
## AN ACTION RESEARCH INVESTIGATION TO ANALYZE THE EFFECTS OF QUESTIONS AND NON-VERBAL BEHAVIORS ON STUDENT RESPONSES WITH SUGGESTIONS FOR IMPROVING PRACTICE

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**ABSTRACT:** Action research has been advocated as an effective way to improve teaching practice. I conducted action research to determine the effect of question type and non-verbal behaviors on students' responses. Question type in conjunction with non-verbal behaviors are crucial considerations when motivating quality responses from students in science classrooms. *This article addresses National Science Education Standards A and G and Iowa Teaching Standards 1, 3, 4, 5, 6, and 7.*

One of the most important components of successful science teaching is the use of effective questioning (Clough, 2007). Extended-answer or open-ended questions that demand more than yes/no or short answers in conjunction with positive non-verbal behaviors encourage students to be mentally involved and share their thinking. These behaviors also encourage student creativity and inquiry, and foster an environment that stresses thinking (Penick 1995, Penick et. al 1996).

Many teachers struggle to use effective and productive questions during instruction. This struggle can be partially explained by the formal education that teachers have undergone where rigid ineffective factual questioning strategies are the norm. This state of science instruction is unfortunate as effective questions are one of the most powerful components in quality science instruction. Importantly, effective teacher behaviors, such as questioning strategies, rarely develop naturally. Significant effort is required to improve questioning and other behaviors (Jelly, 1985). One way to improve teacher interactions and behaviors is through deep reflection on one's own practice through action research (Capobianco et al. 2004).

While research makes clear that a teacher's questions and non-verbal behaviors are important, I set out to

perform action research to determine how the type of questions I asked in conjunction with the type of non-verbal behaviors I exhibited would impact the students' response behavior in my high school biology classes. I wanted to determine how best to motivate my students to participate in discussions with extended answers - indicating deep and critical thought on the part of students.

## Methodology

Because this action research was conducted while teaching, methodologies utilized were seemingly loose and unstructured as compared to formal science education research. While audio taping discussion with students in my science classes, I subjected them to interaction combinations varying in depth of question asked, and type of non-verbal behavior displayed by the teacher. Instructional sequences ranged in lengths from as short as a few questions long to discussions that would last the entire class period. Questions varied within each instructional sequence and were categorized as either 1) yes/no and short-answer or 2) thought-provoking short answer and extended answer type questions. The question categories were based on SATIC coding modified from Schlitt and Abraham (1973). During the instructional sequences studied, the varying types of questions based on depth were selected arbitrarily.

Prior to data collection, non-verbal behaviors were randomly selected for each instructional sequence. Non-verbal behaviors were categorized as positive (i.e.: eye contact, expectant looks, expectant hand gestures, etc.) or negative (i.e.: looking at floor, hands in pockets, blank facial expression, etc). These variables were combined to form four categories or interaction types (Table 1).

**TABLE 1**
*Interaction Types used during instruction.*

**Category A:** yes/no and short-answer questions, couple with negative non-verbal behaviors

**Category B:** yes/no and short-answer questions, coupled with positive non-verbal behaviors

**Category C:** thought provoking short answer and extended answer questions coupled with positive non-verbal behaviors

**Category D:** thought provoking short answer and extended answer questions coupled with negative non-verbal behaviors

Although the depth of question could change within one instructional sequence, non-verbal behaviors remained constant throughout the sequence and would be subject to change for the next sequence. Therefore, when analyzing tapes, question interactions were first grouped by non-verbal type and then by question type to make the aforementioned categories which were pooled among all classes and sequences. This resulted in 108 (category A), 19 (category B), 75 (category C), and 10 (category D) question interactions.

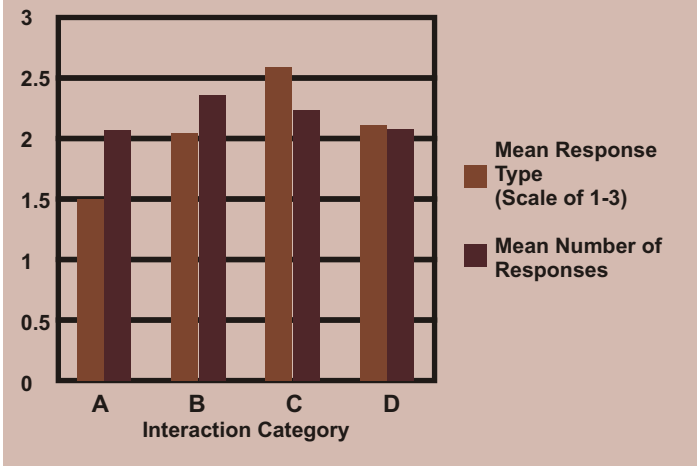
Response variables included 1) number of student responses, 2) type of student response, 3) time to first response, 4) length of response, and 5) discussion generation. The type of response was determined by coding all students' responses to a single question in to one of three categories (1=yes/no, 2=short answer, 3=extended answer). These coded responses were then added up and divided by the number of responses to give a mean type of response value for each interaction. These mean numbers were pooled and then averaged according to interaction type and then graphed. Those mean type of response values closer to three indicated that more extended answers were given. Time to first response was determined as the length of time in seconds from the end of the teacher question to the start of the first students' answer. Length of student response was determined as the length of time in seconds for all response to be given by students for each interaction. Discussion generation was determined based on whether or not students began to interact with *each other* in agreement or debate. Interactions and their responses were analyzed and a mean of the response variables, except the discussion variable, were calculated according to their treatment (interaction type) categories. To analyze the effect of question type and non-verbals on discussion generation, the percentage of questions that resulted in discussion amongst students were calculated for each category.

## Results and Discussion

Although the numbers of student responses were consistent across all categories of treatments with means ranging from 2.09 to 2.37 responses per question, the type of response was not (Figure 1). Response type values ranged from 1.50 for category A interactions to 2.59 for category C interactions. Although these numbers are seemingly not different at first glance, note must be made that these values are on a one to three scale. Thus, these values serve as

**FIGURE 1**

*Mean number and type of student response according to question type and non-verbal behavior.*

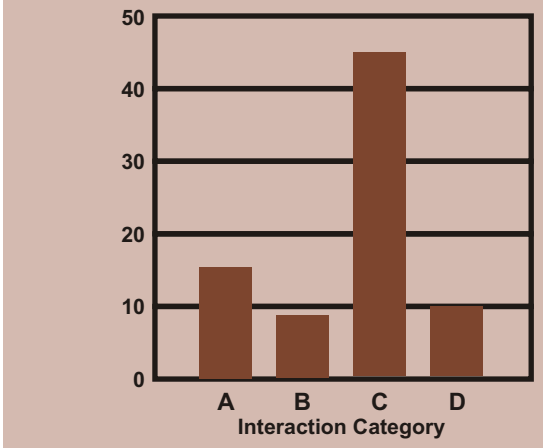



indicators that, not surprisingly, teachers are much more likely to motivate extended answers through the use of extended-answer or open-ended questions *and* positive non-verbal behaviors.

The percentage of discussions was also highest with category C interactions (Figure 2). In this category, 45% of the questions asked were responded with some form of students playing off one another's comments. This is a dramatic increase compared to the next lower category (A) with 16% of the questions resulting in student-student discussions.

**FIGURE 2**

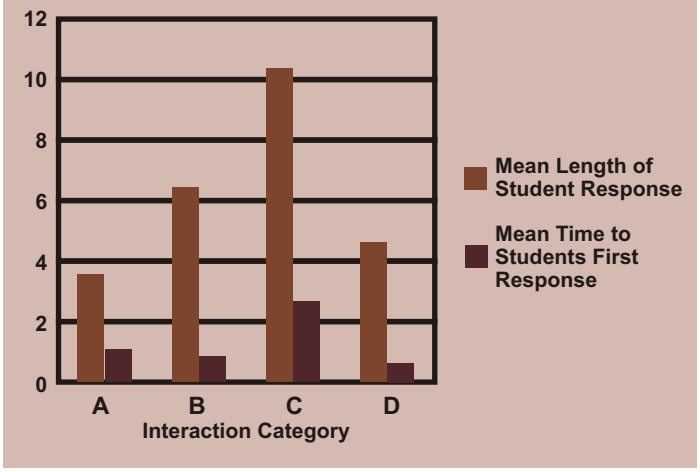
*Percentage of questions that were responded to by discussions according to question type and non-verbal behavior.*




Mean length of student response was the longest in category C interactions at 10.21 seconds (Figure 3). This is, on average, nearly 4 seconds longer than the next highest category (B). In addition, the lowest category (A) had mean student responses lasting 3.67 seconds. These results also support the importance of using positive non-verbal behaviors in conjunction with extended answer questions to motivate students in providing extended answers. Additionally, the positive non-verbal groups produced the longest average response indicating the powerful effects of teacher non-verbal behavior on student responses even more so than the question asked. What should also be noted is that in the sequences with positive non-verbal behaviors, some responses lasted up to almost fifty seconds with both types of questions. Given that many times students may need to "think out loud" to build concepts, this result indicates the need for teachers to provide adequate time for students to articulate their answers. Yet, time is not enough; students need non-verbal clues from the teacher to indicate that their ideas are valued and desired.

**FIGURE 3**

*Mean time to initial, and length of student response according to question type and type of non-verbals.*




Mean length of time to students' first response ranged from 0.99 seconds for category D interactions to 2.61 seconds in category C interactions (Figure 3). Perhaps more importantly though is that the highest values were also in category C interactions ranging up to 25 seconds. This is a dramatic increase compared to highs of 9.56, 4.00, and 1.75 seconds in categories A, B, and D respectively. Perhaps these values in the category C interactions are much higher due to the fact that extended answer/open ended questions in conjunction with positive non-verbal behaviors push

students to think critically before answering. Hence, extensive wait time is needed when posing questions such as these in order to give students the opportunity to construct thoughts.

Overall, these results demonstrate the synergy between a few of the many components for effective instruction teachers must keep in mind throughout all aspects of their practice (Clough and Berg, 1995). While presenting questions to students, teachers must make conscious decisions based on sound rationale of how to word a question, what behaviors to employ while asking, and how long to wait for a response (Rowe, 1986; Schlitt and Abraham, 1973). Although this list is by no means exhaustive, a teacher that is deficient in just one of these considerations may experience decrease in desired student responses. For instance, a question can be worded as an extended-answer question with adequate wait time; yet if non-verbal behaviors are passive or even negative, students may not respond as hoped.

Furthermore, a teacher may portray positive non-verbal behaviors and ask beautifully phrased extended-answer questions, but not provide students appropriate wait time needed to process, construct, and vocalize ideas. In another instance, perhaps teachers have facilitated the supportive environment needed to promote answering open-ended questions, but the teacher only asks yes/no questions that demand a low level of cognitive effort. These types of situations may result in students performing many actions including shutting down or training the teacher to answer the question for them. While aspects of effective teaching are present in each of these situations, students are not likely to construct concepts through critical thought and creativity because the environment is not wholly conducive to answering extended-answer questions and participating in discussions. Considering these situations, the critical role of the teacher in the science classroom is clear.

## Moving toward the desired state of science teaching

The interpretations from this action research clearly support the science education literature and should motivate teachers to enact a plan with well-defined strategies to improve their practice. Many simple strategies can be employed to move one's practice from the current state to the desired state. For instance, teachers can count on their fingers behind their back after posing a question in order to give adequate wait time. Counting to four can have dramatic effects on the number and quality of student responses (Rowe, 1986). I have even spoken with teachers who posted a sign at the back of the room that states "WAIT" as a reminder.

Teachers can also integrate more extended answer/open ended questions into the lesson through several strategies. One strategy is to prepare such questions relative to the lesson before class. Rather than asking, "What is the basic building block of life?" a teacher might ask, "What role do cells play in life systems?" By asking the latter question, students are more likely to provide more in-depth answers. Teachers can then use the information gained from such responses for making more informed instructional decisions. Rather than just knowing whether students can repeat a vocabulary word, the latter question seeks insight into student thinking. Having these questions ready to integrate into discussions not only conveys a sense of preparedness and motivates discussion, but also pushes teachers to anticipate students' thoughts and answers.

Another strategy teachers should commit to is audio-taping their lessons and reflecting on the questions asked. One tool useful for assessing questioning patterns is the SATIC coding scheme developed by Schlitt and Abraham (1973). Accurate reflection on questions asked gives teachers important insight on their patterns of interaction with students and areas in need of improvement. In addition to questions, teachers ought to pay close attention to their responding behaviors. Rejecting student answers, either verbally or non-verbally, can lead to fewer responses and distress on the part of students. Similarly, always affirming "correct" student responses can have negative effects. If teachers respond to a student idea with "that's right", other students might not share their ideas, even though they do not understand why they are wrong. The only lesson students have learned is *what* the right answer is, not *why* it is correct. By not encouraging all students to provide their ideas, many students will hold onto their inaccurate conceptions and merely memorize the "right" answers for the test.

Teachers that want to improve their non-verbal behaviors may also attempt several strategies. One of these is trial and error in conjunction with journaling. Although this may seem obvious, many teachers do not monitor progress in this way. Another method of

improvement is through videotaping. This strategy gives the teacher the ability to review their own non-verbal behaviors and the reactions that are brought about in students. Lastly, I have invited fellow teachers to sit in on lessons and provide feedback on various aspects of my teaching. This collaboration provides a wonderful opportunity for the critic and the critiqued to reflect and improve both of their practice.

## Conclusion

While science is often characterized by questions and curiosity, science teachers often ignore the art of asking carefully worded questions. The research here presented makes clear that the way teacher questions are worded does make a difference in student response. Yet, asking a well-worded question isolated from positive non-verbal behaviors negates many of the positive outcomes of an extended-answer question. The synergy required among all a teacher does quickly becomes overwhelming. Having concrete strategies to improve one's practice can keep us focused and moving toward the desired state of science instruction.

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