

WHO WANTS TO BE A CHEMIST? FORMATIVE ASSESSMENT MADE FUN AND ENGAGING

By

SANGEETHA BALAKRISHNAN

Assistant Professor, Department of Education in Science and Mathematics, Regional Institute of Education, Mysore, Karnataka, India.

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ABSTRACT

Formative assessment—assessment intended to enhance teaching and learning—is an indispensable part of a teacher's tools. As opposed to summative assessment, formative assessment is carried out periodically through the course to get an insight into the students' understanding of the content. Formative assessment is tacit, but planned formative assessments help the teacher and the learner better in their objectives. This article presents the use of a game show format—Who Wants To Be A Millionaire—in a postgraduate chemistry classroom for a formative assessment that was both fun and engaging. The article is an attempt to disseminate a good practice in chemistry education to a wider audience to be adopted as deemed fit.

Keywords: Formative Assessment, Quiz, Multiple-choice Questions, Chemistry, Game Show.

INTRODUCTION

Assessments are an integral part of the teaching-learning process. Assessments have different purposes, and accordingly, are carried out in different ways. The overarching purpose, however remains that the various stakeholders – students, teachers, parents, the education boards/ universities, policymakers – see empirical evidence of progress made by students.

The first kind of assessment is tacit. This is the assessment in place when a teacher after delivering their lecture asks one or the other variant of the question: Did I make myself clear? Depending on the students' reactions, the teacher might then deliver an impromptu mini lecture or adopt some other means to drive home the point of the original lecture. This assessment however, can also happen in not too subtle ways by means of pop-quizzes, asking students to summarise the topic just taught, by short written tests etc. The teacher's intent here remains to be made aware of the muddy points in students' comprehension of the lecture. And once this is known, the teacher then addresses the points that the students haven't quite understood well, before proceeding on to the next topic. Such assessments are called formative assessments (Bell

& Cowie, 2001) and they frequently take place and spread over the entire course term as the teacher goes from topic to topic or lesson to lesson. The aim of this assessment is to improve instructional methods and provide feedback to students based on their understanding of the topic until then. For the students, such assessments are a means to monitor their own progress in the course (Bell & Cowie, 2001).

The second kind of assessment is the final examination given at the end of the course/ semester/ year. These are designed to judge student competency after a set period, and serve to evaluate the effectiveness of instructional programmes. These are called summative assessments (Bell & Cowie, 2001). It is based on the results of students' performances in these assessments that educational reforms are thought about as and when necessary.

A third type of assessment called the accountability assessment is intended to drive changes in educational practices and policies by holding people accountable for achieving the desired reforms (Bell & Cowie, 2001).

The processes that constitute, and the outcomes of

summative and accountability assessments tend to become open to a wide discussion with the rapid dissemination of information in our technological era, and in great measure due to the right to information in democratic nations. While a healthy discourse might well lead to progress, it behooves one as an educator to highlight that a formative assessment when administered intelligently, would address many a concern in the other two assessments. This is by no means to say that formative assessment is the be-all and end-all of educational assessments, but it makes sense to say that it is that lodestone which when handled well can mould the shape of things to come, for the better.

Formative assessment is therefore the primary tenet of this report. A significant component in teaching for conceptual development (Bell, 1995) is that, it stresses on a dialogue with students for it to meet its objective (Scott, 1999).

1. Formative Assessment: A Quandary and Some Faltering Steps

Snyder's work in the latter half of the last century engendered the concept of a hidden curriculum (Snyder, 1971). This, he contended, was something different from the formal course curriculum and had to be discovered by the students if they wanted to do well in the course. This hidden curriculum vicariously focused on marks, and thereby called on students' adeptness in intuiting it. Accordingly, Miller and Parlett talk of cue-seeking and cue-deaf students (Miller & Parlett, 1974). The former are those who are oriented to discovering what would be rewarded in the (summative) assessment, while cue-deaf students revised everything in the course curriculum for the assessment. It has been reported that students over the years have become strategic in their use of time and 'selectively negligent' in not paying attention to content which they think will not be assessed (MacFarlane, 1992).

In such an educational backdrop it is not surprising that formative assessment has declined in its rigour (Gibbs & Simpson, 2005). More worrisome are the reports that effective feedback by the teacher, which is an essential component of such assessments, is losing its effect

(Hounsell, 1987; Lea & Street, 1998; Wotjas, 1998). Students sometimes do not read the feedback given to them or do not understand it. Therefore, it becomes important that formative assessment be carried out in a way that engages the students, and sets the stage for providing feedback from the teacher in a way that is not daunting. Introduction of games could well be a way to make this possible. It is known that games boost student morale and interest (Shatz & LoSchiavo, 2005), and that a lightened mood can negate communication apprehension (Wycoff & Pryor, 2003). Further, games, it is contended to expand the learning matrix to include a more interactive approach opening up the possibility for developing learning dimensions (Light & Cox, 2001).

2. Game on!

This report describes a formative assessment done in postgraduate chemistry courses based on the popular game show *Who Wants to be a Millionaire* (WWTBAM). The objective here was to check for student understanding of the concepts taught, incorporating an element of fun. The quizzes were administered in I and II year M.Sc. chemistry classes. The topics covered were: Orgel and Tanabe-Sugano Diagrams (I year), Charge Transfer Spectra (I year), and Introduction to Organometallic Chemistry (II year). The topics were first taught in the class, and the quizzes were then administered as a means of assessment-cum-revision. The quiz in both the classes was rife with excitement for the students (and for the teacher!). WWTBAM is a popular game show in India as in other parts of the world, so the students were widely aware of the rules and format. But the students' excitement on being exposed to the game in a classroom setting was something to behold.

Adopting popular game shows for teaching-learning is not radically new. There are reports of instances when *Jeopardy!* (Sarason & Banbury, 2004), *Trivia* (Zakaryan et al., 2005), *Survivor* (Howard et al., 2002), and *Face Off* (Meterissian et al., 2007) have entered the classrooms as educational tools. WWTBAM indeed has been popular with educators across disciplines (Sarason & Banbury, 2004; Wolfe, 1993; Meterissian et al., 2007; Cook & Hazelwood, 2002; Turner, 2008; Silverstein, 2003; Hudson

& Bristow, 2006; Moy et al., 2000; Hartmann & Cruz, 1998; O'Leary et al., 2005; Henry, 1997; Fukuchi et al., 2000). The present report is the first in documenting the use of this game show in a chemistry class. The author, however did find an instance of review of chemical concepts in a pharmacotherapeutics course using this game format (Roche et al., 2004). Also, most educators until now have made use of PowerPoint to conduct their WWTBAM quiz. While PowerPoint does meet the end, it however can be a little disengaging given that the availability of suitable software provides students with an almost-real simulation of the game show. This report documents the use of one such software. The report, however does not provide data to comment on the effect of WWTBAM on student grades. This is a report of a classroom exercise which was enthusiastically welcomed by the students, and it is thought that it is deserving of a wide readership because of the possibility it affords to other educators to try it in their classrooms. It is, ultimately, an effort to share an engaging mode of formative assessment.

3. The Game Until Now

Roche et al. (2004) made use of WWTBAM format to reinforce the relevance of chemistry to therapeutic decision making and patient care in a pharmacy program, and reported that the students found the game format to be effective in advancing learning. Hudson and Bristow (2006) report on a formative assessment using the WWTBAM format with first year undergraduate medical students emphasising that making an educational activity fun need not detract from the focus of giving feedback on learning. The student comments in this paper on their impressions of the quiz reveal that the informal way of learning took a lot of pressure off them. Moy et al. (2000) describe the use of WWTBAM to review pulmonary physiology with first year medical students. The game show has also been used as a teaching tool in surgical residency (Meterissian et al., 2007) and in occupational therapy (Lim & Rodger, 2010).

Sarason and Banbury (2004) report on the use of WWTBAM and Jeopardy as active learning methods in their Management class, and stress on the importance of facilitating learning in a manner that is fun and engaging.

Cook and Hazelwood (2002) have made use of the WWTBAM format in their accounting classes as a learning activity that is an alternative to the traditional lecture. They emphasise that the game provides a relaxed classroom atmosphere for the students and an enjoyable method of presentation for the instructor. Kirkland and O'Riordan (2008) reported on the use of WWTBAM in their marketing class. While they assert that the game show experience was both creative and fun, the improvement in student grades after the participation in the game however, was not significant. McEacharn (2005) describes the use of this game in her auditing class. The author found an increase in student score after administering the game based quiz. A questionnaire based survey further indicated that over 95% of the students agreed that the tool was useful in learning the course information. The game show has also found takers in engineering (Silverstein, 2003) and biology (Turner, 2008) education.

4. The Who Wants to be a Millionaire Software

The "Who Wants To Be A Millionaire" (n.d.) software used in this report can be downloaded from the internet. The site terms it Flash Who Wants to be a Millionaire and describes it to be designed by a teacher for use in the classroom as a SmartBoard review game. The game is available for download for both Windows and Mac.

At the same site, one can generate their own game using what is called the Who Wants to be a Millionaire Generator. This is a page that lets one create a game file consisting of 15 multiple choice questions. Each question carries four options, one of which is correct. And one is required to key in the correct response when generating the quiz.

After all the space boxes for the questions and answers are appropriately filled, the game can be saved by means of a suitable name. This game file is made available online and can be accessed by anyone at the site. To play the game offline, one needs to download the created game file as a text document into the same folder as the FlashWWTBAM software. To begin playing, the software is opened and when prompted, the name in which the file is saved is to be entered. This loads the

questions on to the software, and one is all set to play the game. The complete folder with the software and the quiz text file can be transferred to another computer, without the need to download the software afresh. The creation of the game file (the quiz per se) can be done in about 20 minutes if the questions have already been given considerable thought.

The game begins with the choice of a contestant for what is dubbed the hot seat. There are many ways to select a student for the hot seat; the fastest finger being the most popular. In this report however, the order in which the students were seated in the class was the criterion. That said, it makes sense to change the mode of selection each time so that all students remain prepared.

The contestant (student in the hot seat), as in the game show, had to answer one question at a time. It was a multiple-choice question with four options, of which one was correct. The correct answer took the student to the next question. The student of course won some money with each correct answer, the ostensible goal being to win a million dollars. Needless to say, money remained a mere idea in playing this game that the students had fun amassing. But each question and its attendant multiple-choice answers served as springboards to dive into a discussion on the topic at hand. As in the television show, the software provides three lifelines: 50/50, Phone a Friend, and Audience Poll.

Creativity is the key here. The teacher, depending on the class, would do well to bend the rules of the game to meet the learning objectives therein. For making the quiz more interactive, for Phone a Friend, instead of going by the software option the contestant in the hot seat was provided the choice to pose her question to a classmate right there in the class. For audience poll, it was made exciting by having a show of hands (The software route throws up a bar graph depicting percentages for the choice of the four options in the multiple-choice question). The option which begat the highest number of takers was chosen by the contestant. It helped that the class strength was 26 (in both the classes). For making use of the 50/50 option, the software eliminated two of the four choices, and the student then had to make an

intelligent guess among the remaining two choices. The contestant proceeded to answer the questions until she got one wrong, whereupon the next student took her place in the hot seat. It goes without saying that by tweaking the rules of the game as suitable, the teacher is assessing not just the student in the hot seat, but a larger section in the class simultaneously. The real success of the game however is the discussions that ensue when a question stumps the contestant, and in the moderation and feedback provided by the teacher.

Figures 1 and 2 present two screenshots of questions with the game in progress in the Orgel and Tanabe-Sugano Diagram assessment. Figure 1 is the screenshot of the first question as the game begins, and Figure 2 depicts Question 5 as the game progresses. Towards the left in

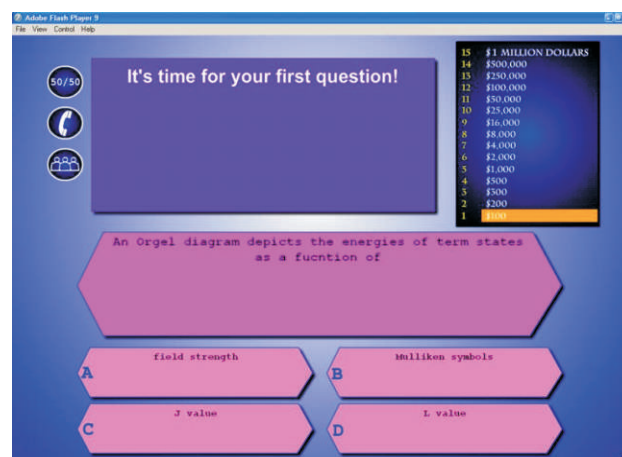


Figure 1. A Screenshot of Question 1 in Orgel and Tanabe-Sugano Diagram Assessment

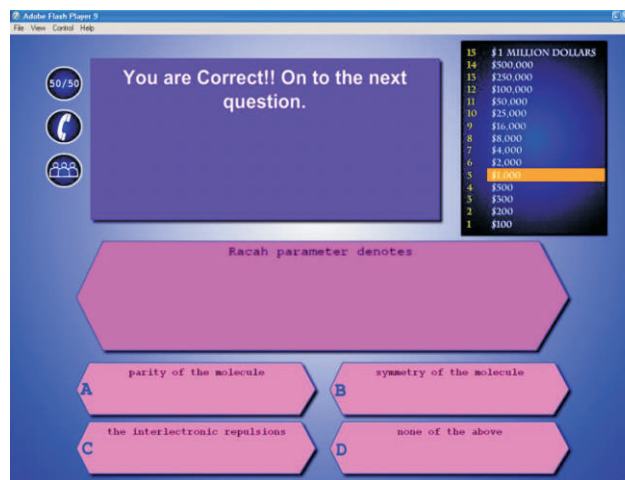


Figure 2. A Screenshot of Question 5 in Orgel and Tanabe-Sugano Diagram Assessment

both the screenshots, the three lifelines are visible. A mention needs to be made of this: when an incorrect answer choice is clicked upon, the software run ends, and one needs to start the game anew.

5. Multiple-choice questions. What's the deal?

The use of Multiple-choice Questions (MCQs) for assessments is not new, and the author hastens to add here that these have largely been used in summative assessments. These are particularly popular in large classes where marking can take up a large amount of time (Pampllett & Farnill, 1995). However, a disadvantage that these MCQs are held to suffer from is that they only test knowledge recall, and do not test the higher order learning outcomes (Bloom, 1956). It is also said that they encourage students to take a surface approach to learning. However, proponents of MCQs as an effective assessment tool aver that designing questions that require knowledge of multi logical thinking and using plausible alternatives to the correct answer to challenge the students' discriminating judgment will increase the ability of MCQs to measure critical thinking skills (Masters et al., 2001). It has also been discussed how MCQs can be used to evaluate everything from definitions to questions involving interpretation at their core (McBeath, 1992). Good MCQs should be short, understandable, and discriminating.

This report, as must be evident by now, made use of MCQs for the formative assessment. It is indeed possible to design MCQs that test higher order cognitive skills in students. Also, with careful planning the entire quiz can be designed with questions coming up in increasing order of difficulty. A nod in favour of this possibility is the Graduate Record Examination (GRE). This is not to mix up formative and summative assessments, but the argument here is that MCQs when thought through properly can indeed be an effective means to gauge student understanding. And at the formative assessment stage, the teacher indeed does stand to gain the direction to go forward, leading the students along.

Conclusion

Formative assessments are an integral part of teaching-

learning. This two-way process indicates to the teacher, what the students have not quite comprehended well, and provides students a way to check their own progress. For formative assessments to meet the learning objective, they can be made fun and engaging, so that students feel confident to open up for a discussion. One way to introduce this levity is by means of games, and this report documents the use of Who Wants to be a Millionaire game show format to test student understanding of concepts taught in postgraduate chemistry classes. The students welcomed the exercise, and it made way for an enjoyable revision of the muddy points in the concepts taught.

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ABOUT THE AUTHOR

Dr. Sangeetha Balakrishnan is currently working as an Assistant Professor in the Department of Education in Science and Mathematics at Regional Institute of Education, Mysore, Karnataka, India. She received her PhD in Physical Chemistry from Ruhr-University Bochum, Germany. She thereafter held postdoctoral stints in KAIST and Hanyang University in South Korea. She specialized in Nanoscience during this tenure. Her research interests include History and Philosophy of Science, Chemistry Education Research, and Science Writing.