

STIMULATING CRITICAL THINKING THROUGH QUESTIONING IN THE CLASSROOM

Dr Elizabeth Gyuse

Abstract

The study examined professors' questioning pattern in a small New York City. Liberal Art College which places an emphasis on developing leaders who can think critically. Three samples each of professors' written and audio taped oral questions were analyzed and classified into lower or higher order questions using Bloom's taxonomy. The findings showed that the professors asked an average of 25 questions per 50-minute class with an average wait time of 2.9 seconds. Overall, professors asked more lower order (54.6%) than higher order (28.2%) oral questions and more lower order (51.4%) than higher order (48.6%) written questions. The following are recommend deliberate actions to improve on the reasoning levels of professors' questions: prepare well-developed performance objectives for each lesson; reduce amount of multiple choice, matching and true/false type written questions; use more how and why questions; and videotape lessons and replay them for personal feedback and self-appraisal.

Introduction

A major goal of higher education is to help students develop critical thinking. One way for this to happen is through the use of questioning by the teacher. Therefore, a useful indicator that students' critical thinking abilities are being developed is the type of questions asked by teachers in the classroom while teaching as well as in assignments, tests and examinations. This study is a survey of such questions in a small college that has placed a higher value on developing critical thinking.

Questions

Questions are a powerful tool in the teaching/learning process. In ancient Greece, Socrates, the great philosopher used questions to examine understanding and discover truth. Jesus, the model teacher also used questions to probe people's thoughts, to answer the people's questions, and to illustrate essential truths. Teachers have been asking questions since instruction began. It is estimated that teachers ask an average of six to eight questions out of every 10-class minutes (Cruikshank, Bainer, & Metcalf, 1999). However, not all questions aid the development of critical thinking. It is desirable therefore that instructors know the kinds of questioning that enhances this skill and learn how to employ it. Generally, questions considered enhancers of critical thinking are open-ended, demand application of knowledge to solve problems, analyze, synthesize, and evaluate (Chance, 1986; Hummel & Huitt, 1994). These are also classified as higher order questions. Higher-order mental skills seem to activate academically invigorating classes. Some questions demand only knowledge and comprehension. These are considered lower order. While necessary as a foundation to critical thinking, exclusive use of such questions promotes rote learning. Using good questions is the most important work of the teacher (Cazden, 2001).

Critical Thinking

Critical thinking is an important issue in education today (Huitt, 1995). What is critical thinking? There are various definitions of critical thinking; one that is most appropriate in this context is by Scriven & Paul (1992). They define critical thinking as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action". Critical thinking includes divergent thinking that is independent, flexible, and imaginative. It promotes inquiry and discovery of relationships. In the context of teaching, using higher order questions has been shown to be one teaching tool that can help to promote and/or improve the complex activity of critical thinking (Tama, 1989; King, 1995; Huitt, 1995). Fortunately, developing the ability to think critically is not dependent on subject matter. The skill can be developed while teaching a pure science, just as well as it can be developed through the

study of philosophy or any of the humanities. Students develop their-critical thinking skills as they grapple with both specific questions teachers ask, as well as the strategies employed to teach the content. Good questions therefore train students to not simply to remember facts but also to use facts to solve problems in both theoretical and real life situations (Ruggiero, 1991; Barnes, 1992).

With this in mind, the study examines the number and kinds of questions utilized by professors in the classroom and on tests and examinations. In both cases, it attempts to identify any patterns that may be present.

Study Design The Case

The study focuses on questioning pattern of professors at The King's College, New York City. Founded in 1938, the college reopened in 1999 as a college in the city, after more than 60 years of operating as a small suburban college. The college already had a reputation of good academic offerings in the Liberal Arts. In its new location at the Empire State Building, the college has the vision of being a leadership college that produces graduates, who can think well, speak well and write well. Thus, developing critical thinking is very high on the college's agenda. At the time of the study, the college had 120 students, 12 full time professors and several adjuncts teaching a full slate of Liberal Arts courses. Most of the students are enrolled in the Associate in Arts (AA) degree program and a few are in the B.S. program. The AA program in the college is positioned to function like a core or the foundation upon which the baccalaureate programs are being built. The study therefore concentrated on classes offered to students in the AA program. The size of the college is ideal for the study for at least three reasons: First, it allows most of the full time teaching faculty to be involved. Secondly, classes are small, setting an ideal situation for intensive teacher/student interaction. Thirdly, the college covers a good range of subject disciplines, including the humanities (Cultural Anthropology, English, Bible, Languages, History and the Social Sciences) and the sciences (Mathematics, Biology, Chemistry, Physics, and Environmental Science).

Data Collection

Videotaping is perhaps the most ideal method for collecting data for this kind of study because it provides opportunity to obtain authentic, unbiased reflection of teaching practices. It reveals not only the number of questions being asked, but also the environment in which they are asked. Videotaping allows the researcher to capture the tone and other non-verbal communication strategies employed by the teachers as well as the corresponding non-verbal responses by, students. However videotaping is both-expensive and can intrude on the class. Direct observation could have been used, but it is difficult to capture all the questions asked, and near impossible to classify them on the spot. This could lead to inaccuracies in documenting and biases in interpreting the result. Either way, students and teachers may be unaccustomed to the presence of a camera or person in the class and "play to the gallery" rather than conducting a normal class. Of course it is possible, at a price, to record unobtrusively, but the design and cost of such an undertaking would make it unaffordable. A low cost method, audio-taping, was therefore adopted. Professors were given small, but sensitive audio tape recorders capable of recording for more than 60 minutes. The idea was for them to turn it on at the beginning of the lesson and forget it until the end. Three samples of the professor's 50-minute classes were audio taped and the questions extracted for analysis. Written test and examination questions by the same professors were also analyzed. The wait-time, time allowed by the teacher for student to answer an oral question, was also analyzed. All the twelve full time professors took part in the exercise, but due to technical difficulties or unique scheduling situations, only nine are included in the analysis.

It should be noted that the use of audio taping is not without problems and limitations: Any form of known external observation of any human behavior tends to modify the behavior. It was hoped that using small sensitive machines and recording three times would minimize the intrusion of the tape. Another drawback is the pickup range of the tape recorder. Because some teachers move about in the classroom, some questions were not clearly recorded making it difficult to classify. To overcome this problem, any indistinct question was referred back to the professor concerned for clarification. By replaying the tape, they were able to provide an accurate rendering of the question, which was then classified. The most serious limitation however, is the inability to obtain non-verbal cues, which would have been a great help for further study and interpretation of results.

Method of Data Analysis

Bloom's taxonomy is used as the framework to analyze the questions in this study. Bloom's (1956) taxonomy of educational objectives consists of six hierarchical levels, in ascending order: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The taxonomy was originally designed to classify educational objectives and course content into levels of thinking based on a hierarchy of mental operations required to understand them. Oral and written questions can be classified in a similar way. This is principally because there is a very close relationship between the stated objectives and the content of a course and the questions (assessment) that derive from them. The first two levels, knowledge and comprehension, are regarded as lower-order, the last four, application, analysis, synthesis, and evaluation are regarded as higher-order. Managerial questions, are not part of the hierarchy even though they are used in the class as explained below:

1. Knowledge questions ask for a recall of information. For example: What are four types of speeches? Which scientist discovered X-rays? Words typically used in the questions include: define, recall, list, label, name, state, translate, recognize, remember, interpret by using maps, graphs or tables, who, what, where, and when,
2. Comprehension questions ask students to demonstrate that they have sufficient understanding to reorganize and arrange materials mentally. For example, explain the importance of religion in a culture. Describe the process of ossification. Words typically used include: describe, compare, contrast, rephrase, illustrate, put in your own words, and explain.
3. Application questions ask students to use previously learned information, principle or generalizations to solve a problem. For example, According to our definition of marriage, which of the following sets of people would be considered married? How would you set up a video camera? Given an article from the Wall street journal, re-write it to make it suitable for New York Times. Words typically used include: apply, classify, use, employ, write an example, solve, compute, construct, how many, which, and what is?
4. Analysis questions require students to break down concepts and principles in order to better understand them. It involves identifying motives, reasons and/or causes for specific occurrence, considering and analyzing available information to reach a conclusion, Inference or generalization based on this information. For example, why was nuclear energy such an attractive alternate energy source? Trace the circulation of a drop of blood from the tip of your right little finger to your heart. Words typically used include: identify motives/causes, draw conclusions, determine evidence, support, categorize, and analyze.

Synthesis questions ask students to take several parts of something and put them together to make a whole. It involves making predictions, producing¹ original communication, solving problems in creative ways. For example: What would you do if you were the President of the United States during this era of terrorism? How can we raise money for our ecology project? Make your own atomic model from what you know_ of atoms" so far. Words typically used include: predict, produce, create/make, hypothesize, write, design, develop, synthesize, construct, and how can we improve, what would happen if, devise, develop, and how can we solve?

5. Evaluation questions ask students to judge the merit of an idea, a solution to a problem or an aesthetic work based on definite criteria not just personal opinions. It could also involve forming an opinion on an issue, applying objective criteria or personal values. For example: To what extent do you think Abraham Lincoln was responsible for the freedom of slaves in America? Which method is the most effective for determining where a major highway should be located? Given a video of a tennis match, rate the match in terms of tennis tactics and skills. Words typically used include: do you think, judge, critique, justify, recommend, and to what extent?
6. Managerial questions. A seventh category of questions is not part of Bloom's taxonomy, and does not fit into the hierarchy. It is in its own class and is designated as managerial questions. Managerial questions are oral questions that do not fit into any of the six types but deal with classroom issues. The issues are usually not directly related to the learning process but are important for knowing what to do during the class. For example: Why didn't you turn in your assignment? Where did we stop last time?

Whose Turn is it to Read?

Research findings over the last 40 years have confirmed that the taxonomy is a hierarchy. It has also been argued that while both evaluation and synthesis are higher order questions, they do not fit the hierarchical arrangement. For example, some feel that the order of these two levels should be reversed because evaluation is easier to accomplish than synthesis. Others suggest that evaluation and synthesis have the same level of difficulty but use different cognitive processes (Anderson & Krathwohl, 2001). However, for the purpose of this study, the debate does not adversely affect the analysis because the study seeks to classify teachers' questions broadly into higher-order and lower-order and all agree that evaluation and synthesis questions are higher order.

Findings

Patterns and Types of Oral Questions

Frequency of Oral Questions

Too many questions without the opportunity for a response is as counterproductive to developing critical thinking as too few or inappropriate questions. How frequently did professors ask questions of any kind? Table 1 shows the total and average number of questions asked by each professor surveyed. The average for a 50-minute class period ranges from 18 to 32. The average for all the professors is 25 questions with a wait time range from 0 to 3.4 seconds. The average wait time is 2.9 seconds. By implication, on the average, professors asked one question every two minutes of class

time and gave less than 3 seconds for thought to occur. It would be interesting to find out the percentage of responses to the questions and the quality of such responses. It was observed that the professors with the lowest number of questions also tended to provide more wait time. It was also observed that many professors answered their own questions, in which case the questions were more of props rather than being designed to elicit a response.

Table 1: Frequency of Questioning

Professor	Total number of Questions	Average/ 50-minute class ¹
PA	N/A ²	N/A
PB	70	24
PC	90	30
PD	53	18
PE	N/A	N/A
PF	96	32
PG	75	25
PH	74	25
PI	54	18
ALL	512	25

1. Since frequencies are whole numbers, each fraction was rounded up to the nearest whole number. 2. N/A means there was no oral data available for that professor

Types of Oral Questions

Table 2 shows the distribution of oral questions asked by the different professors according to their types using Bloom's taxonomy.

Table 2: Distribution of Professors' Oral Questions by Type (Percentages)

Type of Questions		Professors							Mean %	
		PB	PC	PD	PF	PG	PH	PI		
Lower Order	Knowledge	31.4	29.0	41.5	37.5	48.0	37.8	27.8	36.2	54.6
	Comprehension	7.2	14.3	26.4	25.0	24.0	14.9	16.6	18.4	
Higher Order	Application	8.6	16.7	3.8	6.3	2.7	5.4	0.0	6.3	28.2
	Analysis	21.4	11.1	13.2	9.4	14.7	16.2	11.1	12.5	
	Synthesis	2.9	0.0	1.9	3.1	0.0	0.0	5.6	2.0	
	Evaluation	11.4	5.6	3.8	5.2	4.0	10.8	11.1	7.4	
	Managerial	17.1	23.3	9.4	13.5	6.6	14.9	27.8	16.2	16.2

Overall, professors are asking more "lower order" (54.6%) than "higher order" (28.2%). oral questions. There is also a significant amount of managerial type questions (16.2 %) being asked in class. It should be kept in mind that managerial questions may help the flow of class time but they do not contribute directly to learning or the development of critical thinking skills. From this table it would seem that professor's oral questions need a lot of improvement if they are to help students develop critical thinking skills.

Pattern and Types of Written Questions

Table 3 shows the corresponding pattern of written questions. Because there is no direct interaction between the teacher and students during tests and examinations, there are consequently no managerial questions.

Table 3: Distribution of Professors'¹ Written Questions by Type (Percentages).

Type of Questions		Professors									Mean %.	
		PA	PB	PC	PD	PE	PF	PG	PH	PI		
Lower Order	Knowledge	25.0	24.1	31.8	62.3	32.5	20.0	22.7	20.0	17.6	28.5	
	Comprehension	14.3	24.3	20.0	10.4	17.5	-25.0	14.3	26.7	52.9	22.9	
Higher Order	Application	11.0	20.7	25.9	7.5	37.5	10.0	18.0	13.3	5.9	16.6	
	Analysis	35.7	20.7	11.8	13.2	5.0	10.0	31.3	20.0	5.9	17.5	
	Synthesis	7.0	3.5	7.0	4.7	2.5	30.0	0.0	0.0	11.8	7.6	
	Evaluation	7.0	6.9	3.5	1.9	5.0	5.0	5.7	20.0	5.9	6.9	

Overall, the professors' use of lower and higher order written questions is more evenly divided, namely 51.4% lower order and 48.6% higher order respectively. This appears to be an improvement compared with the oral questions but may not be good enough to help students develop critical thinking skills. In the first instance, the proportion of higher order questions is still marginally lower than those of lower order. This suggests that instructors are testing primarily for knowledge and comprehension, rather than higher levels of interaction with the material. In the second instance, asking higher order questions during examinations, a more stressful time for students, when you did not demand higher order interaction during class is disingenuous.

Comparison of Pattern of Oral and Written Questions

Table 4 is a comparison of the number of lower and higher order oral and written questions asked by the professors.

As the table shows, most instructors use primarily lower order questions when both oral and written questions are combined. It was observed that the professors with the highest lower order written questions are those who include a generous amount of multiple choice, matching or true/false questions on their tests and examinations. While these are good for covering a lot of content materials, they also encourage memorization and may discourage critical thinking skill development.

Table 4: Overall Pattern of Oral and Written Questions. (Percentages)

Professors	Lower Order ¹ (Oral and written)	Higher Order (Oral and Written)
PA	N/A	N/A
PB	43.4	48.1
PC	47.6	40.8
PD	70.3	25.1
PE	N/A	N/A
PF"	55.3	39.5
PG	54.6	42.1
PH	49.7	42.9
PI	57.5	28.9
1. These figures exclude managerial questions, which are regarded as wasted opportunities.		

Tables 5 and 6 are an attempt to discern if there is a difference in the types of questions professors use while teaching (oral questions) and when they are testing (written questions). In Table 5, lower order questions are examined. It should be noted that managerial questions, which featured prominently in the oral questions are considered lost opportunities for the purpose of encouraging critical thinking. They may help maintain flow in the class, but they contribute nothing to helping the students think more critically.

Table 5: Comparison of Patterns of Lower Order Oral and Written Questions (Percentages)

Professors	Oral	Written	Difference	Mean
PA	N/A	39.3	N/A	N/A
PB	38.6	48.2	-9.6	43.4
PC	43.3	51.8	-8.5	47.6
PD	67.9	72.6	-4.7	70.3
PE	N/A	50.0	N/A	N/A
PF	65.5	45.0	17.5	55.3
PG	72.0	37.1	34.9	54.6
PR	52.7	46.7	6.0	49.7
PI	44.4	70.6	-26.2	57.5

If professors are consistent in their pattern of questioning, there should be little difference between the distributions of oral or written questions. The difference between them should be small. The pattern however, shows a wide range from negative 9.6 % to as high as positive 34.9%. This shows that there is a wide difference between the professors' patterns. A high positive difference shows that the professors ask a lot of lower order questions in the classroom but few in the written questions. By implication, they are demanding lower order thinking in the class but expecting higher order thinking during examinations.

Table 6 examines the same issues now comparing higher order questioning patterns. The negative figures in the "difference" column show that the expectation in written questions is for higher order thinking but the oral questions do not demand as much. This is understandable in a classroom situation where there is direct interaction between teacher and students. Even so, if higher order thinking is going to be encouraged, higher order questioning should be dominant not only in written, but also in oral questioning.

Table 6: Comparison of Patterns of Higher Order Oral and Written Questions (Percentages)

Professors	Oral	Written	Difference	Mean
PA	N/A	60.7	N/A	N/A
PB	44.3	51.8	-7.5	48.1
PC	33.4	48.2	-14.8	40.8
PD	22.7	27.4	-4.7	25.1

PE	N/A	50.0	N/A	N/A
PF	24.0	55.0	-31.0	39.5
PG	21.3	62.9	-41.6	42.1
PH	32.4	53.3	-29.9	42.9
PI	27.8	29.4	-1.6	28.6

Discussion of Findings

Teachers who stimulate students' thinking by asking higher order questions promote learning because higher order questions require students to process information in ways associated with greater comprehension and understanding. In light of this, the findings documented above mean at least two things:

1. The professors' average number of oral questions, 25 per 50-minute lesson, is high and the average wait time of 2.9 seconds is too short if an environment conducive to critical thinking is to be fostered. Over twenty-five years of research findings show that when teachers wait for 3-5 seconds after asking a question, the discourse in the classroom improves significantly (Dillon, 1984, 1988; Rowe, 1986; Cazden, 2001). The figure of 3-5 minutes is a benchmark or the point at which improvements begin to show. To obtain an average of 25 questions for each 50-minute period implies that a question is being asked every 2 minutes. When you combine such frequency with a short wait time, the picture that emerges is that of a teacher who is doing most of the talking in class. Even if the questions are high order and suitable, unless time is provided for the process of comprehending the question, formulating a response and verbalizing it, the desired development of critical thinking will hardly occur. Conversely, if students are interacting, they would take some class time to do it, therefore there is a greater likelihood that there would be fewer questions asked by the teacher. In a number of classes, it appeared that teachers not only asked but also answered their own questions. Once students become familiar with such a pattern, there is greater likelihood that they will hold back their answers knowing that the teacher would provide the answer anyway. Such behavior is not conducive to the development of critical thinking.
2. Both the oral and written questions need to include a greater number of higher-order questions. The oral questions need more improvement than the written. This agrees with other studies, which have shown that teachers generally ask proportionally fewer higher-order questions in the class than other types (Gyuse, 1982; Dillon, 1984; Rowe, 1986; Cazden, 2001). If students are not given practice through oral questioning in class to deal with questions that make them use critical thinking skills, it will be unreasonable and unfair to expect them to respond favorably to written questions that require them to use critical reasoning. This was borne out by the finding that students consistently scored lower on written questions that demand higher-order reasoning than on those demanding lower-order reasoning.

Conclusions

There is a need to improve the quality of questions by including a larger number of higher order questions especially during oral presentations. Simply having professors give more essay-type or activity-oriented assignments will not necessarily improve students' critical thinking skills. The following are suggested deliberate actions that professors can take to improve on the reasoning levels of their questions:

- *Prepare well-developed performance objectives* for each lesson. Include various levels of achievement and set questions to reflect these objectives.
- *Reduce the amount of multiple choice, matching and true/false type written questions* and/or include higher order questions in these to stimulate critical thinking under examination conditions.
- *Think through the oral questions to ask in class and include some of these in the lesson plan.* Depending on the subject, it may be possible to give prior reading assignment and organize the

whole class time around carefully selected higher order questions. In this strategy, students have content from the readings; and interact with each other and the teacher through the structured questions. The students therefore become familiar with higher-order questions both

in class and on examination.

- *Videotape or audiotape lessons and replay them for personal feedback and self-appraisal.* Watching and listening to yourself teach allows you to make corrections as appropriate in a non-threatening way. Professors can also invite trusted colleagues to come into their class and give them feedback on their use of questions and wait-time.

Unless the questions we use complement the content we teach, critical thinking skills will not likely occur among university level students. As Swaim & Stefanich wrote in 1996, "Higher level thinking cannot be demanded. We can only learn it through nurturing a series of successfully deliberate efforts until students reach the desired levels of performance."

Recommendations

Asking good questions is an art that can be mastered only with practice and deliberate planning. As Moore (1999) aptly noted, the key to effective use of exposition with interaction is good questioning and the teacher must keep on refining his/her ability to think, plan and ask questions throughout the lesson. Taking cognizance of large classes and inadequate teaching facilities in many universities, it is recommended that professors who desire to engage students more in developing their-critical thinking skills should:

- Learn to listen more carefully to students and increase their wait-time tolerance to give students more opportunity to think and ponder their answers;
 - Not ask too many questions, rather, they should ask more how and why type questions that require thinking and reasoning and reward it appropriately both in class and on tests; examinations and projects.
- Where there is a good library and Internet access, give students assorted reading assignments and then use "the Socratic method" of questioning (a questioning-and-interaction sequence designed to draw information out of students rather than pouring it into them) to teach specific lessons.
- Discourage behaviours such as inattentiveness, restlessness and fearfulness on the part of students and dogmatism, inflexibility and lack of confidence on the part of professors. These behaviours tend to negate the development of critical thinking skill.

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