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ABSTRACT

To provide a clear idea of the specific teacher behaviors involved in questioning and how these behaviors relate to each other, this paper develops a conceptualization of the interactional components of questioning and reviews research evaluating the benefits of alternative questioning techniques. The paper first describes different methods of asking initial questions--the first question in a series--and looks at different kinds of initial questions teachers can ask, specifically examining "higher level" questions and offering suggestions for research in this area. The paper next discusses the components of teacher responses to student questions: accepting, evaluating, and commenting. The paper concludes with a discussion of question sequences, specifically the redirect sequence and the follow-up sequence, and calls for communication scholars to undertake more research in the area of teacher questioning. A 69-item reference list is included. (FL)

CONCEPTUALIZING AND VALIDATING TEACHER QUESTIONING SKILLS

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Abstract

Questioning is a communicative skill that plays an integral role in effective instruction. While a number of articles and texts offer advise about questioning, the benefits of specific questioning techniques are often assumed, not established. The importance of validating specific questioning techniques before including them in training programs is evident. This paper develops a conceptualization of the interactional components of the questioning process, and reviews research evaluating the benefits of alternative questioning techniques.

CONCEPTUALIZING AND VALIDATING TEACHER QUESTIONING SKILLS

Scholars from a variety of disciplines recognize that competent questioning skills are an important component of effective instruction. Cooper (1981) notes that "All teachers, regardless of their subject area, must explain concepts, establish human relationships, ask and answer questions, resolve conflicts, and lead discussions, all of which involve communication skills" (p. 224). The conclusions of two recent reviews of questioning research highlight the importance of the communicative skills involved in teacher questioning. Wilen (1982) argues, "Since communication is an essential of teaching, and questioning is an integral part of classroom verbal interaction, to a substantial degree teacher effectiveness is affected by questioning skill" (p. 25). Lange (1982) writes, "The basic language of the classroom is a dichotomy of teachhers' questions and students' responses. When considered in this way, we realize that any lack of success in classroom situations is probably the result of inattention to the question-response cycle and its content" (p. 180).

Questioning skills are considered important because of their presumed relationship to a number of important educational outcomes. The two most frequently studied outcomes have been students' achievement and critical thinking skills (Gall, 1984). The significance of both these variables is well established. Under achievement has been defined as an individual's failure to master skills they have the capacity to learn (Carrol, 1963). Thought of in this light, an instructional technique which results in improved student achievement reduces the amount of wasted student capability. Additionally, instructional techniques which result in improved achievement have also usually improved students' attitudes toward school (Medley, 1979). The development of critical thinking skills has often been thought of as a major goal of the

educational process. A number of educators have argued that schooling should not present students with "correct" or "acceptable" ideas, but instead should develop students' reasoning skills so they may critically choose which ideas to accept on their own (e.g., Scheffler, 1973). Our discipline's support of discussion and debate activities reflects commitment to this second educational goal.

This review of the questioning literature is motivated by three objectives. The first is to present a useful conceptualization of teacher questioning skill. Like most social interaction skills, questioning skill is composed of many verbal and nonverbal behaviors. A broad conceptualization of questioning skill is argued for here. Aside from those skills involved in asking initial questions, the paper maintains an effective questioner must also master skills related to responding to student answers and asking sequences of questions. This tripart conceptualization of questioning skill is illustrated in Appendix A, and serves as an organizational scheme for the review.

A second objective is to clarify which "behavioral skills" have been validated as effective questioning techniques. Given the widespread belief that questioning is an important part of effective instruction, it is not surprising that several books (e.g., Hyman, 1979; Wilen, 1982) and articles (Cacha, 1981; Deethart, 1974; Nyquist & Booth, 1977) offer advice on questioning techniques. Additionally, a host of training programs have been developed to instruct teachers in questioning techniques (e.g., Borg, 1972; Dangel, Conrad, & Hopkins, 1978; Good & Brophy, 1974; Otto & Schunk, 1983; Saunders, Fall, Nelson, & Smith, 1975; Wagner, 1973). These programs have utilized a variety of training methods, including modeling, practice with feedback, cognitive discriminative analysis, microteaching, and interviews (for a review of the effectiveness of many of these methods see Levinson-Rose & Menges, 1981).

One problem with these articles and programs is that the benefits of specific questioning techniques are often assumed, not established. Educators and trainers have frequently assumed that if questioning is an important part of effective instruction, specific questioning techniques which are popular must be beneficial. The result is that many programs instruct teachers to use questioning "skills" which may be ineffective or even detrimental to student success. To support this claim, research evaluating the "skills" taught in a training program developed by Borg (1972) was reviewed. The Borg program was chosen as an example for several reasons: it is representative of the various training programs; it clearly defines the techniques being trained; and it trains a variety of techniques. Results of this examination are displayed in Table 1. Of the eight techniques that are trained, only two have been shown to have positive effects on student achievement and/or critical thinking skills. Two techniques appear to be unrelated to student success, and two have been documented as detrimental to student success. At this point it is difficult to draw conclusions about the effect of one of the techniques (higher level questions), and no research has directly examined the final technique.

The practice of including questioning techniques in training programs before establishing their validity has at times even resulted in having two training programs instructing educators to enact the exact opposite behaviors. McNeil and Popham (1973) explain that:

> "In some instances teachers are learning contradictory skills at different institutions. For example, the Far West Regional Laboratory uses a minicourse to train teachers to repeat [student's] answers less often; but the Northwest Regional Laboratory has a training program in Flander's

> Interaction Analysis which has as one measure of preferred 'indirect teaching' more repetition of pupil's answers" (p. 229).

There is an obvious need to validate teacher questioning skills before large amounts of time and monetary resources are spent on training them. McNeil and Popham (1973) believe there is "a danger that new teachers are learning practices which are not only irrelevant but harmful to pupil progress" (p. 229). Since this paper reviews research that has focused on the benefits of various techniques, it should help determine what we know, and what we need to know, about questioning skill.

A final objective is to suggest theoretical explanations for why variations in questioning methods may influence students' achievement and critical thinking skills. Dillon (1982) notes, "In general, the educational literature contains little theory of questions but many presumptions about their nature, function, and effect" (p. 160). The failure to develop theoretical explanations has limited researchers' ability to predict and understand why question variation influences achievement and critical thinking; moreover, it has hindered researchers ability to resolve what appear to be contradictory findings in some areas. Presumably, variations in questioning techniques have effects because they influence the process by which students generate answers. Gall (1984) recently outlined a five step process of answer generation: (1) attending to the question, (2) deciphering the meaning of the question, (3) generating a covert answer, (4) generating an overt answer, and (5) revising the answer. Gall's outline suggests that theories drawn from a social cognitive or information processing perspective may provide explanations for questioning effects. Such several theories are employed here to suggest tentative explanations for various questioning techniques.

With these three objectives in mind a critical review of research examining questioning behavior is presented. Research examining these behaviors is grouped into three categories: asking initial questions, responding to student answers, and asking question sequences.

Asking Initial Questions

Initial questions are defined as the first question in a question sequence. If no sequence is pursued, then each question is an initial question. A teacher leading a discussion is likely to ask many initial questions, but initial questions can also be used during lecture to verify that students are comprehending the material being presented (Hyman, 1979).

While most initial questions pertain to academic content, observational research has found that approximately twenty percent of the questions teachers ask deal with non-academic content such as procedure or discipline (Gall, 1970). Little research has examined the effects of using questions as a procedural or disciplinary tool. In the realm of initial questions about academic content, research has focused on two areas: different methods of asking questions, and different types of questions that can be asked.

Methods of Asking Initial Questions

While many suggestions have been offered concerning methods of asking initial questions, research has addressed only two issues: singularity and wait time$_1$.

Singularity refers to the number of questions contained in an utterance: an utterance containing one question is singular, while an utterance containing

two or more questions is non-singular. An example of a non-singular question is:

Teacher: Let's talk about John Quincy Adams. When was he President, and what party did he belong to?

Wright and Nuthall (1970) examined singularity in a correlational analysis between thirty teaching variables and achievement. The observers coded the behaviors of seventeen elementary science teachers, and then administered an achievement test they developed to the students (N = 296). Students' I.Q. and general science knowledge were controlled. Utterances containing one question were positively correlated with achievement (r = .54), but utterances containing two or more questions were negatively correlated (r = -.42 and -.43, respectively). In terms of Gall's (1984) model, many non-singular questions may be difficult to decipher, since students may be confused about exactly what information is being requested.

A second variable pertaining to the method of asking questions is a teacher's use of wait time. In an early article about this variable Rowe (1974a) broke wait time into two parts. Generally, wait $time_1$ can be defined as the amount of time that elapses from the end of a teacher's question to when a student responds; wait $time_2$ can be defined as the amount of time that elapses from the end of a student's response to the teacher's response (for specific rules on coding see Rowe, 1974a). Although some articles have grouped the two types of wait time into one variable (Honia, 1982; Tobin, 1980), there is evidence that the two should be distinguished. The two types of wait times have been shown to result in different outcomes (Rowe, 1974a), and trainers have encountered different problems in teaching them (DeTure, 1979).

Observational research has documented that in the average classroom both types of wait time are typically less than one second (DeTure, 1979; Rowe,

1974a; Tobin, 1980). Given this, researchers began examining the effects of training teachers to use longer wait time (usually about three seconds). Findings from studies which have either looked specifically at wait $time_1$ or have grouped the two types of wait time are presented here, while findings from research focusing specifically on wait $time_2$ are presented in a subsequent section.

One result of the utilization of longer wait time is that the pattern of classroom interaction changes. Rowe (1974a) found teachers trained to increase their wait $time_1$ had significantly fewer students fail to answer questions than their counterparts using shorter wait $time_1$. Answer generation involves several steps -- deciphering a question's meaning, searching memory for relevant information, organizing information into a coherent response (including any necessary logical reasoning), and overtly responding -- and brief wait $time_1$ may short circuit this process before it reaches completion. Rowe (1974a) also discovered positive relationships between longer amounts of both types of wait time and: the amount of inferences made from evidence; the number of spontaneous student questions; and the number of responses made by students labelled as "slow" by their teacher. A more recent study (Honea, 1982) grouped both types of wait time and found similar results. Increased wait time resulted in longer student responses, more spontaneous student questions, and more student-student interaction. While these studies indicate that the length of wait time affects student interaction, they have not shown that the variable affects student success. The exception might be Rowe's finding that longer wait time increases "speculative" thinking and inferences made from evidence, but she does not define these variables with sufficient clarity to judge if they are similar to critical thinking skills (a more precise description of the latter is contained in the discussion of higher order questions).

Tobin (1980) has examined the effect of longer wait time on student success. Combining the two types of wait time into one variable, Tobin trained elementary science teachers to use longer wait time. Tobin then had trained and untrained teacher presents two identical sessions to their students (N = 733). Following each lesson students completed an achievement test developed by the experimenter. Students taught by the longer wait time teachers did significantly better on the second achievement test than students taught by the shorter wait time teachers (the difference approached significance on the first test as well).

Several questions about the effects of wait time remain unanswered. First, the effects of wait time on both student achievement and critical thinking skills needs clarification. Tobin's description of his dependent variable measure is very brief, and it does not specify if the test was composed of closed, factual questions or more open ended questions requiring the students to use higher order cognitive processes. Hence, the research indicates that use of longer wait times probably has beneficial effects, but the precise nature of these effects is not known. Second, individual difference variables need to be included in future research. Past research has shown that longer wait time results in more student verbalization. This result may be beneficial for only some types of students. For example, several researchers have concluded that students with high levels of oral communication apprehension both prefer and perform better in classrooms with low amounts of discussion and student interaction (Dowaliby & Schumer, 1973; McCroskey & Anderson, 1976; Scott & Wheeles, 1977a). McCroskey and Anderson, for instance, found that both the A.C.T. and G.P.A. scores of a group of students having high oral communication apprehension were significantly lower than their low oral communication apprehension counterparts; however, grades of the two student

groups did not significantly differ in a large lecture class that allowed little teacher-student interaction. The authors note that the study's large sample size (N = 709) produced a powerful test of their hypothesis; hence, it is unlikely the failure to detect significant grade differences in the large lecture class was due to type II error. The authors also report that the high communication apprehension group had a significantly more favorable attitude toward mass lecture classes than did the low apprehension group. Finally, researchers might examine what is an optimal amount of wait time. While research suggests that too little wait time$_1$ is problematic, it seems likely that a teacher may also wait too long before responding to student answers.

Different Types of Questions

Factual vs. "Higher Level" Questions. A second area of research on initial questions has focused on the different types of questions teachers can ask. The majority of this research has examined the effects of asking questions at different cognitive levels. This research has its genesis in Bloom et al.'s (1955) Taxonomy of Educational Objectives, a book which attempted to specify which cognitive processes should be focused upon by teachers who wanted their students to become critical thinkers. Bloom's taxonomy contains six hierarchical levels: knowledge (the lowest level), comprehension, application, analysis, synthesis, and evaluation. While both the comprehensiveness and the hierarchical nature of the taxonomy has been questioned (e.g., Furst, 1981), it has had a tremendous impact on the questioning literature. A variety of question hierarchies have subsequently been developed (see Gall, 1970, p. 709). Two of the most popular categorization schemes are illustrated in Table 2.

Observational research has consistently confirmed that about sixty percent of the questions asked by teachers across grade level and subject matter fall at the memory or factual level (Daly & Korinek, 1980; Wilen, 1982). For the last fifteen years scholars have investigated the effects of asking more higher-order questions on student achievement and/or critical thinking skills. The research is both plentiful and confusing. Several reviews and meta-analyses of this research exist (Medley, 1979; Redfield & Rousseau, 1981; Winne, 1979). Therefore, this paper briefly summarizes the methods and conclusions of these articles, and then provides suggestions for how future research might resolve what often seem to be contradictory conclusions.

Winne (1979) reviews eighteen studies of the effects of differing amounts of higher order questions on student achievement and critical thinking skills. The review contains useful, in depth descriptions and criticisms of the methodologies of these studies. Studies are grouped into two categories: those Winne believes have sufficient internal validity that any between group differences can be attributed to treatment, and those without sufficient internal validity. Frequent problems found in this latter category include the failure to conduct manipulation checks and the failure to control possible confounding variables. Winne then conducts a voting meta-analysis. Studies are placed in one of three categories: those yielding significant positive results (i.e., some combination of high and low level questions is superior to predominately low level questions), those yielding significant negative results, and those yielding non-significant results. The category containing the largest number of studies was that of no difference, both when all the studies were analyzed and when only "internally valid" studies were included in the analysis. This result occurred both when test questions requiring lower or higher level cognitive processing served as the dependent variable. Winne does

note that many studies reviewed suffer from statistical and design flaws that could have prevented the positive effects of higher level questions from being discovered.

A second meta-analysis of the higher level question research was conducted by Redfield and Rousseau (1981). After critiquing the voting method meta-analytic technique, the authors reanalyze the studies reviewed by Winne using an effect size statistic. The review analyses the twelve of the eighteen studies from which data necessary for the meta-analysis could be obtained. Two studies completed after the Winne review were also included. The effect size analysis concluded that the inclusion of higher level questions benefited student performance: across the studies the results indicated that "average" student would score at the 77th percentile if a member of the experimental group (receiving a substantial percentage of higher level questions) but would score at only the 50th percentile if a member of the control group.

One question about the Redfield and Rousseau review is the dependent variable that was analyzed. Most of the studies included in the review contained measures of both factual recall of information plus mental manipulation of it through higher level cognitive processes. However, the effect size analysis focused only on "achievement" as the dependent variable. It is unclear whether the authors analysed only the factual recall portion of the fourteen studies' posttests, or if scores on factual recall and higher order posttest questions were combined. If posttest measures were combined, different results might have been reported had they been analysed separately.

A third review of the higher order question literature is presented by Medley (1979). Medley began by collecting research which focused on the relationship between teaching variables and student achievement in students from varying socio-economic backgrounds. Medley then used four criteria to

narrow the number of studies. These were: (1) The study must have measured long term change, not just immediate change that occurred after treatment manipulation. (2) Observers in the study provided descriptions of specific teacher behaviors. Studies in which observers made evaluative judgments about teacher behaviors were not included. (3) Teachers used in the study were generalizable to the population of all elementary school teachers. (4) The specific teacher variable (e.g., asking higher versus lower order questions) accounted for at least fifteen percent of the variance in student success.

In Medley's judgment fourteen studies satisfy all four criteria. From these studies he draws a number of conclusions about effective styles of teaching students of varying socio-economic classes. For students from disadvantaged backgrounds Medley (1979) concludes, "Teachers who ask the most high-level and the fewest low-level questions . . . are the ones who are the least effective. Teachers who use more low-level questions and fewer higher-level questions . . . are the most effective teachers" (p. 24).

There are several questions that can be raised about Medley's review. First, the justification for only including studies in which the independent variable accounted for fifteen percent of the variance in the dependent variable could be challenged. Medley contends that he wants to concentrate his review on "important" relationships, but he does note that, "It was decided quite arbitrarily that the minimum overlap in variance should be 15 percent . . ." (p. 19). Improving a student's achievement score five percent might move him or her up a grade level. Including all the studies that met the first three criteria and that had significant relationships of any size might have altered the review's conclusion. Second, the dependent variable in the studies reviewed appears to be long term achievement gains (see Medley, 1979, pp. 16-17). The studies Medley reviewed apparently did not utilize critical

thinking (higher order) questions in the dependent variable measures. Thus, the review's conclusion should be limited to the important variable of student achievement.

This summary of the three reviews on higher-order questions highlights the seeming inconsistencies plaguing this research area. Many of the inconsistencies appear to be the product of conceptual and methodological limitations. After reflection and study of this literature, the following list of suggestions for future research was compiled:

(1) Inclusion of Appropriate Dependent Variable Measures. One hypothesized effect of asking students higher level questions about academic content is that they will develop and improve their higher level cognitive processes from the practice of answering such questions. This analysis point to two problems with dependent variable measures in previous research. One problem is the frequent use of multiple choice (M.C.) questions to asses higher order cognitive processes. Students who had answered higher level questions might be expected to perform no differently than students who had answered factual questions on a factual, memory level achievement test (e.g., a M.C. exam); however, the first group of students might be expected to perform better than the second on a test (e.g., an essay exam) requiring mental manipulation of information through higher order cognitive processes. Of the fifteen studies reviewed by Winne that included critical thinking as a dependent variable, nine asked only M.C. posttest questions. Since higher order questions from the "synthesize" and "evaluation" levels do not have correct answers, M.C. questions are an inappropriate method of testing this dependent variable (Sanders, 1966). Gall (1970) argues dependent variable measures should include both M.C. and short answer questions, and suggests several qualitative criteria for assessing the strength of student responses to short answer questions.[1]

A second problem is the frequent failure to differentiate between higher order posttest questions tapping the same academic content covered in the classroom discussion versus higher order posttest questions tapping completely new content. Andre (1979) reviews evidence that the effect of higher level questions within written prose is limited to the specific topic covered within the prose. While some have suggested that repeated practice in answering higher level questions on various topics should improve students general higher order cognitive processes (e.g., critical thinking skills), the limited training period in most studies (see developmental teaching sequence section) provides additional reasons for suggesting that the benefits of higher order questions may be limited to mentally manipulating information previously covered in discussion. The possibility that higher level questions' impact on critical thinking skills may be less general than previously supposed should not be interpreted as suggesting such effects are inconsequential. Andre (1979) explains that when a teacher assigns or asks questions about a passage of reading, rote memorization of the ideas contained is seldom the only instructional goal; rather, understanding and evaluating the principles or concepts underlying the idea, and the applicability of such concepts to future situations that could be encountered, are also important goals. To summarize this second problem, posttest measures should differentiate between the two types of higher order questions, and reviews should consider the two potential effects of higher order questions (topic specific vs. general) separately.

(2) Utilization of Appropriate Category Coding. Rosenshine (1979) posits that many of the questions coded in past research as higher level do not require higher order cognitive processing. Questions that do not require students to cognitively manipulate information, such as simple questions of opinion, may not improve students scores on either M.C. or short answer

posttests. Saunders et al. (1975) suggests coding questions into three categories: memory level, higher level, and personal opinion.

(3) Utilization of Appropriate Design Construction. The majority of the studies reviewed in the Winne (1979) and Redfield and Rousseau (1981) meta-analyses suffer from one of two design flaws: the failure to use a pretest, or the inappropriate analysis of change scores. Ten of the 18 studies reviewed by the two meta-analyses administered no pretest to subjects, but used only a treatment -- posttest design. This practice is especially problematic for the several studies which made no attempt to randomly assign subjects, simply using intact classes as treatment and control groups. In these studies it is impossible to determine if between-group differences are due to the treatment or initial differences in ability levels of the classes. Even the studies which made some attempt to assign subjects to treatment and control randomly could be strengthened by administering pretests as an additional control of any initial between group differences.

Of the eight studies that did administer a pretest, three analysed change scores (pretest-posttest) with an ANOVA design. This design would be appropriate if there were not a correlation between subjects' change scores and their pretest scores; however, in the behavioral sciences these two scores are almost always significantly correlated (Cohen & Cohen, 1975). Thus, a subject's change score in these studies reflected not only the treatment, but to an unknown degree also how she performed on the pretest. The procedure tends to overcorrect for the effects of pretest scores; consequently, if two persons benefited an equal amount from treatment, the person who scored highest on the pretest would receive a lower change score than her counterpart. The conclusions of these three studies are therefore questionable. The solution to this problem is to analyze posttest scores as the dependent variable in an

analysis of covariance or partial variance design (Cohen & Cohen, 1975). The level of questions would be the independent variable, and pretest scores would serve as a covariate. This design partials out the effect of a subject's initial ability (pretest score) in an appropriate fashion.

(4) Documentation of Question-answer Congruence. Winne (1979) proposes that studies need to verify that a higher order question results in students' using a higher order cognitive process to answer the question. Results of a study conducted by Mills, Berliner, Rice, and Rosseau (1980) supports this position. The researchers trained 54 elementary and junior high teachers in one of three classification systems. They then taped discussions led by the teachers, measuring the match between the level of each question and answer. For all three systems the percentage of question-answer correspondence was just over 50%. Hence, in many studies higher order questions may not be resulting in students' using higher order cognitive processes and therefore not improving these critical thinking skills. Mills et al. make two suggestions for how future research might improve the degree of question-answer level congruence: train teachers to give verbal cues so that students know what level the question is, and train students to classify questions so they understand the various cognitive processes.

(5) Utilization of Developmental Teaching Sequence. Studies of higher order questions have teachers begin asking all levels of questions simultaneously. Such a practice may at times overload or confuse students, and result in the frustration of being unable to answer questions. Wright and Nuthall report a positive correlation (r = .45) between the percentage of questions students answer and achievement. It is suggested that this may be a problem with past research for two reasons. First, the vast majority of research on higher level questions has been conducted with elementary students.

Since many of the cognitive abilities necessary to answer higher level questions such as role taking or moral judgment (see Damon, 1983) develop with age, simultaneously introducing six or seven types of critical thinking might be especially confusing to younger students. Second, the manipulation or training period of many studies is quite short. Five of the 18 studies in the two meta-analyses had teachers ask higher level questions for only one period before assessing effects, providing students with an extremely limited amount of time to practice answering the variety of higher order questions. Future research might have teachers move up the hierarchy of questions sequentially over a number of lessons, teachers might begin by asking memory and translation questions for two or three lessons. Using Sanders (1966) classification system as an example, teachers might begin by asking memory and translation questions for two or three lessons, and then add each level sequentially over approximately the same period of time.

(6) Analysis of Individual-difference Variables. Future research needs to include individual difference variables. Past research has rarely examined individual student differences; only four of the eighteen studies in the Winne review included such variables (two included sex, one included age, and one included urban vs. rural background). One variable that could be included in future research is students' socio-economic status. Medley (1979) reviewed a number of studies focusing on various instructional communication variables and found that 62% of the variables that improved the success of low SES students were detrimental to high SES students. A second variable could be communication apprehension. Higher level questions usually require longer answers, and a number of studies reviewed earlier conclude students high in communication apprehension were significantly more successful in classrooms with limited student verbalization. Inclusion of these variables in future research might uncover differences masked by past research.

(7) Presence of Theoretically Guided Research. The final suggesion is that future research be conducted from within a theoretical perspective. The presence of a theoretical perspective provides no guarantee of a resolution of seemingly inconsistent research results, but the absence of such a perspective leaves researchers few tools to clarify such findings. Researchers have supposed that variations in question type have effects because such variations produce differences in students' answer generation process; variation in questions' cognitive level most directly effects the methods students use to process and thereby remember the questions' content (step 3 in Gall's model). Consequently, Craik and his associates' (Craik, 1977; Craik & Lockhart, 1972; Cermak & Craik, 1979) "levels of processing" model of memory could provide one useful perspective for interpreting and clarifying the results of the higher-order questioning literature.

In the theory's original formulation, Craik and Lockhart (1972) reject a two-store model of memory (short term and long term stores) in favor of a model conceptualizing information processing as occurring in a series of stages or levels. "This conception of a series or hierarchy of processing stages is often referred to as 'depth of processing' whereas greater 'depth' implies a greater degree of semantic and cognitive processing" (Craik & Lockhart, 1972, p. 675). The theory posits that deeper levels of processing will result in "more elaborate, longer lasting, and stronger [memory] traces" (Craik & Lockhart, p. 675).[2]

The levels of processing model is relevant to the questioning literature because different level questions require students to processes content at varying cognitive depths in order to produce a covert response. Andre (1979) explains that "Factual questions are believed to involve less complex cognitive processing than questions requiring more than direct memory" (p. 282), and

notes that educators' belief in the necessity of asking questions from different levels is grounded in the belief that "processing more-or-less deeply for meaning will produce differential effects on learning and retention" (p. 281).

Andre argues that although the model has received considerable empirical support, most studies have utilized methods containing important differences from the context of classroom questioning (p. 281). Fortunately, a few studies (e.g., Paris, 1975, study 2) provide support for the model's applicability to this domain. Paris had 96 elementary students (16 from each kindergarten to fifth grade) read story paragraphs, respond to eight questions about each paragraph, participate in a ten minute distraction task, and then complete a free recall measure about the paragraphs. Four of the eight questions were at rote memory level (e.g., Was Linda's doll new?), while four inquired about inferential relationships (e.g., inferring necessary preconditions to make the paragraph true; inferring possible consequences of actions in the paragraph; etc.) The data were analysed via hierarchical regression, entering grade level at step 1 and the number of correct scores on inferential questions at step 2. The results indicate that answering inferential questions correctly accounted for 11% of the various in free recall scores after the effect of grade level had been statistically controlled. Interpreted within the levels of processing viewpoint, the study supports the contention that deeper cognitive processing of questions significantly improves later recall of question content.

One factor making the levels of processing framework attractive as a theoretical perspective is that the model provides straightforward rationales for many inconsistencies in the questioning literature. First, superior retention of deeply-processed information occurs only if the retrieval context (i.e., the examination or posttest) is similar in nature to the learning

situation (i.e., the classroom discussion) (Craik & Lockhart, 1972, p. 678; Jacoby & Craik, 1979, p. 7). A discussion including 80% higher level questions would therefore be expected to produce superior posttest scores in comparison to a discussion involving 20% higher order questions only if the posttest consisted of predominantly higher level questions. This first point highlights the necessity of avoiding only multiple choice posttests. Second, the model can account for developmental and individual differences in the effect of question level. Concerning developmental differences, the depth at which information is processed is influenced by factors in addition to external stimuli (e.g., level of question asked), such as the student's level and organization of pre-existing topic knowledge (Craik & Lockhart, 1972; Naus et al., 1978; Nau & Halasz, 1979). Piaget & Inhelder (1973; Inhelder, 1969) have demonstrated that children's retention in tasks involving numerical and spatial relations, causal relations, and scientific concepts improve as children develop more sophisticated schemes for organizing and storing such information. Naus et al. (1978) explain these and similar findings can be easily incorporated within the framework: "Since the depth-of-processing formulation views memory as the assimilation of incoming information into one's current knowledge base, the implication is that a child's existing semantic knowledge determined in a real sense what is remembered" (p. 228). The framework therefore suggests that differences between students exposed to high versus low level questions should not emerge until the students' cognitive structures and processes develop to the point where they can formulate covert responses to higher-level questions. Concerning individual differences, the preceding discussion suggests children of lower SES may develop sophisticated social cognitive structures more slowly than their higher SES counterparts, probably because of differences in family interaction. Sociolinguistic (Berstein, 1975)

and constructivist (Applegate, Burke, Burleson, Delia, & Kline, 1985) research provides indirect support for the latter claim. Finally, the levels of processing framework provides a theoretical explanation for the difficulty posed by question level-response level incongruencies. Winne (1979) suggests such incongruencies may account for past failure to find expected differences, since students must actually process a teacher's higher order question at deeper cognitive levels to obtain any potential benefits from such questioning.

Since depth of processing theorists have discussed a host of variables that influence processing level, the framework provides many possible directions for future research. For example, Jacoby and Craik (1979) provide evidence that subjects required to make more difficult decisions process information at deeper levels; question difficulty could be investigated both across and within cognitive level. Additionally, Andre (1979) reviews evidence that the impact of question difficulty may be curvilinear, and Jacoby and Craik (1979) hypothesize difficulty effects may interact with source (teacher) credibility. Thus, the levels of processing perspective can generate suggestions for where researchers could focus attention in attempts to clarify the higher order questioning literature.

This discussion has examined three reviews of the research of higher level questions. Several suggestions for future research are presented. However, questions can be classified by means other than the cognitive process necessary to answer them. The next portion of this paper explores three other variations in question type.

Additional Types of Questions. Three other ways that questions may be classified are (a) open versus closed, (b) rhetorical versus non-rhetorical, and (c) answer known versus answer not known. The first of these variables can be considered on a spectrum. Questions at the closed end of the spectrum have

one "correct" answer; questions at the open end of the spectrum have many possible answers which can be supported by logic and evidence. Since extremely low level questions are closed and extremely high level questions are open, the closed-open dimension is often considered to be synonymous with the low level-high level dimension previously mentioned. However, questions at a medium cognitive level can be either closed or open. Consider the following question:

Teacher: O.K. class, why does principle X apply to this situation?

If there is one correct answer to this application level question then it is closed; alternatively, if there are a variety of legitimate answers the question is open. It may be beneficial to distinguish these dimensions in future research. One effect might be more consistent results in research varying the frequency or proportion of higher order questions.

Coulthard (1977) reports that teachers ask few open ended questions. Research to date supports teacher's frequent use of closed questions. Most studies have found an inverse relationship between open ended questions and student achievement (Rosenshine, 1979; Wright & Nuthall, 1970). Wright and Nuthall reports a positive correlation (r = .46) between the percentage of closed questions and student achievement, and a negative relationship (r = -.21) between the percentage of open questions and achievement. One explanation for these results is that students are able to answer open ended questions less frequently than closed questions. Since closed questions provide students with concrete response alternatives (e.g., yes or no), they seem to be easier to attempt to answer. Gall (1970) reports a strong positive correlation (r = .90) between these two variables, as well as a positive relationship (r = .45) between the percentage of questions that result in an

overt pupil response and achievement. Since the two variables, percentage of open ended questions and percentage of questions producing a student response, have been found inversely related, future research might explore if teachers can use techniques that help students attempt to answer open ended questions.

Another way in which questions can be categorized is rhetorical vs. non-rhetorical. Zillerman and Cantor (1973) have investigated the use of rhetorical questions during lecture. They speculated that previous research had failed to find a difference between the use of rhetorical questions and the use of statements because subjects were maintaining a higher attention level than they would in the natural classroom. Using a two-factor design (rhetorical questions vs. statements; high vs. low attention levels) they discovered that students whose instructors used rhetorical questions did perform significantly better on a factual recall test in the low attention condition.

Finally, Dillon (1982) has suggested that questions could be classified on the dichotomy of answer known by the teacher (non-inquiry) versus answer not known by the teacher (inquiry). Logicians, linguists, and philosophers have developed several properties common to questions of inquiry (Dillon, 1982). Both the questioner (Q) and the respondent (R) assume that: (1) the Q does not know the answer and the R does; (2) the Q desires and needs to know the answer; and (3) the Q believes the R can supply the answer. It is apparent that in most cases teacher questions do <u>not</u> fulfill these criteria. Dillon argues that because of this most classroom questions do not develop the thinking process of either the teacher or students: " . . . because teacher questions do not express perplexity or seek unknown information, they serve little function in the teacher's own thinking, and likely do not stimulate higher-cognitive processes in students . . . One implication for practice, especially during

discussion classes, might be for the teacher to pose questions about which the teacher experiences perplexity" (1982, p. 160). It is important to recognize that Dillon's suggestion is limited to the case where the teacher's goal is to develop students' critical thinking skills (e.g., not during a review for an examination). Future research could examine if inquiry questions do help students develop the variety of cognitive skills reviewed in the discussion of questioning hierarchies.

The first section of this review has focused on asking initial questions, and variations in both the method of asking questions and the type of questions asked have been explored. Section two focuses on responding to student answers.

Responding to Student Answers

A second category of questioning skills involve responding to students' answers. Initially, it may seem that questioning skills should encompass only those skills involved in asking questions. This paper has adopted a broader conceptualization of questioning skill for two reasons. First, responding to students' answers appears to be part of the structure of the question-answer sequence. Coulthard (1977) has analysed teacher-student interaction during discussion using content analysis. He concludes there is a consistent structure to the question-answer sequence. In most cases the structure is as follows: the teacher asks a question, a student answers the question, and the teacher responds to the student's answer (T-S-T, T-S-T , . . .). Rarely does the structure consist of only questions and answers (T-S, T-S, . . .). Thus, responding to questions is part of the process of instructional questioning. Second, responding to answers poorly may mitigate developed question asking

skills. For example, a teacher who asks initial questions skillfully but frequently criticizes students' answers may be no more successful than a teacher who asks initial questions poorly. Mastering both types of skills may be necessary to become an effective questioner.

Coulthard (1977) has also analyzed teacher responses in detail. In most cases teacher responses are composed of three parts: accepting (taking the student's answer into the conversation, often by repeating it), evaluating (assessing the worth or relevance of the student's answer), and commenting (adding additional information to the student's answer). The three parts are illustrated in the following example:

T: When did Columbus discover America?

S: 1492

T: 1492 (accepting)

That's very good Mary. (evaluating)

It was the fall of 1492 to be exact. (commenting)

Research on teacher responses is therefore divided into these three subcomponents.

Accepting

Under the category of accepting two variables have been explored. The first is the length of wait time$_2$ (the amount of time before responding). Research on the effect of extended wait time in general has been previously discussed. Lengthening wait time$_2$ may have both positive and negative consequences. Research has shown that students whose teachers wait longer to respond give significantly longer answers (Rowe, 1974a; Deture, 1979). Since Wright and Nuthall (1970) report a negative correlation (r = -.23) between

extended pupil response (more than two lines on their transcript) and achievement, it appears longer wait time$_2$ has a slightly negative effect on factual learning for students as a whole. However, this conclusion must be qualified in two respects. First, the effect may vary with the type of student. Rowe (1974a) found teachers waited significantly longer for students they rated as bright than for students they rated as slow (3.0 sec. vs. 2.0 sec.). When teachers were trained to wait for 3.0 seconds before responding, their expectations of slow students increased. A number of studies have supported the relationship between teacher expectations and student achievement (see Scott & Wheeles, 1977b). Second, the effect may vary with the dependent variable of interest. Longer student responses may be inversely related to factual achievement, but future research might explore their effect on critical thinking skills as well.

The second variable under this category is repetition of students' responses. Coulthard (1977) notes this is a common technique used to indicate recognition of a students' answer, as well as to pass the answer on to the students who may not have heard it. Different training programs have advised teachers both to repeat and not to repeat students's answers (McNeil & Popham, 1973). The only study examining repetition of students' answers concluded it was not correlated with achievement (Wright & Nuthall, 1970). Rowe (1974b) indicates that breaking the habit of repeating students' responses may help lengthen wait time$_2$, but it is certainly possible both to wait before responding and then to begin the response by repeating the student's answer. After accepting a student's answer into the discussion, a teacher usually makes an evaluation of it.

Evaluating

Coulthard (1977) describes evaluating as assessing the worth or relevance of a student's answer. One type of evaluation a teacher can provide is feedback. In this paper, feedback is defined as a statement which explains if, and in some cases why, the student's answer is correct or incorrect. Brophy (1981) explains the importance of providing students with feedback. "Almost 100 years of research has established that knowledge of results facilitates learning, and usually is essential to it" (p. 6). Little research has examined effective styles of providing feedback to students' responses, but it seems likely that the guidelines that have been developed for giving effective feedback in general (e.g., specificity, timeliness, etc.) would apply (e.g., Crable, 1981). Teacher feedback to a student's response might also include information concerning why the student produced a correct or incorrect answer. The literature on communication and self attribution is relevant here (Dweck & Goetz, 1978; Schneider, Hastorf, & Ellsworth, 1979, chap. 5). Several studies have linked feedback to student self attribution for success or failure and to student performance. For example, Dweck (1975) worked with students who generally expected to fail and who gave up quickly after failure. One group was given a month of complete success experiences; a second group was given a month of predominantely success experiences, but were instructed to attribute failure to lack of effort rather than success when they did fail. Following the training period students in group one quickly reverted back to their pattern of "learned helplessness," but students in group two continued to work on problems after initial failure. Miller, Brinkman, Bolen (1975, study 2) also documented the influence of feedback on self attribution and performance. The researchers assigned 96 second graders to one of six conditions: two

attribution conditions, two persuasion conditions, a reinforcement condition, and a control condition. In the attribution conditions students were told they were good math students by several sources (e.g., teacher, principal, etc.); in the persuasion conditions students were told there were many reasons they should become good math students (implying a negative self attribution). Pretests and immediate and delayed posttests were administered for mathematics self concept and aptitude. Results revealed that only the self concept of students in the two attribution conditions significantly improved. Additionally, students in both attribution conditions scored significantly larger achievement gains than other conditions on immediate and delayed posttests. These studies suggest that self attribution framework could provide theoretical guidance for future research on feedback to students' responses. Since feedback that encourages attributing failure to lack of effort has the potential to threaten students' "face," future research might examine if such feedback must also provide face-support (e.g., Applegate, 1982) to be effective.

In addition to providing students with feedback, teachers sometimes praise or criticize their students. Brophy (1981) argues that praise "connotes a more intense or detailed teacher response than . . . [does] feedback . . . praise statements express positive teacher effect" (pp. 5-6). Thus, the response "South Dakota, that's right Billy" is feedback, whereas the response "South Dakota, very good Billy" is praise. Brophy notes that one way a teacher can praise a student is by explaining why his/her answer is valuable. The opposite of praise is criticism -- expressing negative affect toward a student in a response. Teacher criticism has consistently been found to be negatively related to student achievement (see Daly & Korinek, 1980), though the correlational nature of most research prevents conclusions about the causal

direction of this relationship. However, findings on the effect of praise have not been as consistent.

Several reviews have concluded that the correlations between praise and student achievement are usually weak and often in conflicting directions (Brophy, 1981; Dunkin & Biddle, 1974; Rosenshine & Furst, 1973). Brophy notes that most studies have found a weak positive correlation between the frequency of praise and achievement, but a nonsignificant correlation between achievement and the ratio of the number of good answers praised to the total number of good answers.

Two suggestions may help clarify the relationship of teacher praise and student success in future research. First, praise needs to be measured in qualitative as well as quantitative terms. O'Leary and O'Leary (1977) have suggested three qualities common to effective praise:

(1) Contingency -- The praise should be linked to the behaviors the teacher wishes to reinforce (i.e., praise only correct answers).

(2) Specificity -- The praise should identify the specific behavior/statement that is correct/valuable, and (unless it is obvious) explain why it is correct/valuable.

(3) Credibility -- The praise should sound sincere, and be believable.

Observational research illustrates the importance of using qualitative measures. Rowe (1974b) found elementary science teachers gave more specific praise to students they perceived as bright than to students they perceived as slow. Similarly, Dweck and Goetz (1978) review evidence that although the amount and type of praise or criticism given to mastery oriented and learned helpless students does not differ, the messages teachers direct at mastery

oriented students focus on much more specific aspects of their performance. This research suggest that qualitative measures of praise may correlate more strongly with achievement.

Second, individual difference variables need to be examined. For example, Brophy (1981) has suggested that vague praise may be beneficial for younger students, since they may not be able to differentiate between specific and non-specific praise. However, older students, whose social cognitive structures and processes are much more developed, may make the attribution that the teacher believes they are dumb if the praise is not specific or credible. Additionally, both Brophy (1981) and Medley (1979) review evidence that praise has differing effects on students of differing SES.

Commenting

After evaluating a student's response it is not uncommon for teachers to provide additional information about the topic of discussion. A limited amount of research has directly examined this part of a teacher's response. Wright and Nuthall (1970) found the frequency teachers provided "reflective" comments following pupil answers was not significantly related to achievement. Medley (1979) concludes that the teachers who are the most successful with students from low SES backgrounds are those who do not expand upon pupil comments. One possibility is that the effects of commenting is determined by the function it serves. Informative summaries at the end of topical units have been positively related to achievement (Medley, 1979; Wright & Nuthall, 1970); comments which summarize material before moving on to new topics might also be beneficial. However, comments which deter from class material and prevent student-teacher interaction are most likely to be detrimental in effect.

The second section of this paper has examined research on the three parts of teachers' response behavior: accepting, evaluating, and commenting. After a teacher asks an initial question and responds to a student's answer, one option he/she has is to pursue a sequence of questions. The final section of this paper examines research focusing on question sequences.

ASKING SEQUENCES OF QUESTIONS

Education scholars have often mentioned the importance of question sequences. Over fifteen years ago Gall (1970) encouraged scholars to focus on question sequences. Arkowitz (1981) explains the importance of examining sequences of behavior when assessing social skills such as questioning: " . . . simple frequency counts may obscure some very important issues relating to the timing, sequencing, and context of behaviors: issues which may determine the adequacy or skillfulness of behavior" (p. 302). Wilen (1982) draws a similar conclusion when he writes that "without a strategy, a discussion can become a series of questions lacking cohesion and purposeful sequence" (p. 9-10).

Two types of question sequences have been discussed in past research. The first is the redirect sequence -- the teacher asks one question to several students before moving on to the next question. Hyman (1979) argues this strategy should enhance group participation and attention. Hyman (1977) observed teachers in the classroom and found that about ninety percent of the question sequences used were redirect sequences. Several studies have examined the effect of redirects on student achievement. Wright and Nuthall found a positive correlation (r = .54) between the use of redirects and achievement.

Two studies have manipulated the use of redirects. Gall, Ward, Berliner, Cahen, Winne, Elashoff, and Stanton (1978) found no significant difference

between student achievement and critical thinking skills for students whose teachers used redirects and those who did not. Riley (1981) found that the effect of redirects depended on the type of posttest question. Students who teachers used redirects performed significantly better on knowledge questions, but did not significantly differ from the no redirect group on comprehension or analysis questions. Future research might evaluate the effect of a redirect sequence on the cognitive activities required to answer questions from all levels of Bloom's taxonomy.

The second type of question sequence is the probe or follow-up sequence. Follow-up questions can serve several functions, such as to clarify a student's response, request additional information from a student, or request a student to justify or explain how s/he reached a conclusion (Nyquist & Booth, 1977). Research has failed to link the use of follow-up questions to achievement gains (Gall et. al., 1978; Wright & Nuthall, 1970). Future research could address several questions. First, follow-up questions might be divided by function to determine if some types are effective in specific situations while others are not. Additionally, the effect of follow-up questions on critical thinking skills might be studied. Hyman (1977) argues that by starting at low level questions and progressing to higher level questions follow-up sequences could be used to develop students' cognitive skills.

CONCLUSION

This paper has presented a conceptualization of the behaviors that compose the process of teacher questioning. Section one described different methods of asking initial questions and different types of questions that can be asked. Section two discussed the three components of a teacher's response to a student's answer; the final section examined question sequences.

The paper hopes to serve three functions. First, the conceptualization of teacher questioning skills should provide a clearer idea of the specific teacher behaviors involved in the process of questioning and how these behaviors relate to one another. Second, the review should clarify which behavioral "skills" have established validity. In the introduction it was argued that educators and trainers often instruct teachers to utilize questioning techniques which are in vogue, without carefully examining the evidence for the techniques. Many training programs have instructed teahers to use techniques which are probably unrelated or even detrimental to student success: "Much effort has been wasted in training teachers to behave in the ways that the least effective ones do" (Medley, 1979, p. 26). The review highlights which behaviors have been established as beneficial. When validational evidence was inconsistent, the paper provided suggestions for future research exploring in what types of situations, for what types of educational objectives, and with what types of students the technique might be beneficial. Finally, in several instances the review suggested theoretical frameworks that could guide such future research on questioning strategies.

Communication scholars are in an excellent position to begin validational work on specific questioning techniques. Galvin and Cooper (1981) concur that process variables such as questioning "are at the very heart of teaching and are, perhaps, where our communication education researchers' efforts should be focused" (p. 57). If in the future a number of specific questioning techniques are validated, the positive effect on students' achievement and critical thinking skills could indeed be significant.

Notes

[1]This first suggestion also implicitly advances an important tenant of question asking: the instructor should adapt the question level, as well as the type of test question, to the specific desired instructional goal. Memorization and critical synthesis or evaluation of topical material are different instructional goals which necessitate adaptation of both classroom and examination question level.

[2]One frequent criticism of the levels of processing model is the difficulty of determining an index of processing depth independent of recognition or recall level. "Material that is deeply processed is predicted to be remembered effectively, but that which has been remembered is also alleged to have been procedded to a deep level. Both (presumed) degree of processing and recall are obtained from the same data" (Naus, Orensetin, Hoving, 1978, p. 223). To avoid this circularity an independent criteria of processing depth must be specified prior to hypothesis testing. In the area of classroom questioning the cognitive level of a teacher's question or students' overt responses could serve as an independent criteria. The search for such criteria has resulted in reformulations of the original theory; for example, depth is now often coceived as a multidimensional construct rather than a single continuum (e.g., Jacoby & Craik, 1979; Naus et al., 1978).

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TABLE 1

REVIEW OF EVIDENCE CONCERNING SKILL VALIDITY OF BORG (1972) PROGRAM

Description of Skill	Evidence of Validity	Documented Relationship with Student Success (to date)
1. Redirecting the same question to several students	Wright & Nuthall (1970): positively correlated with achievement (r = .54) Gall et al. (1978): manipulated redirects (yes/no); no sig. differences between groups Riley (1981): manipulated redirects; sig. difference for 1 of 3 types of questions	Positive
2. Framing questions that require longer answers	Wright & Nuthal (1970): longer student responses negatively correlated with achievement (r = -.23)	Negative
3. Framing questions that avoid yes/no replies (closed)	Wright & Nuthall (1970): percentage of closed questions positively correlated with achievement (r = .46); percentage of open questions negatively correlated with achievement (r = -.23) Rosenshine (1979): frequency of open questions negatively correlated with achievement	Negative
4. Framing questions that require pupils to use higher cognitive processes	Winne (1979): reviews 18 studies, concluded no effect on achievement or critical thinking skills Redfield & Rosseau (1981): reviews 14 studies, concluded positively related to student success Medley (1979): concluded negatively related to achievement for students of lower SES status	Not yet established

5.	Prompting students/ seeking pupil clarification and insight	Wright & Nuthall (1970): not sig. correlated with achievement Gall et al. (1978): manipulated (yes/no), no sig. differences between groups	Unrelated
6.	Teacher shouldn't repeat his/her own questions	No on point research	Not yet established
7.	Teacher shouldn't answer his/her own questions	Wright & Nuthall (1970): percentage of questions answered by students positively correlated with achievement (r = .45)	Positive
8.	Teacher shouldn't repeat pupil answers	Wright & Nuthall (1970): not sig. correlated with achievement (r = .17 corr. between repeating answer and achievement) McNeil & Popham (1973): other programs train exact opposite	Unrelated

*This program was developed by the Far West Regional Education Laboratory. It was reported by W. R. Borg (1972) in the Journal of Educational Psychology, 63, 572-579 (see table 1 in the article).

TABLE 2

SUMMARY OF TWO CLASSIFICATION SCHEMES

Sanders (1966)

1.	Memory:	student recalls or recognizes information.
2.	Translation:	student changed information into different words or a different code (e.g., put in own words).
3.	Interpretation:	student discovers the relationship among facts, values, and/or skills.
4.	Application:	student solves a lifelike problem that requires identification of an issue and selection of the relevant knowledge/skills.
5.	Analysis:	student solves a problem by demonstrating knowledge of parts of a problem and/or different ways of thinking about the problem.
6.	Synthesis:	student solves a problem that requires original/creative thinking.
7.	Evaluation:	student makes a judgment of good--bad or right--wrong using standards/criteria he/she chooses.

Gallagher & Aschner (1963)

1.	Cognitive memory:	student reproduces information from memory.
2.	Convergent thinking:	student analyzes/integrates information he/she is given or has memorized; characterized by highly structured (closed) questions.
3.	Divergent thinking:	student uses own ideas to provide the information needed to answer the question; characterized by less structured (open) questions.
4.	Evaluative thinking:	student makes judgments of value, morals, or worth; characterized by less structured (open) questions.

APPENDIX

A CONCEPTUALIZATION OF TEACHER QUESTIONING SKILLS