NATIONAL FORUM OF TEACHER EDUCATION JOURNAL
VOLUME 21, NUMBER 3, 2011

Critical Thinking and Constructivism Techniques for Improving Student Achievement

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ABSTRACT

NAEP data suggest that student outcomes in American education are a little better–and in some cases worse–than they were 30 years ago. Moreover, students in some other advanced, technological countries consistently outperform American students on international tests in science and mathematics. The ultimate goal of the No Child Left Behind legislation is that all students will demonstrate competency over challenging subject matter in the core subject areas—reading, mathematics, science, and social studies—and learn to use their minds well, so they are prepared for responsible citizenship, further learning, and productive employment in our Nation's economy. In this article, I discuss the condition of education in America and offer two approaches to teaching subject matter (critical thinking and constructivism) that may result in major improvements in student achievement.

Accountability for school improvement is a central theme of federal and state polices. The No Child Left Behind Act of 2001 (Public Law 107-110) sets demanding accountability standards for schools, school districts, and states, including new state testing requirements designed to improve education. For example, the law requires that states develop both content standards in reading and mathematics and tests that are linked to the standards for grades 3 through 8, with science standards and assessments to follow. States must identify adequate yearly progress (AYP) objectives and disaggregate test results for all students and subgroups of students based on socioeconomic status, race/ethnicity, English language proficiency, and disability. Moreover, the law mandates that 100 percent of students must score at the proficient level on state tests by 2014. Will schools, school districts, and states be able to respond to the demand?

Where Are We Now?

The National Assessment of Educational Progress (NAEP), often referred to as the nation's "report card," is the only nationally representative continuing assessment that measures what students know and are able to do in the core subject areas. NAEP is administered at fourth grade, eighth grade, and twelfth grade at various points in time. Both public and private

school students in grades 4, 8, and 12 are sampled and assessed on a regular basis. The NAEP tests are developed nationally by teachers, curriculum experts, and the public. The NAEP is authorized by Congress and directed by the National Center for Education Statistics of the U.S. Department of Education.

The data suggests that student outcomes in American education are a little better–and in some cases worse–than they were 30 years ago. NAEP reports that only one third of 12th graders are able to perform rigorous reading passages. The average reading levels of black 17-year olds is about 4 years behind that of white students and mathematics scores of this group is about 2 years behind white students (Howard, 2011; U.S. Department of Education, 2010a; Paige, 2011). Differences between white and Hispanic reading scores on the NAEP have been declining consistently since 1975 (U.S. Department of Education, 2010a). The gap between white and Hispanic mathematics scores on NAEP has been declining since 1975, as well (U.S. Department of Education, 2010a). Merely 11% of secondary students demonstrate a good understanding of history. The general standards of American schools compare unfavorably with those of other industrialized nations (U.S. Department of Education, 2010b). NAEP data and International Educational Achievement (IEA) studies suggest that students are not learning how to think. In other words, although student learning of facts and basic skills has improved slightly over the past three decades, the development of more advanced reasoning abilities has declined.

To achieve major improvements in student achievement will require fundamental changes in the way subject matter is taught. Classroom teachers at all levels should consider critical thinking and constructivism that offer real promise for improving the achievement of all students in the core subject areas.

Critical Thinking

The concept of critical thinking may be one of the most significant trends in education relative to the dynamic relationship between how teachers teach and how students learn (Mason, 2010). Critical thinking shifts classroom design from a model that largely ignores thinking to one that renders it pervasive and necessary (Cohen, 2010; Tittle, 2010; Vaughn, 2009). Critical teaching views content as something alive only in minds, as modes of thinking driven by questions, as existing in textbooks only to be regenerated in the minds of students.

Once we understand content as inseparable from the thinking that generates, organizes, analyzes, synthesizes, evaluates, and transforms it, we recognize that content cannot in principle ever be "completed" because thinking is never completed. To understand content, therefore, is to understand its implications. But to understand its implications one must understand that those implications in turn have further implications, and hence must be explored thoughtfully.

The problem with didactic teaching is that content is inadvertently treated as static, as virtually "dead". Content is treated as something to be mimicked, to be repeated back, to be parroted. And since students only rarely process content deeply when they play the role of passive listeners in lecture-centered instruction, little is learned in the long term. Furthermore, because students are taught content in a way that renders them unlikely to think it through, their minds retreat into rote memorization, abandoning any attempt to grasp the logic of what they are committing to memory.

Those who teach critically emphasize that only those who can "think" through content

truly learn it (Numrich, 2010). Content "dies" when one tries to mechanically learn it. Content has to take root in the thinking of students and, when properly learned, transforms the way they think. Hence, when students study a subject in a "critical" way, they take possession of a new mode to thinking which, so internalized, generates new thoughts, understandings, and beliefs. Their thinking, now driven by a set of new questions, becomes an instrument of insight and a new point of view.

History texts become, in the minds of students thinking critically, a stimulus to historical thinking. Geography texts are internalized as geographical thinking. Mathematical content is transformed into mathematical thinking. As a result of being taught to think critically, students study biology and become biological thinkers. They study sociology and begin to notice the permissions, injunctions, and taboos of the groups in which they participate. They study literature and begin to notice the way in which all humans tend to define their lives in the stories they tell. They study economics and begin to notice how much of their behavior is intertwined with economic forces and needs.

There are ways, indeed almost an unlimited number, to stimulate critical thinking at every educational level and in every teaching setting (Dunn, 2010; hooks, 2009; Liecester, 2010). When considering technology for this stimulation, the World Wide Web (WWW) is important to instructional design; it contains three keys to educational value: hypertext, the delivery of multimedia, and true interactivity (Stewart, 2010). These values are operant and alive in the classroom through such applications as: graphics, sound, and video which bring to life world events, museum tours, library visits, world visits, and up-to-date weather maps (Griffin, 2010). Through these WWW mechanisms, a constructivist instructional model advance higher level instruction, such as problem solving and increased learner control. The WWW becomes a necessary tool for student-centered discovery and research. Of course, it can also be used for lower level drill and practice.

At every level and in all subjects, students need to learn how to: precisely put questions, define contexts and purposes, pursue relevant information, analyze key concepts, derive sound inferences, generate good reasons, recognize questionable assumptions, trace important implications, and think empathically within different points of view (Dunn, 2010; hooks, 2010; Leicester, 2010). The WWW enables learners and teachers in each area by providing information for good reasoners to figure things out (Bowell; Levy, 2010). Critical thinking may be a key organizing concept for all educational reform (Bulach, Lunenburg, & Potter, 2012).

Constructivism

Constructivism is another, somewhat related, trend in education that can play a dynamic role in the relationship between how teachers teach and how children learn. One foundational premise of constructivism is that children actively construct their knowledge, rather than simply absorbing ideas spoken to them by teachers (Fosnot, 2006; Phillips, 2000; Larochelle, 2010). For example, Jean Piaget (1970) proposed that children make sense in ways very different from adults, and that they learn through the process of trying to make things happen, trying to manipulate their environment. Theories like these, which assert that "people are not recorders of information, but builders of knowledge structures," have been grouped under the heading of constructivism (Pass, 2005; Wadsworth, 2004). Thus, students are ultimately responsible for

their own learning within a learning atmosphere in which teachers value student thinking, initiate lessons that foster cooperative learning, provide opportunities for students to be exposed to interdisciplinary curriculum, structure learning around primary concepts, and facilitate authentic assessment of student understanding.

In constructivist theory, it is assumed that learners have to construct their own knowledge—individually and collectively. Each learner has a repertoire of conceptions and skills with which she or he must construct knowledge to solve problems presented by the environment. The role of the teacher and other learners is to provide the setting, pose the challenges, and offer the support that will encourage cognitive construction (Chaille, 2008). Since students lack the experience of experts in the field, teachers bear a great responsibility for guiding student activity, modeling behavior, and providing examples that will transform student group discussions into meaningful communication about subject matter (Flynn, 2005).

Constructivism emphasizes the processes by which children create and develop their ideas. Applications lie in creating curricula that not only match but also challenge children's understanding, fostering further growth and development of the mind (Baltes, 2007; Kincheloe, 2006; Leitner, 2010). Furthermore, when children collaborate in cooperative learning groups, they share the process of constructing their ideas with others. This collective effort provides the opportunity for children to reflect on and elaborate not only their own ideas but also those of their peers as well. With the improvement and access to the WWW, the children's cooperative classroom becomes the world (Payne, 2010; Stewart, 2010). In this cooperative learning setting, children view their peers as resources rather than as competitors. A feeling of teamwork ensues. These processes have resulted in substantial advances in student learning (Bulach, Lunenburg, & Potter, 2012; Larochelle, 2010; Phillips, 2000).

Constructivism is serving as the basis for many of the current reforms in several subject matter disciplines. The National Council of Teachers of Mathematics (NCTM) has published its document, *Curriculum and Evaluation Standards for School Mathematics*, which calls for mathematics classrooms where problem solving, concept development, and the construction of learner-generated solutions and algorithms are stressed rather than drill and practice on correct procedures and facts to get "the right" answer. The National Committee on Science Education Standards and Assessment similarly has issued its document, *National Science Education Standards* which calls for science education reform based on experimentation and learner-generated inquiry, investigations, hypotheses, and models. The National Council of Teachers of English (NCTE) has called for emergent literacy as an important thrust in language arts reform. Interdisciplinary curricula is the theme of social studies reform being advocated by the National Council of Social Studies.

Principles of Constructivist Pedagogy

Jacqueline Brooks and Martin Brooks provide a detailed description of constructivist classroom practice and its theoretical underpinnings in their book, *In Search for Understanding: The Case for Constructivist Classrooms* (2005). They provide five principles of constructivist pedagogy: (a) posing problems of emerging relevance to learners; (b) structuring learning around "big ideas" or primary concepts; (c) seeking and valuing students' points of view; (d) adapting curriculum to address students' suppositions; and (e) assessing student learning in the context of teaching.

Principle 1: Posing problems of emerging relevance to students. Relevance does not have to be pre-existing for the student. Not all students come to the classroom interested in learning. Relevance can emerge through teacher mediation.

Principle 2: Structuring learning around primary concepts. When designing curriculum, constructivist teachers organize information around conceptual clusters of problems, questions, and discrepant situations, because students are most engaged when problems and ideas are presented holistically rather than in separate, isolated parts. Much of traditional education breaks wholes into parts and then focuses separately on each part. But many students are unable to build concepts and skills from parts to wholes.

Principle 3: Seeking and valuing students' points of view. Students' points of view are avenues into their reasoning. Awareness of students' points of view help teachers challenge students, making school experiences both contextual and meaningful. Teachers who operate without awareness of their students' points of view often doom students to dull, irrelevant experiences, and even failure.

Principle 4: Adapting curriculum to address students' suppositions. Teacher mediation is a key factor in adapting curriculum to address students' suppositions. The teacher can abstract student learning or help build their own bridges from present understandings to new, more complex understandings. If suppositions are not explicitly addressed, most students will find lessons devoid of meaning, regardless of how charismatic the teacher or attractive the materials used. While it is the teacher who structures the opportunity, it is the students' own reflective abstractions that create the new understanding.

Principle 5: Assessing student learning in the context of teaching. Multiple-choice, norm-referenced tests are structured to determine whether students know information related to a particular body of knowledge. The overarching question posed by such activities is: What do you know?" Authentic assessment focuses on analytical thinking and performance, whereas norm-referenced, standardized tests focus on low-level rote skills.

Becoming a Constructivist Teacher

Brooks and Brooks (2005) provide the following set of descriptors of constructivist' teaching behaviors, which they feel teachers can use to experiment with the approach. The set of descriptors describes teachers as facilitators of learning and empowerers of students to construct their own understandings of content, not simply as providers of information and managers of behavior.

Constructivist teachers encourage and accept student autonomy and initiative. Autonomy and initiative cause students' pursuit of connections among concepts. Students who formulate questions and then go on to answer and analyze them are taking responsibility for their own learning and become problem solvers as well as problem finders.

Constructivist teachers use raw data and primary sources, along with manipulatives and interactive and physical materials. In the constructivist approach to teaching, learning becomes the result of research related to real problems. For example, students can be assigned to read historical accounts of the effects of social policies of the early 1980's on the economic profile of the African-American population in America. Or students can be taught to read the census reports and encouraged to generate their own inferences about social policies. The latter approach allows students to construct their own understandings of the issues.

When framing tasks, constructivist teachers use cognitive terminology such as "classify", "analyze", "predict", and "create". Formulating tasks around cognitive activities such as analysis, interpretation, classification, and prediction, and explicitly using those terms with students, fosters the construction of new understandings about content.

Constructivist teachers allow student responses to drive lessons, shift instructional strategies, and alter content. This does not mean that students' interest or lack of interest in a topic determines whether the topic is taught or that whole sections of the curriculum will be eliminated. It does mean that constructivist teachers will capitalize on "teachable moments" throughout the school year. These are moments when the students' interest, knowledge, and enthusiasm intersect and transcend a particular lesson. For example, the Persian Gulf War may have provoked student initiated discussion during that time period.

Constructivist teachers inquire about students' understandings of concepts before sharing their own understandings of those concepts. When teachers share their ideas before students have an opportunity to formulate their own, students' examination of their own ideas is eliminated. In such environments, most students will stop thinking about the concept and wait for the teacher to provide the "correct answer". Consequently, students are prevented from constructing their own ideas and theories.

Constructivist teachers encourage students to engage in dialogue, both with the teacher and with one another. One way that students change or reinforce their ideas and theories is through social discourse. Students are empowered when they have an opportunity to present their own ideas and hear and reflect on the ideas of others. This process helps students construct new understandings or reflect on their existing ones. According to Robert Slavin (2009), student-to-student dialogue is the foundation upon which cooperative learning is based.

Constructivist teachers encourage students' inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other. Complex, thoughtful questions, that have more than one response, challenge students to delve into issues deeply and broadly and to form their own understandings of events and phenomena.

Constructivist teachers seek elaboration of students' initial response. Students' initial responses about issues are not necessarily their final thoughts, nor their best thoughts on a topic. Through elaboration of students' initial responses, they frequently reconceptualize and assess their own errors and, in the process, construct their own understandings of issues, concepts, and theories.

Constructivist teachers engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion. Cognitive growth occurs when an individual reformulates a current perspective. Students at all levels formulate and refine ideas about phenomena and then tenaciously hold onto these ideas as eternal truths. Even when confronted with authoritative evidence that challenge their views, students generally adhere to their original ideas. When teachers provide experiences that might engender contradictions, the framework for students' original ideas weaken, causing them to rethink their perspectives and formulate new understandings.

Constructivist teachers allow wait time after posing questions. In most classrooms, there are some students who are not prepared to respond to questions or other stimuli immediately. They require more time to process information. Teachers that require immediate responses prevent these students from thinking through theories and concepts thoroughly, forcing them to become spectators. These students learn quickly that there is no point in mentally engaging in teacher-posed questions.

Constructivist teachers provide time for students to construct relationships and create metaphors. Constructivist teachers structure and mediate classroom activities and provide the necessary time and materials for learning to occur, which causes students to construct patterns, relationships among concepts and theories for themselves. Constructivist teachers also encourage the use of metaphor as a way to facilitate learning. Metaphors help students to understand complex issues in a holistic way and to ruminate mentally with the parts of the whole to determine whether the metaphor works.

Constructivist teachers nurture students' natural curiosity through frequent use of the learning cycle model. The learning cycle model has been used in science education for some time (Buxton, 2011). The model describes curriculum development and instruction as a three-step cycle: discovery, concept introduction, and concept application. First, the teacher provides an open-ended opportunity for students to interact with purposefully selected materials. This step is designed to generate student questions and hypotheses from working with the materials (discovery). Next, the teacher provides lessons aimed at focusing the students' questions, providing related and new vocabulary, framing with students their laboratory experiences, and such (concept introduction). Finally, students engage in one or more interactions of the discovery-concept introduction sequence. Students work on new problems with the potential for evoking a reflective, new look at the concepts studied previously (concept application).

The aforementioned descriptors of constructivist teaching highlight practices that help students to construct their own understandings of challenging subject matter content. These descriptors can serve as guidelines for interpreting what it means to become a constructivist teacher. For specific examples of how to implement each of the descriptors, see Brooks and Brooks (2005).

Conclusion

NAEP data suggest that student outcomes in American education are a little better–and in some cases worse–than they were 30 years ago. Moreover, students in some other advanced, technological countries consistently outperform American students on international tests in science and mathematics. The ultimate goal of the No Child Left Behind legislation is that all students will demonstrate competency over challenging subject matter in the core subject areas—reading, mathematics, science, and social studies—and learn to use their minds well, so they are prepared for responsible citizenship, further learning, and productive employment in our Nation's economy. Critical thinking and constructivism offer real promise for improving the achievement of all students in the core subject areas.

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