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SAUDI TEACHERS' PRACTICES OF FORMATIVE ASSESSMENT: A QUALITATIVE STUDY

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Abstract

Shifting from teacher-centred to student-centred practices requires teachers to understand strategies to interact with students in science classes. Formative assessment strategies are very critical component of classroom interaction where teachers obtain information about student learning wherever possible. Traditionally, however, teachers ask questions and evaluate student responses but without investigating student contributions to the classroom interaction. This qualitative study aimed at developing teachers' knowledge of formative assessment strategies when teaching science-based inquiry in Saudi Arabia. 12 teachers were observed when teaching science and details of one teachers' practices of formative assessment is presented in this study. Formative assessment framework that describes assessment conversations is used and modified to observe teachers' assessment practices. Assessment conversation consists of four-step cycles, where the teacher elicits information from students through questioning, the student responds, the teacher recognizes the student's response, and then uses the information to develop further inquiry. Findings indicate that teachers ask questions and receive responses but rarely allow students to share their own ideas or discuss their own thinking. The study underlines the importance of integrating formative assessment strategies during scientific inquiry teaching for professional development as a way to increase student participation and allow opportunities for students' inquiry in science classes.

Key words: *assessment conversations, formative assessment, science inquiry.*

Introduction

Effective implementation of formative assessment plays an integral role in initiating and continuously modifying scientific inquiry teaching practices. Previous research suggested by evidence the effectiveness of teachers' roles on formative assessment in normal classroom work (Black & Wiliam, 2009; Black, 2003; Wiliam, 2000). It is argued that when teachers are able to use assessment strategies such as their use of questioning and the ways they respond to their students' thinking, they could develop effective assessment practices in science classes (Gitomer & Duschl, 1997; Black & Wiliam 1998). Black (2013) theorised that assessment for learning can be informal through quality questioning and is often formative in nature. For example, teachers can use questioning strategies to explore students' prior knowledge and make students' thinking explicit to the whole class, and other learning tasks that elicit evidence of student understanding (Black,2013; Ruiz-primo & Furtak,2006).

Teachers' insufficient understanding of student-centred teaching strategies in science classes can, however, impact on their implementation of formative assessment strategies when teaching science based inquiry. Most researchers (Osborne, Erduran & Simon (2004); Resnick, Michaels & O'Connor (2010); Scott, 1998; Wolfe & Alexander, 2008) have argued that the way in which the teachers interact with their students in inquiry-based, instructional settings

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is still a major challenge. In the Saudi Arabian context, for example, the teachers are already challenged by the existing forms of authority and control in their science classes thus leading to a minimization of opportunities for their students' engagement and to a reduction in those dialogic interactions, which are essential for inquiry instruction. This enactment of inquiry-science is often further constrained by the Saudi students' expectations that, as Roehig and Luft (2004) noted, their teachers will provide them with the correct answers.

Furtak (2006) found that in the guided scientific inquiry classrooms, middle school teachers experienced difficulties to manage their student request for the right answers despite their teaching experience, discipline background or professional training. Furtak (2006) suggested that teachers needed to learn strategies that could support them to withhold the right answers and encourage further students' inquiry.

Roehrig and Luft (2004) also reported the teachers' frequent difficulties whilst trying to attain the form of teacher authority and control that is required by inquiry instruction. They also indicated how the group of teachers, who most often fell into the traditional practices, expressed the need for the students to know the right answer. They all viewed science as a body of knowledge and they did not stop to consider how scientists came to know the supporting evidence for this body of knowledge in the first place. Implications from this body of research are that science teachers have been challenged in their efforts to enact dialogic teaching in their classrooms.

Ruiz-Primo and Furtak (2006) developed a model for teachers with focus on how to enact formative assessment strategies when teaching science based inquiry instruction. The ESRU (Elicitation, Student responses, Recognising, Using). model suggested strategies that may support teachers to go beyond the traditional IRE (Initiation-Response-Evaluation) pattern of discourse (Mehan, 1979). In this model the elicitation phase (E) suggested that the questions posed should be critical to the students' current understanding as previously highlighted by Black (2003). A common issue that is associated with the elicitation phase in traditional classes, when initiating a topic, is that many teachers discuss the concept and then ask students to recall what have been presented to them (van Zee et al., 2001).

The (S) phase in the ESRU model indicates a student response that represents student thinking so as can facilitate teacher's subsequent decision making. The recognising phase (R) represents the teacher's strategies when responding to the students' initially presented ideas. These strategies suggested different ways in which teachers can value student contributions to the classroom discussion. In the using phase (U), of the teacher's strategies the teacher uses information that is being collected about students' thinking which may support teacher's actions to move learners toward their learning goals. Oliveira (2010) also discovered that, by the teachers learning specific strategies that would elicit a student's prior knowledge and would acknowledge their contributions, they can change their ways of conversing in inquiry-based contexts. In so doing, teachers would become aware of their authority, thus allowing more opportunities for their students to have better inquiry-experiences.

The results from these studies are encouraging and important and certainly need to be explored in the Saudi Arabian context in which the traditional approach to teaching science remains predominant. Thus, this study aimed at exploring the problems associated with Saudi teachers' practices of formative assessment strategies by following their ways of eliciting and responding to their students' ideas in science classes. By understanding teachers' practices of formative assessment and identifying their strategies when interacting with their students, this study is expected to help teachers to be aware of their practices and support them to think about strategies that engage the students in dialogic interactions where their ideas and contributions will be valued.

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Methodology of Research

General Background of Research and Sample Selection

This qualitative study explored primary Saudi teacher practices of formative assessment. Primary science teachers in southern region were invited to participate in a professional learning course. This course aims at supporting Saudi teachers to enact a formative assessment strategies when teaching science using the 5Es (Engage, Explore, Explain, Elaborate, and Evaluate) guided inquiry approach (Bybee, 2009). They recently introduced to new Saudi National curriculum requesting them to teach the 5Es guided model. Before their participations 12 six grade science teachers voluntarily agreed to observe their science classes. The parents of the students drawn from these teachers' classes were contacted and consent forms were also obtained prior to their participations. All of these teachers participated in previous professional development programs but did not include the integration of formative assessment strategies in scientific inquiry teaching. In this qualitative study, the intent was not to generalize about a population, but to develop an in-depth exploration of a central phenomenon (Creswell, 2012).

Instrument and Procedures

Both an audio-recorder and field notes were used to capture the teacher-student interactions and the teachers use of assessment strategies, wherein the teacher elicits, recognizes and uses student responses, as stipulated by Furtak and Ruiz-Primo, (2006). These strategies were modified to suit the formative assessment strategies used by Saudi teachers. This was based on the lengths of the observed conversation-cycles (see Table 1). For example, a teacher might have asked questions that generated only a response and then moved on to another student, or continued on lecturing. In this case, the strategy was classified as only belonging to the elicitation phase (E).

These strategies can also be classified in the recognition phase (R). In this case, the conversation cycle required the teacher to pose a question and, then, to react after receiving a response. Opportunities were, thus, presented to classify strategies at the elicitation (E) and at the recognition (R) phases. In the third phase, when a teacher followed the reaction to a response by an action that used responses to develop more dialogic teaching, the questioning strategies were identified and coded as a complete ESRU cycle of the three phases, elicitation (E), recognizing (R), and using (U).

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Table 1. Classroom observation form.

ESRU cycles and strategies / Conversations	Elicitation (E)	Student Response (S)	Recognition (R)	Using (U)	Strategies used
Incomplete ES cycle	√	√			Formative assessment strategies of the elicitation phase were observed for this ES cycle (for example, asking for recalling previously discussed ideas).
Incomplete ESR cycle	√	√	√		Strategies of elicitation and recognition phases were observed for this ESR cycle (recognising by clarifications after receiving an initial response)
Complete ESRU cycle	√	√	√	√	Strategies of elicitation, recognition and using were observed for this completed ESRU cycle (promoting the following response by a why question).

Data Analysis

The approach for analysing assessment conversations was adapted from the method proposed by Ruiz-Primo & Furtak (2006) .This approach called ESRU and was used to code the teacher-student interaction in which the teacher asks a question to elicit a student response (E); the student responded (S); the teacher recognized the student's response (R); and the teacher used the information collected to support the students' learning. In this study, the ESRU model was modified considering the context of the lecture teaching approach established by the participant teachers. As a result, some strategies were codded different to that suggested by Ruiz-Primo & Furtak (2006) . For example, a potential difficulty arose when trying to code the strategy for the elicitation phase. With some questions in the elicitation phase that asked with an evaluative purpose the elicitation strategy coded as check recall of facts (Oliveira, 2010; Kearsley, 1976). These questions requested students to explain their thought based on what the teacher already conveyed to them in the lecture asking questions that can display their knowledge of the right answers. The elicitation phase thus coded as E (evaluative).

Results of Research

Table 2 shows an example of one of the teacher's strategies and use of formative assessments when interacting with his students. Khalid's strategies appeared to be designed to help his students' understanding of scientific concepts and relationships after they had been introduced to a critical mass of facts. The following table 2 provides an overview of a selection of those transcripts that best explained formative assessment strategies used by Khalid.

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Table 2. A selection of teacher-student interactions.

Line	Speaker	Questions	Types	Strategies used	Questioning cycles
1	T	Now, how do you explain the occurrence of day and night?	Explanation	Checks recall of facts.	E (evaluative)
2	S1	Because of the earth and the sun.			S
3	T	What happens to them?	Interpretation	Clarifies and elaborates.	R
4	S1	They rotate.			S
5	T	How?	Interpretation	Clarifies and elaborates. Promotes thinking with a 'how' question.	R U
6	S1	The sun rotates around the earth.			S
7	T	Do you mean the opposite?	Confirmation	Asks for 'yes/no'.	R
8	S1	Yes. The earth…			S
9	T	How long does it take the earth to complete one rotation around its axis?	Explanation	Checks recall of facts.	E (evaluative)
10	S2	Day and night.			S
11	T	But, how many hours?	Information retrieval	Clarifies and elaborates.	R
12	S2	12 hours.			S
13	T	Is this the length of the day and the night?	Confirmation	Asks for 'yes/no'.	R
14	S2	Oh, no, it's 24 hours.			S
15	T	What causes the seasonal changes?	Reason	Checks recall of facts.	E (evaluative)
16	S3	Different sunlight at different places on the earth.			S
17	T	This is all because the earth's axis is tilted by almost 23.5°		Answers his own question.	R
19	T	What happens to the earth as we discussed?	Interpretation	Checks recall of facts.	E(evaluative)
20	S2	It is much closer to some part.			S
21	T	Do you mean some part of the earth is closer to the sun?	Confirmation	Asks for 'yes/no'.	R
22	S2	Yes.			S
31	T	How do lunar eclipses occur?	Reason	Checks recall of facts.	E
32	S6	The earth's shadow			S
33	T	Yes. The earth blocks the sunlight and causes a shadow on the moon. It is not dangerous to look at a lunar eclipse because there is no light coming from the moon.		Answers his own question.	R

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34	T	When the earth's shadow totally hides the moon, we call this a 'total lunar eclipse', because we cannot see the moon. What about if part of the moon receives sunlight?	Concept completion	Answers his own question. 'Fills in the blank' answers.	E (evaluative)
35	S6	I think we will see this part.			S
36	T	Here we call this a "partial lunar eclipse".		Answers his own question.	R

As shown in Table 2 the common formative assessment strategies can be classified into some groups.

Elicitation strategies with evaluative functions

In the previous table 1, the questions used to initiate each assessment conversation can be differentiated on the basis of the information requested, but the strategies clarified the purpose of the assessment, which was to 'check on the recall of facts'. In line 1, for example, Khaild asked an explanatory type of question to elicit the first responses from the students. The strategy that was used shows that Khaled asked this question to review an answer that had been given in a prior discussion. This elicitation question was, thus, considered to be evaluative E (evaluative).

Some of the elicitation questions appeared to be open-ended; these were, however, only used to encourage the students to guess the answer that the teacher was expecting. These questions were asked to initiate the discussion, and ranged from simply retrieving the information as in asking – "How long does it take the earth to complete one rotation around its axis?', to asking the students to explain as at line 15 – "How do lunar eclipses occur?" and, also, to asking them to provide their reasons as at line 31 – "What causes the seasonal changes?". Khalid also requested that the students should make a comparison between things as in "What are the differences between the phases of the moon?"

Recognizing and using strategies that directed the students' responses to the right answers

After receiving the initial answers in each conversation, Khalid then engaged with some of the students to interpret their responses. His strategies, which were used to recognize and to use the students' responses seemed, however, to only direct the students to the right answers that had been previously given in the lecture. These strategies are listed below:

1) Asking for 'yes/no' answers as in conversation 1 at line 7 –"Do you mean the opposite?" and in conversation 2 at line 13 – "Is this the length of the day and of the night?" These strategies and questions required the students to confirm whether or not they were in agreement with an idea; this is known as a 'confirmation-check type' of question as suggested by Oliveira (2010).

When answering his own questions as at line 17 – "This is all because the earth's axis is tilted by almost 23.5°" and, rather than continuing with the questioning process, Khalid then tended to, instead, provide an answer to the posed question. He provided detailed statements after asking questions when he obviously felt that he had not fully explained some points in the lecture (see lines 33, 34 and 36 in table 4.1).

2) Responding with a 'fill-in the blank' question: On some occasions, Khalid initiated a new conversation with an idea or a statement and asked questions that required the students to only 'fill in the blank' form. An example of this type can be seen at line 34 where he started his statement and then asked "What about if part of the moon receives sunlight?" In this example,

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Khalid had already defined the total lunar eclipse and had moved on to thinking about the partial eclipse, which made him ask the students to complete the description of a concept or to choose an answer from different, but possible answers. These questions were coded as 'concept completion'.

The previous, recognizing strategies, which had been employed after receiving the students' initial responses, showed that Khalid had employed strategies that direct the students' thinking to the right answers. Despite the fact that Khalid had appeared to interpret and to recognize the students' responses by asking 'How' and 'Why' questions, after having presented the content to the students, his use of 'reactive questions' then became less effective in their support of further inquiry.

3) Focusing on a small number of learners: table 2 reveals that Khalid tended to focus on eliciting as much information as possible from an individual student before engaging the next one in the conversation. He usually identified a particular student before posing his question. He then recognized a prior response that had been made by the student and he then moved through a series of questions in accordance with a planned agenda; this was done in a manner that had been previously identified by Chin (2007). When a student had responded with a short or with an incomplete answer, Khalid had probed further with short questions to encourage the student to limit his response only to the pre-determined answer.

This strategy can explain the increase in the amount of coding for the element (R) as can be seen in table 2 in the questioning cycle's column. During this conversation, Khalid asked the first student to explain the occurrence of day and night. The student responded – "Because of the earth and the sun". Khalid then asked for more clarification and pushed for elaboration –"What happens to them?" When the student continued to give uncompleted answers as in – "They rotate", he probed further – "How?" and then led the student to the correct answer by asking for 'yes/no' answers – "Do you mean the opposite?"

More interpretative strategies were commonly used when using questions to interpret students' ideas as can be seen in lines 3, 5, and 19. This strategy might have helped in clarifying the individual student's thoughts; it might, however, have taken up too much time with only certain individuals, thus leading to less engagement with the whole class.

The ESRU cycles

It should be noted that the average number of cycles was low with an average of only 12 cycles per lesson. This appeared to be related to the allocation of more time to the lecturing of different concepts and assignation of less time for the classroom interactions. It could have also been related to an increase in the length of a conversation by the use of following questions, which asked the students to interpret their answers.

The commonly used cycle the incomplete ESR (elicits-student's response-recognizes). This pattern showed an increase in the number of interactions due to the students' responses and the teaching method used; the associated questioning levels did not, however, appear to place a high, cognitive demand upon the learners. The previous discussion indicated that, despite the fact that some of questions were asked for explaining, for interpreting or for reasoning purposes, these questions mostly required the students to display those 'right' answers that had been previously discussed in the lecture.

The complete ESRU cycle was rarely employed. In such cases, the strategy was to ask questions and encourage the students' explanations and used their responses but did so in a way, however, that directed those responses to the predetermined answer.

The incomplete ES cycle was rarely used as well. This cycle reflects very closed conversations that require a student to provide only a 'fill in the blank' answer and to provide 'yes/no' answers such as in, for example, 'Have you seen the moon in different phases?'

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Discussion

The above findings revealed the formative assessment conversations were initiated by asking questions about information that had been already explained during the lecture without consideration of students' prior knowledge and experiences. Questions that initiate a conversation have been distinguished based on whether or not they have evaluative functions (Kearsley, 1976; Oliveira, 2010; Wu, 1993). Oliveira (2010) described such questions as being teacher-centred and noted that these have an evaluative nature because they serve only to re-enforce the answers that have already been given to the students .Thus, the goals of the assessments are considered to be evaluative if the strategy is to elicit known information and serve to afford students opportunity to display their previous learned content. This was the case for practices that asked to elicit student initial responses, but did not elicit genuine information that seeks students' conceptual development but rather intended to test their knowledge of the right answers. This is inconsistent with what is required by the inquiry instruction at the beginning of an inquiry activity. Ruiz-Primo & Furtak (2006) contend that formative assessment strategies when initiating an inquiry lesson should explore students' prior knowledge, encourage students' participation and allow opportunities for them to talk and to share ideas, which are based on their own personal experiences.

Despite this fact, Khalid appeared to interpret and recognise student responses by asking "how" and "why" questions. Nonetheless, having presented the content to the students, Khalid's use of these "reactive questions" became less effective to support further inquiry and guide them to construct their evidence-based explanations. This is in agreement with the results of van Zee, Iwasyk, Kurose, Simpson, & Wild (2001) in which, the function of the assessment became to direct learners to the teacher's expected answers when teachers utilised authoritative approaches to lead the classroom discussion.

This study found that the use of some strategies such as responding to the students, by asking 'yes/no' or 'fill in the blank' questions, could sometimes block this talk. In this case teachers did not value the student's response but rather used strategies to keep the discussion focused on what they expected to hear from their students. This is similar with the findings of a study by Roehrig and Luft (2004), which revealed that teachers with teacher-centred beliefs considered that they are responsible for the organisation and transmission of scientific knowledge for the student.

Conclusions

This study has shown the issues with formative assessment practices when teaching science. Assessment conversation in which teachers elicit, recognise, and use students' responses were used to document teacher-student interactions. The strategies used by teachers in this study did not appear to encourage inquiry-based practices. When beginning a lesson teachers tended to explain the content for their students rather than explore learners' prior knowledge and experiences. The following discussions were then used to review what has been conveyed to the learners.

Different strategies were used to direct students' attention to the right answers after eliciting their initial responses. Instead of using strategies that encourage students to share their own thinking such as asking students to observe and provide reasons of why or what might happen, teachers tended to limit students' thinking to the predetermined answers. As a result, the students appeared to be waiting for the teacher to provide them with a final explanation and with a summary covering the important lectured ideas.

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Implications

Formative assessment practices of teachers in this study emphasized the importance of students being able to remember the right answers; the teachers' role was seen as the person who was responsible for explaining the meaning of different, scientific concepts. Therefore, teacher education programmes are needed to support teachers distinguishing formative assessment strategies, which could be used to acknowledge and to promote student thinking; this included the capturing of diverse responses from different groups, the provision of neutral feedback and then, the display of these responses to the whole class.

Such findings underscore the importance for teachers to develop dialogic assessment skills to enact student-centred strategies in science inquiry context. To do so Lyle (2008) argued that the key element to support dialogic approaches can be through challenging students to think for themselves. This requires teachers to use effective assessment strategies that provide students with regular opportunities to talk and "treat their answers to teacher's questions, as stages in an ongoing cognitive quest rather than as terminal points" (Alexander, 2006, as cited in Lyle, 2008.p. 230). These required the role of teachers as "guide on the side" in an environment where students' collaborative talk is valued and used to develop further inquiry (Lyle, 2008).

Limitations

This study has a qualitative form, which considered a small sample of teachers as they interacted with their students. This meant that the population was not sufficient to represent the totality of the Saudi-Arabian context.

It might be argued that restricting the study to such a small size affects the generalizability of the findings. The deep analysis of teacher-student interactions did, however, led to valuable findings that can now be used to inform the development of the formative assessment practices for teachers in science-based inquiry-classrooms in Saudi Arabia.

The context, within which this study took place, posits another limitation on the study results. Since the Saudi-Arabian context has certain characteristics, which are due to its cultural and historical background and the way in which teaching takes place, this might have influenced the results. The Saudi context is, however, very similar to a number of countries in the Middle East, which all have similar educational systems and this is thus a valid context for this investigation.

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