

STRATEGIES AND TECHNIQUES OF QUESTIONING EFFECTUATING THINKING AND DEEP UNDERSTANDING IN TEACHING ENGINEERING AT ESTONIAN CENTRE FOR ENGINEERING PEDAGOGY

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Abstract

Questioning is one of the essential teaching strategies or basic skills of teaching engineering, ensuring that all students learn as much as possible, think critically and acquire deep and thorough understanding of the topics they study. The role of teaching is to bring the knowledge to consciousness by asking questions. In the present article research findings are cited about questioning. Reasons are listed why sufficient wait time is important, appropriate questioning behaviours are described, examples are provided of different levels of questions and questioning practices to avoid are presented. Questioning procedures are described. The basic questioning strategies and prompting techniques used at Estonian Centre for Engineering pedagogy are described in the article. It is also discussed how questioning can create a dynamic learning environment in teaching engineering, based on the practice of Estonian Centre for Engineering Pedagogy.

Key words: *questioning techniques, questioning strategies, questioning procedures, deep understanding, engineering education.*

Introduction

Questioning is considered to be a powerful and universal teaching strategy. Teachers ask an incredible number of questions. They use questions to check recall of an increase retention of information, to interpret information, to guide the development of concepts or skills, to promote thinking, evaluate learning, and to review. During a lesson questions are asked to see if students understand what was presented. Questions keep students attentive and on task.

The problem is that there is a tendency to ask questions as though they are a rice thrown at a wedding. Throwing out lots of questions makes the teacher feel good. These questions often do little to support understanding but the answers that come back make it feel productive. Carefully focused questions, in the other hand, make all the difference. Focused questions are aimed at a particular target. The target is determined by the stage of the instruction and the nature of understanding to be supported. There must be relevant, accessible prior knowledge or it must be provided or constructed; the relationships must be known or capable of construction; the relevant and irrelevant must be discriminated and a need for inferring has to be recognised. The target is likely to be pre-requisite knowledge. Questions, therefore, are aimed at stimulating recall of pre-requisites and practising it. They also serve to indicate where prior

knowledge is deficient and needs to be improved. The nature of the question matches the immediate goal of instruction. Teachers often ask mainly factual questions, regardless of the goal.

Effective teachers phrase questions clearly, avoid run-on questions, and specify the conditions for the response. They probe for clarification and encourage students to critical thinking. Although responses are acknowledged, praise is used with discretion. Many questions require rote memory for a correct response. Perhaps, because questions that require recitation of facts take less time, teachers sometimes avoid asking higher-level questions.

Guidance about questioning usually falls only into two categories: the kinds of questions and questioning techniques.

Types and Levels of Questions

According to Burden & Byrd (2010) when using questions as teaching strategy, it is important to consider the type of the question. There are following types of questions:

Questions for the learning domains. Most questions focus on cognitive domain. Questions can be developed for each level of the cognitive domain: knowledge, comprehension, application, analysis, synthesis and evaluation. The first three levels are considered to require low-level questions because they emphasise primarily the recall and moderate use of the information. The upper three levels of the cognitive domain require high-level questions that go beyond memory and practical recall; they deal with abstract and complex thinking, especially needed in teaching engineering.

Convergent and divergent questions. Two types of answers might be required from questions. *Convergent questions* tend to have one correct or best answer. These questions may be phrased to require either low or high level thinking. *Divergent questions* are often open-ended and usually have many appropriate but different answers.

Types of questions. There are different types of questions for different purposes. *Focusing questions* are used to focus students' attention on the lesson or on material being discussed. They may be used to determine what students have learned, to motivate and generate interest, or to check for understanding during or at the end of a lesson. A teacher may need to prompt students when asking questions. *Prompting questions* include hints and clues to aid students in answering questions or to assist them in correcting and initial response, a prompting question is usually a rewording of the original question with clues or hints included. *Probing questions* may be needed when a student does not answer the question completely. In this case a teacher may stay with the same student by asking one or more probing questions that are intended to seek clarification and to provide guidance students to more complete answers (e.g. What do you mean by that? Could you explain that more fully? What are the reasons for that?).

According to Eggen & Kauchak (2006) when using questions and answers, teachers can help students progress well beyond a low level. Bloom's taxonomy is one way to look at levels of questions at student readiness and appropriate objectives are considered. Examples of key words or phrases in each category are as follows:

Knowledge level (recalling or recognising information) – Recall, Define, List, What? How many? Where? Who? Where? When?

Comprehension level (describing, putting in own words, giving examples) – Describe, Give an example, Rephrase, Summarise, Explain, Interpret, Paraphrase, What's the main idea?

Application level (applying to a new context; using a concept to solve a problem) – Classify, Select, Prepare, Operate, Solve, Use, Demonstrate, Relate.

Analysis level (discover, or break down into the parts; find the structure) – Outline, Analyse, Diagram, Subdivide, Infer. What are the causes? What is the order? What are the reasons?

Synthesis level (organise into a new way, or into a new whole) – Plan, Construct, Create, Produce, Design, Rewrite, Devise, Combine.

Evaluation level (judge based on criteria, a rationale, or standards) – Judge, Criticise, Support, Appraise, Justify, Discriminate, Which is better? Why? Do you agree? Why?

Bloom's taxonomy should not be used rigidly nor used as a linear and inflexible hierarchy. It is a guide to varying questions and to moving from low to higher levels. There is little point, however, in arguing about exactly where in the taxonomy a given question fits.

Questioning Techniques and Strategies

Once instruction begins, a teachers needs to use effective questioning techniques to get the desired results. In teaching engineering it is important to consider a number of factors when selecting questions. Based on a research Burden & Byrd (2010) outlined fundamental questioning techniques suitable for engineering education:

Plan key questions to provide lesson structure and direction. Teachers should write questions into lesson plans, at least one for each objective, especially high-level questions, necessary to guide discussions. It is also important to ask spontaneous questions based on student responses.

Phrase questions clearly and specifically. Teachers should direct the question to the entire class, each student in the class thus think, he or she could be asked for the response. It is important to avoid vague or ambiguous questions such as "What did we learn yesterday? Ask single questions and avoid run-on questions that lead to student confusion. Clarity always increses the probability of accurate responses.

Adapt questions to student ability level. This enchances understanding and reduces anxiety. Teachers should phrase questions in simple, natural language, adjusting vocabulary and sentence structure to students' language and conceptual levels.

Ask questions logically and sequentially. It is important to avoid random questions lacking clear focus and intent. Teachers should consider students' intellectual ability, prior-understanding of content, topic, and lesson objectives. Asking questions in a planned sequence will thus enhance student critical thinking and learning, particularly during discussions. Early questions provide background for review. Follow with questions that increase understanding and then application to solving problems. Concluding questions can lead to new insights or be used to evaluate.

Ask questions at a variety of levels. Use knowledge-level questions to determine basic understandings and diagnose potential for higher-level thinking. Higher-level questions provide students opportunities to use knowledge and engage critical and creative thinking.

Follow up student responses. Develop a response repertoire that encourages students to clarify initial responses, expand their responses, lift thought to higher levels, and support a point of view or opinion. For example, "How would you clarify that further?", "How can you defend your position?"

Give students time to think when responding. Engineering teachers should increase wait time after asking a question to three or even five seconds to increase the frequency and duration of student responses and to encourage higher-level thinking. Insisting on instantaneous responses, particularly during discussions, significantly decreases the probability of meaningful interaction with and among students.

Use questions that encourage wide student participation. Engineering teachers should distribute questions to involve the majority of students in learning activities. For example, call on nonvolunteers, using descretion regarding the difficulty level of questions. It is important to encourage student-to-student interaction and recommended to use circular or semicircular seating to create an environment conducive to participation, particularly during discussions.

Encourage student questions. This promotes active participation. Student questions at higher cognitive levels stimulate higher level of thinking, essential for inquiry. It is recommended to give students opportunities to formulate questions and carry out follow-up investigations of interest.

According to Tileston (2004) Socratic questioning techniques or seminars provide opportunities for students to use higher-level thinking strategies in regard to the subject matter. When executed well, these activities give students opportunities to provide their own interpretations and viewpoints and to use critical thinking and problem solving. It is wise if a teacher models the format by taking responsibility for the first of these seminars. After the students understand the tactics involved, they may be allowed to

take over the process. Students working in small groups discuss given questions. The type of question chosen depends on the subject matter and the objectives of learning.

The classification scheme of questions helps teachers to conduct goal-specific recitation periods. According to Orlich (2007) there are four basic questioning strategies:

1. *Convergent questioning* – focuses on narrow objective. When using this strategy, teachers encourage students to focus on a central theme. This elicits short responses and focus on lower levels of thinking – knowledge or comprehension level. This strategy is suitable when using inductive teaching (proceeding from a set of specific data to a student derived conclusion), or direct instruction (Under what conditions will water boil at less than 100°C?)
2. *Divergent questioning* – opposite of convergent questioning, rather than seeking a single focus, the goal is to evoke a wide range of student responses, eliciting higher-level thinking responses (application, analysis, synthesis). Teachers should allow students to present their responses without interference. Students should locate different sources of information to share a variety of viewpoints (Why would you choose ach welding over gas welding?)
3. *Evaluative questioning* – is based on a divergent questioning strategy with component of evaluation added, emphasising the specific criteria on which students should base their judgements. Teachers should help students develop a logical basis for establishing evaluative criteria (What reasons could be given to switch to either gasohol or hydrogen fuel for our automobiles?).
4. *Reflective questioning* – draws its historical perspective from the classical Socratic method of questioning. This strategy stimulates a wide range of student responses, having also evaluative element, the goal being to require students to develop higher-order thinking: to elicit motives, inferences, speculations, impact, contemplation. The process initiated by reflective questions may also be called critical or analytical thinking. This approach gives a double value – students work cooperatively and they have to think. The types of thought processes that can be stimulated through reflective questioning are as follows: seeking motives, expanding a vision, listing implications, searching for unintended consequences, identifying issues, analysing persuasive techniques, making unique interpretations, inferring values, challenging assumptions, seeking meanings (What impact have personal computers made on our school courses?).

Questioning Procedures

The way questions are asked is important, especially in teaching engineering. The climate of questioning should be positive and encouraging. According to Lang & Evans (2006) and Burden & Byrd (2010) there are the following questioning procedures to follow:

Get the undivided attention of the entire class. All students should feel a part of the teaching/learning process and think they personally are being addressed.

Use variety and unpredictability in asking questions. Students should know that they may be called on at any time, regardless of what has gone on before. It is important to be cautious about using predictable patterns, such as calling only on students who raise their hands, always calling on someone in the first row first (or another particular area), taking questions in the same order as in the textbook, and not questioning a student again after he/she has answered on a question.

Ask the question before calling on a particular student. Asking the question before calling on someone allows all students more time to consider the question and a possible answer, creates greater interest, and increases attentive behaviour. If one student is named before asking a question, others may not pay attention to what follows.

Wait at least for 5 seconds after asking a question before calling on a student. After asking a question it is important to provide the student with enough time to reflect on a complex question and formulate an appropriate answer.

Call on a specific individual to respond. Requests for responses should be spread among volunteers and nonvolunteers, matching question difficulty with student likelihood to respond successfully. Teachers should require students to respond to the whole class, a student's answer may lead to the next question, students should exercise to complete their answers.

1. *Do not consistently repeat student answers.* It often results in students believing that they do not need to listen to their fellow students' answers and that there is no need to speak loudly, if a response was unclear, ask the student to rephrase it, or use a redirect. On occasion, for emphasis another student can be asked to repeat the answer.

Ask questions that relate to students' own lives or similar situations. Students will find learning more meaningful when it can be related to their own lives and interests.

2. *Vary the types of questions being asked.*

According to Nilson (2003) there are also some practices to avoid in questioning, especially in teaching engineering:

1. *Yes-no questions* – they encourage guessing and have little diagnostic value.
2. *Leading questions* – as they contain a portion of answer or suggest the answer and may encourage dependence on a teacher.
3. *Short-answer questions* – except when drilling or preparing for high-level questions, avoid questions largely restricted to narrow, short answer, memory, or recall in order to help students improve their ability to think.
4. *Run-on or interrupted questions* – which add confusing and unnecessary detail or are long and may cause students to forget or wonder what was asked.
5. *Multiple questions* – cause students to forget what was asked, wonder which question to answer, or what is really asked.
6. *Rhetorical questions* – may cause students to be inattentive and not respond when actually asked.
7. *Blanket questions* – questions such as, “Does everybody understand?” or “Do you have any questions?” usually waste time and have little or no diagnostic value, it is wiser to ask the students to solve a problem, thus demonstrating, whether they have understood the topic or not.
8. *Repeating the question* – may encourage inattentiveness, interrupt the flow of discussion and centre the interchange on a teacher. However if a question was poorly phrased or too complex, it may need to be rephrased or broken into sub-questions.

According to Orlich (2007), Melezinek (1999), Newton (2000), Burden & Byrd (2010), the basic rule for asking questions is to proceed in three steps: ask the question, pause, and then call a student. There are several reasons to use a *wait time*. First it gives students a chance to think about their responses, especially if higher-level questions are asked. This pause also gives time to read students' nonverbal cues. After the student has given a first answer to the question, it is essential to wait again, because it gives students additional time to think and allows others to respond as well without prompting. The benefits of wait time for students are: longer responses, more student discourse and questions, fewer non-responding students, more student involvements in lessons, increased complexity of answers and higher achievement.

After asking a question, pausing, and calling for or accepting students' responses, the teacher has a major decision to make. Should the answer be received and reinforced with a rewarding encouragement? If the response is somewhat incomplete, should the student be prompted to make a more complete answer? Or should the response be probed to extend knowledge for all students? Prompting and probing seem to occur almost unconsciously in most teachers' classrooms. Planned use of prompting and probing can induce much greater success in students' learning.

A prompt is like giving a hint, a part of the response that the teacher wants a student to make. According to Elliott (2005) there are three types of prompts:

- Redirecting
- Refocusing
- Hinting or suggesting

A teacher may elect to give a nonresponding student a part of the desired response, a hint. The hint is offered in hopes of jogging the student's memory, leading him or her to remember information that

should have mastered previously. A prompt may also take the form of a second question using different terms to redirect attention, varying the vocabulary to better communicate the question.

A *probe* is quite different from a prompt. Probes clarify and elicit higher order thinking skills, they extend understanding among all those listening to the exchange, not the responding learner alone. According to Elliott (2005), probes come in four categories:

They clarify the previous student response.

They lead to an enhanced critical awareness of the previous response.

They lead students to relate one idea to another.

They help students predict eventual outcomes based on the reasoning accumulated in previous responses.

According to Elliott (2005) probes depend on student's response to a question, if the response is:

High quality response – no prompt is needed. It is recommended to invite a student to summarise.

Primary probes: Why do you think the way you do? Can you tie this idea into another? What do you think will happen?

Partial or superficial response – Facilitating prompts: redirect, refocus, hint. Primary probes: What do you mean? Why do you think the way you do? Can you tie this idea into another? What do you think will happen?

Nonresponse – Silence. Facilitating prompts: redirect, refocus, hint.

Questions to Create Higher Order Thinking

Merely asking questions does not cause students to think. But higher-level questions invite and encourage higher levels of critical thinking in students. Furthermore, according to Orlich (2007), it appears that if teachers systematically raise the level of their questioning, students raise level of their responses correspondingly. This requires a carefully planned questioning strategy. Through appropriate questioning student curiosity is fostered. Curiosity is affective dimension of learning and it deals with motivation.

Questioning is a primary tool in teaching engineering for leading students into higher order thinking. Students should be asked more *how*, *why*, or *what do you suppose* questions, not only *what* questions. Knowledge requires memory only, repeating information exactly memorised – the *what*. Comprehension, however, calls for rephrasing, rewording and comparing information. Application requires the learner to apply knowledge and understanding to determine an appropriate, correct answer. Analysis asks students to identify motives or causes, draw conclusions, determine evidence. Synthesis leads students to make predictions, produce original communications, or solve problems. Evaluation causes students to make judgements, offer and support opinions.

Higher-level questions do not guarantee higher-level responses, they only open a very important door to critical thinking for engineering students. If a teacher wants to encourage a response at a particular level of thinking, then he/she must frame the question at an appropriate intellectual level. Engineering teachers should use a questioning hierarchy as a plan for recitations and discussion. This allows to structure facts, concepts and generalisations within a framework for thinking. Questioning hierarchy can also be used to plan declarative statements and to structure them in a hierarchical manner to elicit higher-level student responses.

Through a cleverly planned questioning strategy, an engineering teacher can creatively lead students through the cognitive taxonomy of thinking. Carefully devised questions facilitate the observation, communication, comparison, ordering, categorisation, relating, inferring from, and application of information. Beginning with *what* or the recall questions, in teaching engineering a teacher should lead from the knowledge base into understanding, and from understanding into practical application, from application into a more careful analysis, and after analysis into a synthesis or a reassembling of the notion in a new and different way. This entire process can then be assessed and judged as having merit, quality, or worth, teaching students to evaluate all ideas on a consistent set of criteria.

An engineering teacher could promote observation by directing students to “tell us what you see” or to “list the properties that are apparent in the sample” by asking questions like: “What are the dominant characteristics of this subject?”, “What is the object’s size and shape?”. For comparing information, the scientific thought process that deals with similarities and differences, an engineering teacher should lead the analytic questioning: “How are these alike?”, “How are these different?”, “Which comes first, second, third?”, “On what basis would you group these ideas or objects?”, “What is a different way in which these characteristics can be clustered?”. Following analytic questions, synthesis questions should be asked: “Use the information you have learned to design something new”. The final element of reason and thought would be leading students into evaluation by asking for example “Which experimental design was the best? Why?”. Related to evaluation is the process of inferring, concluding, deciding. This is the scientific thinking process that deals with ideas remote in time and space: “What can be inferred from this information?”, “Predict the outcome and give evidence to support your prediction”, “Under what conditions might we extrapolate from this observed information and believe that a similar reaction could occur under a different circumstance?”.

Discussion

All thinking is driven by questions. Deep questions generate deep thinking. Phrasing questions is important to what goes on in a class discussion. An engineering teacher sets the stage and makes statements that provide information, challenge, summarise and help organisation and development. The statements a teacher makes are as important as the questions posed and the questions or comments that come from students help the discussion. Teachers must design questions that will help students attain the specific goals (objectives or outcomes) of a particular lesson.

Questioning is one of the missing pieces in teacher education. Teachers often ask close-ended questions that don’t allow the students to demonstrate their level of knowledge or lack of knowledge. The quality of response is always affected by the quality of the question. Questions are critical elements for teachers to use to stimulate student thinking especially in teaching engineering.

At Estonian Centre for Engineering Pedagogy special attention is paid to the questioning techniques in teaching future engineering teachers. Research reveals that in teaching engineering, questioning follows lecturing as the most commonly used teaching method, with teachers spending from 35 to 50 percent of instructional time in questioning sessions. The future teachers are guided to use open ended questions that require analysis, synthesis, or judgements and support. This stimulates thinking, moving beyond rote memory. When using questions and answers it is possible to help student progress well beyond a low level. In teaching engineering it is important that questions should be designed to promote thinking and participation. Asking high-cognitive-level questions, requiring critical thinking, not just memory, increases student achievement. The best pattern for younger and lower-ability students is simple questions with high success rates; for high-ability students, harder questions should be asked and more critical feedback given.

According to the research carried out at Estonian Centre for Engineering Pedagogy, engineering teachers ask questions on cognitive level as follows: about 60 percent questions are lower-cognitive, 20 percent are higher and 20 percent are procedural. Higher-cognitive questions are not always better in getting higher-level responses, fostering learning gains. Asking many lower-level questions is appropriate – the greater the number of questions, the greater the student achievement. When lower-level questions are predominant, the level of difficulty should result in a high percentage of correct responses. Students whom teachers perceive as slow or poor learners are asked fewer higher-cognitive questions than students perceived as more capable learners. Increasing the use of higher-cognitive questions considerably above 20 percent, results in higher learning gains. Still asking higher-cognitive questions alone will not necessarily result in higher-cognitive responses.

Teaching students how to draw inferences and providing practice leads to higher-cognitive responses and greater learning gains. Increases in the use of higher-cognitive questions in recitations do not reduce student performance on lower-cognitive questions or tests. Increasing the use of higher-cognitive

questions to 50 percent or more is related to increases in on-task behaviour, student response length, relevant volunteered contributions by students, student-to-student interactions, use of complete sentences when responding, speculative and critical thinking and relevant questions asked by students.

For students, increased use of higher-cognitive questions (up to 50 percent) is positively related to higher teacher expectations about students' abilities, particularly for students teachers habitually have thought to be slow or poor learners.

The way questions are asked is important. It is recommended that teachers ask clear, specific questions using suitable vocabulary level, ranging from the lowest to the highest levels of Bloom's taxonomy and using questions to help students connect important concepts.

Effective teachers teach students how to participate in questioning, explaining why it is important for them to normally follow the routine they wish to establish. As a part of explanations it is recommended to tell the class you value the contribution of everybody as a member of the class. Tell the students that nobody knows everything and it is OK to risk, no sincere answer or question is "dumb" or something to be ashamed of – sincere questions present opportunities for learning. Having students observe the questioning pattern that follows can increase participation and learning and is an important aid to classroom management.

Good questioning is not something that works in isolation. It occurs within the structure of a classroom and exemplifies the key elements of high-quality teaching. Teacher questions are crucial in helping students make connections and learn concepts, and that effective questions monitor students' understanding of new ideas and encourage them to think more deeply. High quality instruction takes place when:

- the teacher's questioning strategies are likely to enhance the development of student conceptual understanding/problem solving (e.g. the teacher emphasised higher-order questions, used wait-time appropriately, and identified prior conceptions and misconceptions).

- the teacher encourages and values participation by all students.

- the climate of the lesson encourages students to generate ideas, questions, conjectures and propositions.

High quality instruction does not take place when teachers use low-level "fill-in-blank" questions asked in rapid fire fashion with an emphasis on getting the right answer and moving on rather than helping students to understand the concepts.

Teachers tend to fall into a pattern of calling mainly on higher-ability students to answer questions the questioning pattern should have all students called upon as equally as reasonable having equitable distribution is a demanding but important challenge. How to handle student responses makes a difference. Discussion and participation should be enhanced. Allowing sufficient wait time is fundamental to encouraging responses. It is agreed that the wait time should be three to five seconds or more, particularly when higher-order questions are asked. The benefits are impressive: students tend to give longer answers (up to 700 percent longer), the number of supported and logical responses increases; failures to respond are reduced; more students volunteer to respond; higher-order responses are given more frequently; students rated as slow by teachers respond more often and ask more questions; more confidence is shown in responding; students ask more questions; student-to-student exchanges increase; students are more willing to risk because the number of speculative responses increases; and the need to discipline decreases. Accordingly increasing wait time could result in higher student achievement, retention, more high-level responses, greater response length more unsolicited responses, deep understanding, critical thinking, more decreases in failure to respond and more questions asked by students.

When wait-time is increased, teachers make better use of questions and answers, they have time to scan the room and encourage students, consider the next question, think about how to handle the responses, teachers are more flexible, make more requests for clarification or elaboration.

Explaining a new topic in teaching engineering can be very effective if it is supported by focused questioning. Focused questioning according to Newton (2000) also stimulates critical thinking requiring comparing or contrasting items determining the cause and effect. At Estonian Centre for Engineering Pedagogy focused questioning has been used and taught to future engineering teachers. Focused questioning can be effectively used in teaching engineering as follows:

1. Set the scene and establish relevance (Did you see the news about power cut? Is it important? Why?)
2. Elicit relevant prior knowledge, to bring it into conscious thought (Who can tell me how a torch works?)
3. Process this knowledge or develop new knowledge that will be needed in the understanding (Suppose the torch is switched off, how it stops the light from coming on?)
4. Focus attention on relevant parts of a situation to ensure that they are encoded in the situation model (Why won't this torch work? Do you think the bulb might be faulty? How could we check it? Would a magnifying glass help?)
5. Deflect attention away from irrelevant aspects of a situation so that they do not figure largely in the processing of the mental presentation of the situation (Watch, I'll take it apart so we can see what's inside. What's this mess on the battery?)
6. Require predictions about the developments of a situation and ensure that the basis of the predictions is appropriate (What would happen if I fastened this wire between there and there?)
7. Compare the final state of the event with the predicted one (Is that what you expected to happen?)
8. Rehearse and integrate the process (So, when we have a break in a circuit, what does it mean? How it could be found where the break is?)

Not all of the named stages are always needed, but it is likely that more than one question in any stage will be necessary to explore fully the various aspects of understanding to be fostered, especially in teaching engineering.

Conclusions

An effective teacher plans questions before the class session, designing them to lead students to higher order thinking. Questioning sessions in classrooms ought to be constructive and cheerful experiences in which students' opinions are respected, their interests stimulated, and their minds challenged. Questioning is a valuable tool for ensuring instructional equity.

Schools have typically neglected teaching for thinking, and transfer thinking operations from one subject to another and to real life. Emphasis has been on information acquisition and low-level content. Students need to do more than learn information. Thinking skills and processes need to be learned, as does the ability to use these in a variety of contexts. If teaching and learning are to be authentic, teachers need to teach for thinking. One of powerful strategies for teaching for critical thinking and deep understanding is questioning.

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