

Reasoning – Meaning, Teaching and Assessing in Education

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It is important to have a firm understanding of what and why we are teaching our students for the education process to be successful. In order for students to develop skills to succeed in the 21st century, they must develop higher order thinking skills that apply content knowledge to situations that help them diagnose and solve problems, ask appropriate questions and be able to retrieve appropriate resources, and be able to learn and understand the rules and principles of their profession and apply them. As Richard Stiggins describes, "we want students to be able to use their knowledge and understanding to reason, to figure things out, to solve certain kinds of problems." (2005)

Learning content and learning to research and acquire content is an important part of our teaching process. Once students have basic knowledge and know how to retrieve additional knowledge if required, they must develop the skills to utilize the knowledge in meaningful ways. Stiggins (2005) has developed a classification of reasoning skills that help us group their differences and relationships: Analytical Reasoning, Synthesizing, Comparative Reasoning, Classifying, Induction and Deduction, and Evaluative Reasoning. Stiggins (2005) admits that these are his consolidated categories of reasoning and shares that every scholar has a different classification system.

Another classification of reasoning that I researched at Iowa's AEA 267 (2006) is based on a combination of work of many educational leaders including Robert Marzano, Jay McTighe, Grant Wiggins, and Richard Stiggins

and I found their resources to be excellent references on developing strategies for teaching a thinking skill/reasoning process. They have defined thinking skills as comparing, classifying, induction, deduction, error analysis, constructing support, abstracting, and analyzing perspectives and reasoning processes as decision-making, problem-solving, experimental inquiry, invention, and investigation. As you can see, what they refer to as thinking skills are what Stiggins refers to as reasoning skills so there's a confusing terminology difference. There are also some defined differences in the categorizations. The categories of analyzing perspectives and error analysis are separated from constructing support (perhaps to highlight determining bias in internet information and research), but I think grouping these three together into Stiggins' category of evaluative reasoning is more logical and simpler. Their category of abstracting/extending is what Stiggins defines as synthesis.

It is important for teachers to determine what reasoning process they need to assess and in doing so should answer the task design question: "What will students do to be able to show they understand the content chosen for them to learn?" (AEA267 2006) A teacher's assessment of student reasoning involves an assessment of the student's understanding of the reasoning standards and requires the teacher's feedback to the student to detail the degree to which their reasoning meets those standards. (Paul, 2006)

To provide opportunities to develop analytical thinking in the classroom we need to show relationships between parts and how the parts

together function as a whole. It can be as basic as parts of hardware of a computer, or get to the complexity of parts of a programming language and how they must be structured and relate to each other. Programming often utilizes patterns that can be re-used and learning and understanding that concept is critical to developing programming techniques such as utilizing functions. Selected response assessments can provide basic information on the student's understanding of relationships but the performance of creating a program that functions provides the best assessment. We start simple and small and build to rather complex results.

The reasoning pattern of synthesizing teaches the student to look for general patterns and then make generalizations about typical structures. This thinking process is utilized constantly in computer programming as many languages have similar constructs. Once a student learns a few different languages, no matter how simple or complex, many similar patterns can be utilized. In fact, the first programming language I ever learned at computer school was an imaginary language that taught the basic concepts because they knew that those concepts could then be carried to the other languages we then learned. I often use selected response assessments with short response followed by a short explanation to assess students identification of patterns. Essay or performance assessments are better for determining students' ability to make the generalizations.

Comparative reasoning allows students to figure out how things are alike or different. It is important for students to develop the skills to identify the specific elements to be compared, select appropriate and important

characteristics on which the elements were to be compared, and clearly state the extent to which each element possesses each characteristic. (AEA267, 2006) Students in my classroom learn to utilize these skills when evaluating different software products for their needs. One of the assessments I've used for this task is for students to create a sales presentation that they must give to the class on why their chosen software product is best for their task.

Classifying requires that students "know the defining parameters of each category and the attributes of those things we are classifying." (Stiggins, 2005) The student needs the skills to clearly identify the elements to be classified and then to identify the categories into which the elements belong. They must be able to describe the characteristics that were used to analyze the extent to which each element fits into each category. In teaching website organization, it is often necessary to have students use a graphic tool to assist them in organizing their content ideas into categories to have them be able to develop an organized and navigable website. Selected response assessments can sample understanding of characteristics but mostly I have found personal communication, group work, and the performance assessment of the various drafts and final product of their work to be the best assessment.

Inductive and deductive reasoning involve students understanding a rule, generalization or principle and either be able to apply that general rule to find the solution to a problem (deductive) or be able to draw conclusions or predictions from specific information based on connections or patterns (inductive). Students should be able to articulate the principle from which

deductions were made and the connection between that rule and their conclusion or how they linked elements with the conclusion. Graphic organizers can be helpful to students identifying the conditions that must be in place for generalizations to apply and identifying the overlap of things that are true. Essay assessments provide a platform for students to describe the principles and explain their thought process to how they determined their conclusion.

To use evaluative reasoning in the classroom, we must apply identified criteria to judge the value or appropriateness of things. Students must be able to identify the important characteristics of whatever it is they are to evaluate and then be able to apply judgmental criteria. In doing so, they learn to discern errors, identify limitations or assumptions or bias, state specific criteria which define value, and be able to rate something on these terms. A rubric is often used in educational environments to assist students in evaluative processes. In teaching website development classes, a large part of each class is spent openly discussing: what do you think makes a good website and what do you think makes a poor one, and why? Students eventually develop their own rubric by which they are assessed based on these class discussions.

In teaching and assessing reasoning, it is important to develop a variety of activities and assessments that teach and indicate how students can apply different reasoning logic to a variety of situations and problems. It is also important for teachers to not focus too narrowly on what is being tested, as "the assessment results will only reveal the students' learning of

the test content, not whether they could perform a related task in a different environment.” (Porter, 1995)

As we all strive to advance students learning to higher levels of thinking processes, we will learn better and more significant ways to teach and to assess student thinking and reasoning skills.

References

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