CHANGE: THE USE OF QUESTIONS IN THE CLASSROOM

Overview of the Research

Since the inception of the Socratic method of teaching, the use of questions by teachers has been considered a crucial learning component. In fact, questioning in the classroom is the second most common type of technique employed by instructors [1]. During the lesson, questions serve to keep up the pace, may prevent students from disengaging and have been shown to be highly effective for producing achievement gains [1]. Moreover, questions can be used to retrieve prior knowledge from long term memory and move it to working memory, where it will act as a scaffolding foundation to which the students will add new information. Thus, the use of questions before a lesson can help in knowledge retention and transfer by using prior knowledge to build upon for future learning [2].

Under one categorization scheme, teachers can ask two types of questions: lower or higher order cognitive processing questions. Lower order questions are those which are used, for example, to summarize and review lessons or to disseminate facts that the students will then commit to memory. These questions are highly effective in imparting basic or factual knowledge, which must be matched to the student's current understanding [1].

Conversely, higher order questions might be used to develop critical thinking, expose new relationships or stimulate students to develop more critical thinking. Moreover, these questions may create cognitive flexibility and this in turn has been linked to self-efficacy [4]. Students who are most self-efficacious (i.e., believe they can succeed in a course) will ask questions [5]. Therefore, ensuring that students feel that they can succeed in the course materials is also going to be reflected in the amount of help-seeking a student utilizes (i.e., questions asked).

Extensive research in K-12 on high achieving students has suggested superior student learning gains when teachers use higher order questions [1]. Moreover,in response to teachers' questions, students increase their on-task behaviors, the length of their question' responses, their voluntary contributions in class, and their student-student interactions as well as engage in more speculative thinking [1, 11].

Questioning: Professors to Students

The increased use of higher order cognitive questions increases the learning gains for older students (i.e., above primary grades). Moreover, teaching students to draw inferences gives students the increased ability to form higher level cognitive responses [1].

In its most common form, wait time refers to the amount of time a teacher waits for students to answer a question. Unconsciously, teachers often convey a lack of belief in a student's ability when they wait less time for an answer. In an indirect way, students are being told they are incompetent [3]. The general rule for wait time is 3 seconds for lower order questions such as factual or procedural information. For higher-level cognitive questioning, the more the wait time within reason, the better. It can be as much as 10 seconds or more. However, if the wait time is longer, the students will become more engaged as it gives them time to think through a problem [1].

After students answer questions, feedback can take a several forms: 1) positive acknowledgement, confirmation, praise; (e.g., "yes, that is a great response!) 2) neutral (e.g., "OK" which acknowledges a correct answer); 3) unhelpful negative criticism (e.g., "Now, let's go back over the ABC's of calculus!") or remediation, which is constructive criticism (e.g., "If you think in terms of differential equations, how would that alter your response?"); or 4) enabling feedback which is a type of feedback which encourages the student to think more deeply. This type can also be in the form of remediation. Of these, the latter is superior as it develops a deeper understanding of the material [6]. An example of this is to reply to a student's answer with a probing question. For example, "Now that you see the relationship between distance and gravity, why do we consider the rate of gravity constant?"

Finally, questions can be used to summarize and reinforce a class lesson. Summarizing reinforces the main points and recaps the information for greater retention. It follows the old adage: tell them what you are going to tell them, tell them, and tell them what you told them. This helps the student commit the information to long-term memory because the more material is repeated, the better [3]. Using questioning during this process can help students recall the information rather than having the professor repeat it.

Questioning: Students to Professors and Students to Peers

Classroom climate is important! If the classroom is intimidating, students who need help may not seek it. One major barrier arises when students fear being labeled as incompetent or lacking in ability [7]. In large classes such as lecture halls, this fear may be compounded.

However, not only is academic support essential from professors, research has differentiated between the consequences of negative reactions from teachers and those of peers. In one study, when students' perceptions were positive toward peers, they were more likely to seek help, but when they anticipated perceived threats to their competence, they were less likely to ask fellow students for help [7].

In engineering programs, professor must create a classroom environment wherein students feel safe asking questions or at least not intimidated to

approach professors and/or peers for further clarification of course materials. As such, feedback to students must never be intimidating or condescending in either verbal or nonverbal communication. However, overuse of praise can also have negative consequences for students [3]. Praise should be used sparingly, but when given it should be specific and genuine [1,3,6]. Other types of feedback may be more effective such as hinting, redirecting from incorrect to correct answers and leading students to the proper answer.

Besides creating a classroom where students are comfortable in asking questions, one factor that increases student-student interactions is the use of extended wait times when waiting for students to answer questions. Increased wait time may also increase the number of questions asked by students. Moreover, when teachers practice a second type of wait time, which is waiting before responding to students, it may increase the quality of the feedback given to students. Teachers can also use this time to summarize and paraphrase the student's response which indicates that the teacher is really listening.

Based upon the research, recommendations for change include the following:

- **Use Effective Questions**

Effective questions are clearly phrased, unambiguous and related to the material at hand. Another major problem occurs when a teacher asks a series of additional questions, attempting to sharpen the focus of the original question. Ask one good question at a time [11].

- **Make Everyone Participate**

Try to call on all students. Avoid overlooking some students because you feel they would be put on the spot. If given the proper classroom climate, wait time, redirection and probing, most students can be guided to answering correctly. This may also insure that students come to class prepared [3].

- **Watch for Gender Bias**

It has been well documented that males are asked more questions and given more in-depth or probing feedback than are females. Males are called on more often and have more intellectually challenging interactions with teachers. This gives males a cognitive advantage as well as they interpret this to mean that their questions are more important [6,8]

- **Use Cognitively Enhancing Feedback Techniques**

Use questioning to promote greater understanding of the materials by redirecting, probing and leading. Also, at times, respond to a student's correct answer with another question to deepen their understanding [6].

- **Use Wait Time**

Remember the golden rule: 3 or more seconds for lower order questions and 10-20 seconds for higher order questions. Teachers should also wait before responding to students' responses [6].

- **Plan Time in Lessons for Questions**

Often professors do not plan time for questions and may ask only questions at the end such as "is everything clear". This is not the maximal way to use questions in the classroom as it is vague and does not promote the type of cognitive growth that effective use of questions such as those that are specific probing questions which engage higher order thought [2, 11].

- **Use Self-disclosure**

Higher amounts of teacher self-disclosure are related to student communication and participation. The best self-disclosure is related to the materials at hand. In short, be yourself. Be real and be transparent. Show concern for your students. Just being a friendly, open and approachable can affect students' help-seeking, participation, self-efficacy and effort. Students will have greater engagement in the course material *if they feel positive toward faculty and their classrooms environment* [10].

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This work is partially funded by NSF under Grant Number HRD-0533530

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