

Using Different Questioning Strategies in High School English Literature and Mathematics Classes

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Abstract— Classroom questioning is the teacher’s key tool that is widely and extensively used to propose a problem to students in order to stimulate their thinking skills. Addressing questions in a classroom contributes to the creation of a positive learning environment with special emphasis on the social context that heavily impacts the extent of learning. According to Vygotsky’s theory of Zone of Proximal Development, social interaction with adults and more knowledgeable partners is seen to strongly influence the progress of learning on the part of the learners; teachers are thus found to contribute much to such interactions through their extensive use of a wide range of questions. This paper aims at analyzing as well as drawing an analogy between the different questioning strategies implemented by English literature and mathematics teachers in classroom settings.

Keywords— Bloom’s Taxonomy, English literature classes, Mathematics classes, Questioning techniques.

I. INTRODUCTION

As defined by Smart and Marshall [1], teacher questioning is a fundamental subcomponent of attaining efficient classroom discourse. Teachers use a plethora of questions that can serve an array of functions; among these functions is “to prompt students to take the next mental step” [2, p.209] and thus sharpen their thinking skills by attempting to anticipate what is to come next; a second function is to encourage students to reflect on and evaluate their prior knowledge and prerequisite skills of the subject matter; a third one is to initiate classroom discussions, which is viewed as so crucial an element that radically enhances students’ high cognitive level responses and reasoning skills. Modeling a variety of verbal formations of questions also feeds in another essential classroom aspect which is helping “students generate their own questions” [2, p.209]; Drake and Brown [3] suggest that students are inclined to formulate their own questions in order to reflect their cognitive quests following the models offered to them by their teachers. Using questions or ‘learning probes’ [4] is also regarded as a fundamental function of classroom questioning. Moreover, questioning purposes like promoting learners’ motivation, arousing their interest, tackling their creativity, assessing their attainments, and increasing their participation in classroom activities are also highly appreciated.

Teachers should possess the required skills for designing sets of questions that would help them achieve worthwhile goals of their instruction. Using combinations of lower-order or convergent and higher-order or divergent questions is

another substantial element of a differentiated instruction. A skillful teacher needs to plan sequences of questions that align with the nature of subject being introduced as well as the type of goal being pursued; sequences that start off with higher-level questions followed by series of lower-level questions is proved to be significantly useful in probing for details about how a specific application works ,e.g. math problems; whereas other sequences that involve featuring a set of lower-level questions before escalating towards higher-level ones is said to suit more subjects that require drawing students’ attention to facts first before prompting them to synthesize, reflect, evaluate and draw conclusions based on the previously introduced pieces of information ,e.g. literary responses [5].

The main purpose of this research paper is to observe how high school teachers efficiently integrate questions, as a classroom discourse strategy, in their instructions in two different subjects, mathematics and English literature. Examining the types and identifying the purposes of the questions used in each subject is another focal objective of this research. The data displayed in this research paper is collected via conducting classroom observations and is meant to answer the following questions:

1. Is there any interplay between the questioning strategies used by classroom teachers and the nature of the subjects being taught?
2. What are the most frequently used types of questions in the classes under examination?

The aggrandizing emphasis on the students’ learning and wellbeing by the KHDA in UAE [6] brings about the significance of classroom instructions, activities, and environment that engage students in higher level thinking; researchers signify using various questioning strategies to broaden and enrich high-level and critical thinking [7].

II. LITERATURE REVIEW

A study by Mortimer and Scott [8] explains that the significant classroom discourse is the evolution of effectual and communicational questioning that stimulates and facilitates students’ cognitive thinking. Teachers have been using questioning techniques in their classrooms for so many years; Socrates, for example, believed deeply in the role of inquiry as for teaching students to transfer knowledge from specific to more general contexts [9] .Additionally, questioning is advocated as a method of augmenting students’ higher-order thinking skills by Smith and Szymanski [10] .On the whole, many researchers have been dedicated to study the importance of classroom questioning [11],[12], [13] and the

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way teachers bridge and connect concepts as well as foster students' understanding by using questions [14].

Questioning is profoundly valued as a "pedagogical tool across all disciplines" [15, p. 106]. Swain [16] argues that ESL teachers should use questions to promote students' language output and thus offer them an opportunity to utilize and validate their emerging language skills. Equally important, Gibbons [17] highlights the powerfulness of teachers' classroom questions as a linguistic and cognitive guide in the development of English language learners (ELL). In the same sense, Gibbons well chronicles the profound effects of ESL teachers' questions on students' learning in her study; she goes on to say that teachers' questions are able to bring about various quality responses on the part of the students. According to Toni and Parse [18], questioning is so pivotal a tool that enhances the amount and depth of EFL learners' output, which in turn leads to better learning. A language research body carried out by Youb [19] reflected the centrality of teachers' questions in the learning process of ELL. In other words, effective teacher questioning can unfold prosperous learning outcomes.

Correspondingly, a substantial number of studies, [20], [21], [22], have investigated teachers' questions in mathematics classrooms; questions are found to have generally assisted students in discussing and deriving mathematical concepts. Furthermore, a body of research conducted by [23], through observing secondary school classrooms, states that the dearth of questions and authentic mathematical activities are among the biggest drawbacks in teaching mathematics. Therefore, teachers ought to effectively facilitate learning by asking level-appropriate questions that, in their core, advance the students' mathematical discourse and thinking skills [24].

Informed by Albergaria Almeida's research [25], though teachers usually ask a large array of questions, most of the questions are of the same type; teachers frequently ask low-level questions that require memory-level responses. Kerry [26] claims that the most prevalent function of teachers' questions is recall while other functions like evoking students' reflection are not commonly spotted. Specifically speaking, Guan Eng Ho [27], in her classroom observation-based study, affirms the notion that teachers in ESL classrooms use closed questions that require restricted responses excessively. Similarly, Sahin and Kulm [28], in their study, figure out that mathematics teachers ask more factual questions than higher-order questions. In this case, classifying questions according to a particular system, e.g. Bloom's Cognitive Taxonomy-revised, lends a helping hand in examining the types of questions teachers usually ask.

Bloom's cognitive taxonomy, as a frame work of this research body, is a hierarchical system that is used to classify "cognitive behaviors into six categories...with learning at higher levels"- knowledge, comprehension, application, "...and skills at lower levels"- analysis, synthesis, evaluation [29, p. 79-80]. Seen as "unidimensional", the original taxonomy was first revised by Anderson and Krathwohl [30] who used verbs rather than nouns to describe the underlying cognitive processes, replaced the comprehension category with understand, disqualified synthesis as a standalone category, and used create at the top of the hierarchy [31].

III. METHODOLOGY

This qualitative educational research relies on collecting, describing and analysing data through conducting observations, "the process of gathering open-ended information by observing people and places at a research site" [32, p. 223]; the people observed are high school girls, seventy eight in number, along with four female teachers in mathematics and English literature classes; and the research site is the private school. Typically, permission was obtained from the school principal, gatekeeper, prior to observation. It's worth mentioning that this is an ethnographic study conducted in a natural setting, classroom, to provide "in-depth descriptions and interpretation of naturally occurring behaviour" [33, p. 151] using observations only as a data mustering tool.

The data used in this research is collected by a nonparticipant or complete observer, "who visits a site and records notes without becoming involved in the activities of the participants", and field notes were recorded during the observations [32, p. 222-224]. In addition, the observational tool or protocol, questions to identify areas an observer should focus on, is adapted from "Looking in Classrooms" [5, p. 334].

The observed natural phenomena to be described are how high school mathematics and English literature teachers incorporate questions in their classroom discourse, what types of questions they usually use, and what questioning strategies they implement. Two observations were conducted per subject, four observations altogether. The following table contains information about both participants and classroom settings:

TABLE I
PARTICIPANTS' PROFILES

Level of students	Discipline	No. of students	Seating Plan	Duration	Teacher's name
Grade 10C	Math	22	U-shape	55 min.	Samar
Grade 12B		19	4 groups		Siham
Grade 11B	English Lit.	17	Pairs		Mariam
Grade 10B		20	U-shape		Dalal

IV. DATA ANALYSIS AND FINDINGS

Teachers of both subjects, mathematics and English literature, made sure the lesson titles and objectives were explicitly written on the white board for students to keep track of. All four observed classes had clear opening and implementation stages, while differed in their closures. On the whole, the noteworthy point to mention is that teachers of both subjects broadly used questioning of different levels and functions as a fundamental classroom discourse tool.

A. English literature classes

As observed in the English literature classes, a wide range of questions were asked throughout the courses of the classes; teachers started with some factual, closed, knowledge-level questions, as a warm-up, in order to arouse students' interest in, draw their attention to, and mostly elicit their prior

knowledge of the subject matter. Subsequently, questions gradually took the so called “gateway to higher levels” of thinking [29]; a blend of understanding, application, and analysis questions got through in pursuance of class discussion initiation, drawing conclusions, fostering critical thinking, and classroom dynamics enhancement. Towards the end of the classes, the types of addressed questions broadened up to be more evaluative and open-ended, which heated up the dynamics as students debated their responses.

TABLE II
SNAPSHOTS OF QUESTIONING TECHNIQUES IN ENGLISH
LITERATURE CLASSES

Subject/content	Examples of teachers' questions	Lesson stage	Level of taxonomy and description
Lit. (1) “The Masque of The Red Death”	“What is the main plot of the story?” “Can you describe room no. 7?” “What are allegories in literature?”	Opening/ lead-in	Knowledge-level/recall/retrieve questions that require students to remember facts already stored in their minds; the students' responses are usually concise with no expected knowledge transformation or manipulation
Lit. (2) “The Teacher Who Changed My Life”	“What is characterization in non-fiction?” “Who is the main character in the story?”		
Lit. (1)	“How did Prospero justify his former behaviour?” “Can you figure out any of the allegories in the story?” “How do you explain the main message of the story?”	Instruction/ implementation	Understanding, applying and analysing level questions that require relatively lengthy responses in which students need to integrate, use, break down, and relate pieces of information
Lit. (2)	“Why did she assume that he is a good writer?” “Why did Mr Hurd use the word ‘forcefully’?”		
Lit. (1)	“What do you think of the main theme of the story?” “Do you think what happened to Prospero at the end was convenient or harsh?”		
Lit. (2)	“How do you feel about this quote from the story ‘...[f]or girls were not supposed to attend school beyond a certain age’?”	Production	Evaluation level questions that require thinking time and lengthy response as students make their own judgements, justifications, and decisions

B. Mathematics classes

In the mathematics classes, both teachers started with warming up students' prior knowledge by demonstrating a function or formula on the board and eliciting ways to solve it; teachers then explained the new concepts. As the teachers proceeded with their lessons, there were lots of probing questions, to trace students' ways of processing information e.g. “How would you use this information to graph the

function?”, and scaffolding questions, to support students' conceptual construction [1], e.g. “Do you need to know(π)to solve the function?”, which ultimately led many students to the correct implementation of the rules. Not to mention the plenty of hands-on activities spotted in both classes. Each of the classes ended with allotting students more practice on the concepts in question as a means of application to ensure students' capability of applying the newly introduced concepts to specific problems.

TABLE III
SNAPSHOTS OF QUESTIONING TECHNIQUES IN ENGLISH
LITERATURE CLASSES

Subject/content	Examples of teachers' questions	Lesson stage	Level of taxonomy and description
Math (1) “Sine and Cosine graph- Amplitude”	“What do you remember about yesterday's lesson?” “Can you show me how you calculate this function ‘ $f(x) = \sin x$ ’?”	Opening/ lead-in	Knowledge-level/recall questions that require students to remember facts already stored in their minds
Math (2) “Differentiation Formulae”	“What is meant by formula?” “Do you remember how to do this formula ‘ $f(x) = 9f - f^2/g^2$ ’?”		
Math (1)	“If this is the function: $f(x) = 2 \sin x$, what is the amplitude of the wave function?” “Can you apply the amplitude rule: ‘max.-min. /2’ to solve the function: $f(x) = \cos x$?”	Instruction/ Implementation	Application and analysis level questions that require students to carry out, compare, find and check given information
Math (2)	“What are other ways to solve this formula: $f(x) = (x^2+2x+1) (x^2)$?”		
Math (1)	“Find both the amplitude and the period of the function: $h(x) = 1/3 \cos 2x$, then graph it”	Production	Application-level questions as a follow-up procedure to practice the formerly demonstrated concepts/rules
Math (2)	“Can you find the derivative of this formula: $g(x) = 3x - 2/2x^2 - 7$ using two different ways?”		

V. DISCUSSION

In general, the teachers of both subjects made a broad use of questioning techniques to keep the lesson in full flow; all classes provided the students with a rich inquiry environment. They used questions of different cognitive levels throughout the courses of the classes; neither of the teachers used

questions as a means of assessment nor did they direct questions at the creating level of the taxonomy. They seemed to have adopted the deductive-based mode of presentation, determined by the instructional objective which is to introduce students to a specific concept or generalization [29], e.g. the rule of ‘amplitude’ in mathematics and the definition of ‘allegory’ in English literature. Besides, they reflected some features of appropriate questioning behaviours, e.g. using proper wait time, attending to students’ questions, and providing instant feedback.

Upon taking a closer look, the differences in the implemented questioning strategies will come in the limelight; the English literature teachers opted mainly for the evaluative strategy, based on the divergent strategy, “to help students develop a logical basis for establishing evaluative criteria”; whereas the mathematics teachers used mostly the convergent strategy that encourages students to “focus on a central theme” [29]. Having said that, a data analysis indicated in [34] study showed that the type of questions most frequently asked in both the English language and the mathematics lessons were lower-order thinking (LOT) questions that proposed the lowest three levels of Bloom’s taxonomy. As per observation and unlike the previous research body findings, the most prevalent type of questions in the English literature classes was evaluative, which is considered among the higher-order thinking (HOT) question types. On the other hand, mathematics classroom observations confirmed the formerly mentioned results about the ubiquity of factual and application level questions which are, according to Thompson [35], among the lower-order thinking types that are “often characterized by the recall of information or the application of concepts or knowledge to familiar situations and contexts” [35p. 97]. In the same way, Weiss, Heck and Shimkus [36] made an overt statement when they said that questioning is one of the weakest aspects in mathematics instruction.

VI. CONCLUSION

As stated by Tay et al. [37], the nature of the two subjects under examination is different –learning English revolves around expressing one’s ideas and thoughts, while learning mathematics aims to acquiring problem-solving skills and concepts. Consequently, due to content differences between the two subjects, the pedagogical approach of each might also differ. The nature of a subject is said to make limitations to the pedagogical strategy including the use of questioning as a part of the classroom discourse.

Personally speaking, as an English language teacher, English literature is a discipline that promotes discussion and reflection; thus, a divergent questioning strategy is the most applicable approach to prompt students’ feelings and thoughts. On the other hand, mathematics as a discipline is bound by rules and concepts as well as a limited range of problem-solving procedures that focus mainly on the achievement - the answers; it’s believed to be based on deductive and logical reasoning, as noted by Ayalon and Even [38], deductive reasoning is a mathematical thinking synonym, with no room for creation. Therefore, a convergent questioning strategy seems appropriate to a limited extent; it might also be reasonable to remark that the nature of mathematical tasks

demands mastery of both convergent and divergent thinking.

The goal of this research paper is to seek answers for two basic questions about whether there is a relationship between the nature of English literature and mathematics as subjects and the questioning strategies employed by the teachers which is revealed affirmative; and what the most prevalent types of questions in use in both subjects are. Both raised queries were relatively tackled and attempted at through the four observations paid to the mentioned classes.

VII. STUDY LIMITATIONS AND RECOMMENDATIONS

Idiosyncrasies, e.g. teachers’ beliefs as claimed by Pham & Hamid [39], and time constraints, e.g. schedules and annual plans, are among the interfering factors that sometimes dictate specific instructional methods and have a say in the effective use of classroom discourse. The limited number of observations and the invariability of tools might have restrained the objectivity of the research results.

According to Morge [1], teacher questioning within an inquiry environment encourages students to elaborate and reflect on their own answers rather than assessing their preciseness which bounces the ball back to them for self-evaluation and knowledge construction. Thus, promoting classroom inquiry environment using a diversity of questions is a universal demand that needs to be well implemented and sustained in the UAE. Moreover, The Common Core State Standards (CCSS), now applied in many local schools in UAE, highlight some necessary reforms related to classroom questioning; they call for an interdisciplinary approach in utilizing common questioning language for instruction [40]. Finally, more bodies of research need to be conducted on wider scales, e.g. using various observational tools and increasing the number of observations as suggested by Shih [41], in order to verify these research findings and fill out the gaps in the previous ones.

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