Lesson goals are the major critical component of a science lesson.
- At the beginning of class, high school science teachers in Saudi Arabia use an introduction, which is considered an input to the lesson, or link the current lesson to the previous one.
- Science teachers use teaching methods that vary depending on the lesson; however, they primarily divide students into groups and use the discussion teaching method.
- The high school science teachers in Saudi Arabia use assessment as one of the critical components of a science lesson.

Most teachers began the interviews by reminding the interviewer that the Saudi Arabian science curriculum has been newly refined and redesigned. Thus, they found themselves looking first at the objectives for each lesson. What the teachers found most significant in the new curriculum is that the goals are written into each lesson. Mohammed says "There are specific objectives for each lesson in the teacher's book. The elements of the lesson are based on these goals. For example, in the atom lesson, the goal is for the student to know the structure of the atom. Each lesson has its written objectives, resulting in the elements of the lesson revolving around these goals" (Lines 54-55). Hamad added "The book has the objectives of the lesson that must be achieved. The most important thing in my preparation for the lesson is to achieve the objectives of the lesson. In addition, I sometimes add some goals that are not in the book" (Lines 47-48).

Q2. What are the Assessment Practices of a Sample of High School Science Teachers in Saudi Arabia?

- How do you assess your students' level of understanding? During the lesson?
- How do you make sure that students achieve your lesson plan goals? Explain?

The following statements are the responses of the teachers to the questions:

- Assessment practices included preassessment, assessment during the lesson and post-assessment. Those techniques included discussions, handouts, verbal questions, and tests.
- A few teachers, particularly the teachers at a secondary school in Jubail City, had access to technology through which they applied formative assessment.

The responses to this question were extensive. Regarding the preface to the lesson, most all interviewees suggested that they begin the lesson with an attention-getting device such as an experiment or a video. In describing what he considered to be formative assessment, Sami mentioned “I start with the preface or introduction in several ways depending on the lesson. For example, I may use an introductory experiment for the lesson, play a video, ask questions on a blackboard, or link the lesson to previous information in previous lessons to enter the lesson through this information. This prepares the students for the lesson and raises their interest in the lesson” (Lines 56-58). Hamad added “At the beginning of the lesson, the previous lesson must be reviewed. Then, preparations for the new lesson include many methods either by asking a question or by drawing a picture of the lesson and discuss” (Lines 54-55). Both of these teachers believed that through these activities, they were assessing their students’ prior knowledge.

Of course, there are many methods used to teach the lessons. The interviewees mentioned PowerPoint, questioning, class discussion and individual worksheets. Many of the teachers used group discussions and brainstorming. One respondent used the term “cooperative learning”, and another used the term “active learning”. Both phrases indicate some of the newer teaching methods used by Saudi teachers. On the other hand, when asked about the use of assessment as a critical component of a science lesson, all the teachers responded with examples of summative assessment. The inference of the researcher was that most teachers understood assessment to be tests, exams, and homework after the lesson. Their responses regarding post-assessment were very similar. Regarding pre-assessment, Mosa said “I call it a preliminary assessment, and it is through reviewing the previous lessons. It always comes at the end of lessons, or I make some lesson for review. I ask students to answer the questions in a quiz to increase students’ enthusiasm, and sometimes the answer comes through the random selection of students. In addition, I sometimes have brainstormed questions and gave students an opportunity to consult and discuss the answer” (Lines 97-100).

One of the more interesting responses came from the question about the use of technology as an assessment tool. Only the teachers from a secondary school in Jubail City were able to respond in the affirmative regarding the use of technology. This school is the only one that gives its’ students iPads. The teachers were very enthusiastic about their use of a program called the Knowledge System, which allows the teachers to use computers for all types of assessment. Here is how Fahad uses Knowledge System. “At the beginning of the lesson, I give the students a short test of the previous lesson through the use of iPads. There is a website called Knowledge System, which connects the teacher and student. We begin the exercise so that I can confirm the students’ retention of information from the lesson. Then, the website shows me the answers of all the students, and I review the answer in front of them as motivation” (Lines 73-78).

Q3. What do the Sampled High School Science Teachers in Saudi Arabia Know about Formative Assessment?

- Are you familiar with formative assessment? If so, please explain. When teachers were asked what they knew about formative assessment, the response was informative.

The following are the responses expressed by the teachers:

- Several of the teachers suggested that they understood the concept of formative assessment and used it in their classrooms.
- Three of the science teachers did not know the term *formative assessment*, but when the concept was explained to them, they responded that they used formative assessment in their classroom.

The questioning turned to a discussion of formative assessment. It should be noted that the interview script did not include (and generally avoided) the term “formative assessment” until this point in the interview in order to draw out practices that might be formative in nature even if participants were not familiar with the term. Teachers generally responded that they understood formative assessment and used it in a variety of ways. Naif’s response was as follows: “Formative assessment is used during the lesson to determine whether the students understand the lesson and whether they achieved the objectives of the lesson. Also, it would be used during the lesson; for example, as I mentioned to you, I use discussions and handouts during the lesson”

(Lines 106-107). Other teachers did not know the term formative assessment but responded that they utilized assessment during their class sessions.

Q4. What are the Sampled Science Teachers' Attitudes toward Formative Assessment?

- What are your thoughts about using formative assessment during your lessons? Please explain.
- (If formative assessment is used.) What are your thoughts about using formative assessment during your lessons?
- (If formative assessment is not used.) Why do you not use formative assessment during your lesson?
- Are there any difficulties in or obstacles to applying formative assessment? Explain.

The following statements express the teacher's responses to these questions:

- Their attitude toward formative assessment was generally positive, and they agreed that formative assessment is important and useful. Their answers indicated, however, the following obstacles to applying formative assessment:
- Lack of class time
- Length of the curriculum and large class size

The teachers offered some solutions to the perceived difficulties of using formative assessment. For example, Mohammed says "I use some procedures. For example, if the lesson has seven or eight points or goals, I divide this lesson into two classes so that I have enough time to apply the formative assessment correctly in each class; thus, I overcome this problem of time" (Lines 157-158), and Naif says "I overcome this problem by distributing students into groups, identifying a leader for each group, and distributing tasks among groups.... In this way I can overcome the problem of the large number of students and the time" (Lines 159-160).

Several of the teachers noted that using formative assessment is important and useful. Mohammed was especially effusive regarding the use of formative assessment. "Certainly, formative assessment is very important and must be used by all teachers. In addition, a teacher who does not use it will face problems in teaching as he explains the lesson, but he does not know whether his students understood—or understand—the lesson. Additionally, he does not have certainty regarding whether the information is delivered to students or not. However, through formative assessment, a teacher knows whether the information of the lesson is moving the students in the right way or not. I consider it essential in teaching" (Lines 140-143).

However, teachers consider class time, class size, and curriculum restraints as obstacles to applying formative assessment. Naif says "The problem is the large number of students per class and the specific time for the lesson, which is 45 minutes; we must ensure that all students understand the lesson, so its difficult to correct the working papers for all students during the class" (Lines 158-159). Salim cautions "Formative assessment takes a large part of the time of the lesson. It is difficult to accurately organize the time to achieve the balance between achieving the goals and the formative assessment as desired" (Lines 96-97). To overcome these problems, the teachers offered a variety of solutions, most involving classroom discussion. Sami says "I try to reduce the time of the preliminary assessment at the beginning of the class and the time of the final assessment so that they answer questions in student groups and not individually. This is faster because the students cooperate with each other. Thus, I reduce the time for these assessments, have more time and use this time for assessment during the class after each point" (Lines 130-132)

Q5. Do the Sampled High School Science Teachers Employ Formative Assessment?

- Do you do anything to measure student learning during a lesson? Explain.
- If you discover during a lesson that some of your students are not achieving the lesson goals, what do you do?
- Are there things that you do to get feedback from students on how well they are achieving the lesson goals? Explain.
- Please explain how you respond to student answers. Written response? Verbal response?
- Are you tracking your students after you give them feedback? Explain.
- Do you ask your students to do any practices after giving them feedback? Explain.

In response to these questions, the majority of the teachers indicated the following:

- They sought correct answers from students through motivational phrases and extra grades.
- When given incorrect answers, teachers tried to give the correct answer or encouraged classmates to give the correct answers.
- They continued to track students who did not achieve the lesson goals, primarily by giving them similar questions or homework or asking them questions during the next class session.

A variety of responses came from the teachers as they discussed the ways in which they received feedback from formative assessment. Correct answers were applauded, but the teacher's feedback for incorrect answers was similar to Abdullah's answer: "However, if the student's answer is wrong, I ask him to stand up. Then, I ask one of the students who answered correctly to give the correct answer, and I then ask the student to sit down after he knows the correct answer" (Lines 199-200). He adds "I ask him to do additional homework and to read the lesson again at home. Then, I track him in the coming classes" (Line 206).

CONCLUSION

This study was designed to explore the use of formative assessment in Saudi Arabian science classrooms. The underlying assumption at the study's onset was that formative assessment is generally not considered to be an important concept by Saudi Arabian teachers. This understanding was informed in part by the research found for the literature review, particularly the research of Al-Wassia, Hamed, Al-Wassia, Alafari, and Jamuoom (2015) as they investigated whether formative assessment was used by medical school professors at King Abdulaziz University in Jeddah, Saudi Arabia. Their research showed that the professors were primarily concerned with summative outcomes, with little concern for the formative needs of their students.

Therefore, the goal in this study was to investigate what high school science teachers in Saudi Arabia understand about formative assessment, their attitudes toward the practice, and how they practice formative assessment in their classrooms, if they do use it.

Interviews with teachers tended to concur with the prior research findings, including the research of Al-Wassia, Hamed, Al-Wassia, Alafari, and Jamuoom (2015). There is a lack of interactive teaching and learning strategies that create the type of trust that allows students to truly interact with their teachers. This was borne out by the interviewee who suggested that if the student did not give the teacher the right answer, the instructor called on another student who could give the answer that the teacher sought, to the dismay of the original respondent. This type of question-and-answer assessment does not allow the student to grow in understanding and development; it only allows right and wrong answers or whatever the teacher is seeking. Scoring high grades becomes more important than gaining knowledge and competency.

The major understandings gained from the interviews are that high school science teachers generally depend on the lesson goals that are prepared by the Ministry of Education in Saudi Arabia and provided through a teacher guide book. These goals guide the teachers toward their teaching and their assessment. Saudi teachers reported their assessment practices to include preassessment, assessment during the lesson and postassessment. These techniques included discussions, handouts, verbal questions, and tests. A few teachers, particularly the teachers at Al-Rowad Secondary School in Jubail City, had access to technology, which they used to assess prior knowledge.

The interviewed teachers spoke well of formative assessment, but in practice, they fell far short of using the practice in the classroom setting. . It was quite clear that they did not have an accurate understanding of the concept of formative assessment and had very little understanding of how to use it in the classroom setting. Most understood the term formative assessment as it applied to the techniques that they were currently using. When probed about their understanding, they indicated that they saw assessment as answering questions correctly, either verbally or on quizzes. Teachers indicated that they gave feedback for students' correct answers through motivational phrases and extra grades. When given incorrect answers, teachers tried to coach the correct answer out of the student or encouraged other classmates to give the correct answers. The teachers agreed that these forms of assessment were important and useful. On the other hand, none of the interviewees mentioned that they retaught the lesson or changed their methods to make sure the students had learned what they needed to learn. This is where the interviewed teachers failed to recognize the second purpose of formative assessment—the adjustment of instruction to address the gaps in understanding. Coffey, Hammer, Levin and Grant (2011) indicated that coursework in formative assessment focuses more on the teacher than on the student, and teachers are not equipped to probe the depth of the students' understanding.

These teachers did not express the idea that formative assessment is about the “gathering and analysis of assessment—elicited for the purpose of determining when and how to adjust instructional activities in order to achieve educational goals” (Popham, 2011, p. 14).

It was apparent that the teachers involved in these preliminary interviews felt a great deal of pressure because of a new curriculum, large class sizes, and time constraints. This matches what Al-Wassia et al. (2015) found in medical school classrooms. The professors were acutely aware of the amount of curriculum to cover in a limited amount of time. The authors also expressed concern about the omnipotence of the professor and student deferring to the authority of the teacher. In their research, Black and Willam (2009) discussed how one of their concerns regarding formative assessment in classrooms is how teachers need to continue to feel in control, and they feel that using formative assessment is an unknown entity and that control and time could get lost, as teachers may need to go back and reteach concepts that were lost. This idea was expressed by the interviewed teachers as well.

Future research will need to overcome the limitations of the current research. These limitations include adding an observation method to collect data to get more in-depth information by observing how science teachers use formative assessment in their classrooms and tracking student performance and understanding. Additionally, the science curriculum, particularly the teacher guide books, should be analyzed to see how formative assessment is addressed because it is apparent that Saudi science teachers rely on the teacher guide books for their classroom lesson plans. Future study will also need to include an analysis of the methods used to teach science educators how to use formative assessment effectively so that the issues of teacher control, time constraints and curriculum can be mitigated to encourage student learning. Teachers need to be assured that the time spent in formative assessment is time well spent and will result in greater student understanding and greater student performance.

Finally, the major limitation of this study is the lack of female subjects. Because of gender segregation in Saudi schools, this limitation can be addressed by adding a female researcher to the study, one who can interview female teachers regarding their use of formative assessment.

Disclosure statement

No potential conflict of interest was reported by the authors.

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APPENDIX A

Interview Protocol

Consent confirmation:

I would like to thank you for agreeing to this interview. Before we begin, I need to ask you if you have read the Consent Form and if you have any questions.

Do you agree to the Consent Form?

If the answer is yes, we continue. If the answer is no, we stop and the interview ends.

Warming Up: Could you please tell me what the university you graduated from, your educational experience, the grades you are teaching, and the kind of science that you teach (physics, chemistry, or biology)?

Table 1. Interview Questions.

Research Questions	Semi-Interview Questions
1. Q. 1. What are the critical components of a science lesson according to a sample of high school science teachers in Saudi Arabia?	A. When you plan a science lesson, what are the critical components of a lesson that you think should be present? Please explain. B. Please briefly describe for me what a typical lesson you teach looks like from beginning to end.
2. Q. 2. What are the assessment practices of a sample of high school science teachers in Saudi Arabia?	A. How do you assess your students' level of understanding? B. How do you assess your students' level of understanding during your lesson? C. How do you make sure the students achieve your lesson plan goals? Explain.
3. What do sampled high school science teachers in Saudi Arabia know about formative assessment?	A. Are you familiar with formative assessment? If so, please explain. A. What are your thoughts about using formative assessment (assessment during your lessons)? Please explain. Like it, don't like it, don't use it etc. B. (If the teacher uses formative assessment) Why do you use formative assessment (assessment during your lessons)? C. (If the teacher does not use formative assessment) Why do not you use formative assessment (assessment during your lessons)?
4. What are the sampled science teachers' attitude toward formative assessment?	D. Are there any difficulties or obstacles of applying formative assessment? Explain? If yes: a) What do you do to go through these difficulties or obstacles of applying formative assessment? b) Are there any roles of your school or Ministry of Education to help teachers to overcome these difficulties or obstacles of applying formative assessment? i. IF YES explain, ii. IF NOT, how do you think they can help you to overcome these difficulties or obstacles?
5. Do the sampled high school science teachers in Saudi Arabia employ formative assessment?	A. Do you do anything go determine student learning during a lesson? Please explain. B. If you discover during a lesson that some of your students are not achieving the lesson goals, what do you do? C. Are there things that you do to get feedback from students on how well they are achieving the lesson goals? Please explain. Follow-up: e.g., questions, quiz or exam, or classroom discussion. D. After you get students answers, i. Could you please explain how you respond to their answers? Written response? Verbal response? ii. Are you tracking your students after you give them the feedback? If yes, explain how? iii. Do you ask your students to do any practices after give them feedback? Please explain?

