Using Technology to Teach for High Test Scores and Understanding

A Brief Summary of Practice and Research

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This white paper provides an overview of how technology can assist educators meet the challenges of preparing schools and students to take high-stakes tests and learn for understanding. Following the introduction, the paper presents a review of the relation between technology, high-stakes testing, classroom teaching, standards, and learning for understanding. Examples illustrate how teachers can apply various technologies to enrich learning environments and prepare students to use their knowledge to achieve both on standards tests and life’s challenges.

Introduction

“No Child Left Behind” (Department of Education, 2002) has been called the most significant education innovation in 35 years. All children will be tested every year in grades 3 through 8. Schools will be held accountable with real consequences tied to funding and to accreditation. School systems must provide research-based curricula and fully qualified teachers to teach all students in all subjects. In addition, all 50 states have implemented standards-based reforms, to some degree, that include rigorous criteria and severe consequences for failure for schools, teachers, principals, and communities. The pressure is definitely increasing for all educators to improve student achievement.

Given this pressure to perform, teachers often choose to teach to the test because that is where the rubber of performance hits the road of accountability (Education Week 2001). The improvement in test scores, however, is often minimal because students’ understanding of the learning objectives is shallow and not sustainable through the high-stakes testing period.

In contrast, teachers whose students do well on standards tests and whose students also appear to learn for understanding plan instruction to include two elements:

1. A strong information base that is the foundation of their students’ understanding, and;
2. Disciplinary conceptual frameworks so students can relate and use their information in ways that reflect understanding.

Successful teachers are performing a delicate tight rope act strung between depth and coverage. Teaching for understanding requires time devoted to digging deeply into a subject along with much discussion and review (Resnick & Klopfer 1989).

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On the other hand, coverage requires moving rapidly over many topics. We are suggesting that technology can serve as a kind of stabilizing bar for teachers to balance standards with curriculum coverage and understanding.

Technology, such as the standards-based instructional resources within bigchalk’s Integrated Classroom, can help teachers meet the demands of these new times. Technology, as evidenced in Integrated Classroom, supports teachers in correlating their classroom teaching with local, state, and national curricula to ensure that all the required material is covered. In addition, technology can help teachers identify teaching materials and activities that are consistent with classroom goals and district and state mandates. Technology can help teachers plan, deliver, and verify that students have covered and mastered the instructional objectives essential for high achievement.

Most importantly, technology can open the classroom to the world. Students can learn from the best materials that the best minds have produced on virtually all topics. Multimedia presentations can engage students by showing how battles were fought, how experiments were conducted, and how authors presented their own works. Interactive programs can teach students the effects of science experiments and provide students with practice and feedback.
Standards and Understanding

There is a clear danger that understanding will be the stepchild of the standards movement. Teachers certainly recognize the need for depth. According to one survey (Education Week 2001), 70% of teachers report there is insufficient time to cover everything on state standards. And, nearly as many teachers report that instruction concentrates too much on what is tested to the detriment of other important topics.

The problem is that most of the changes made as a result of the standards reform movement are far removed from the classroom. Committees of politically connected citizens, politicians, and business leaders usually devise standards. Tests to measure students’ achievement on the standards are generally contracted to consultants that prepare tests as a business.

Teachers find themselves in a quandary trying on the one hand to cover everything but on the other hand to find the time to provide depth to students’ learning. How can teachers resolve this apparent contradiction between standards and understanding? One strategy is to make the standards an asset by connecting classroom curriculum with teaching that promotes understanding. This is a complex task that is, perhaps, classroom teachers’ greatest challenge and one uniquely suited to using advanced technologies in classrooms.

Education researcher and psychologist Lauren Resnick observed that regardless of the standards created or tests developed, if there are not significant changes in classroom practice coordinated with standards then there will be few meaningful differences in student achievement. Because standards are complex and extensive, even the most astute teachers may be overwhelmed trying to plan their teaching to cover all the criteria included in standards.

Nonetheless, political, business and education leaders continue the drumbeat for students who will pass tough standards exams and who can “think” and solve problems. The apparent inconsistency between education standards and general expectations of what it means to meet these standards creates a need for teaching practices that integrate understanding with standards criteria.

Standards and Tests

The general intent of standards is to raise the achievement levels of students by requiring them to meet rigorous criteria. While state tests are usually meant to assess student learning, only 40 states report that their tests are aligned with their standards in English at all testing levels; only 34 states report having aligned tests and standards in math. As a result, there may be mismatches between standards and testing and between curriculum and standards. In addition, Education Week (2001) reported that tests are more likely to measure less demanding learning outcomes such as facts rather than higher-level learning such as analysis and problem-solving applications.

Pressed to demonstrate their own successes and the successes of their schools and their students, teachers often choose to teach to the test because that is where they are most accountable. The consequence is the often-heard criticism of a curriculum that is a mile wide and inch deep (Schmidt, McKnight, and Raizen 1997).

Shallow curricula focus more on information and less on understanding. The goal of classroom instruction becomes covering the material that is frequently so extensive that no topic can be developed to the extent that students build real understanding. Thus, in the classroom there is conflict between superficial but extensive coverage and intense study but less coverage. Coverage appears to win most of the time.

Teachers, whose students do well on standardized tests and appear to learn for understanding, plan instruction to develop a foundation for their students’ to comprehend knowledge. They also develop disciplinary conceptual frameworks so students can relate and use their information in ways that reflect understanding. In effect, teachers need to constantly balance depth and coverage. Teaching
for understanding requires large blocks of time devoted to a specific subject along with much discussion and review. While coverage requires the teacher to present many topics in a short period of time, technology can provide the equilibrium between standards and curriculum and understanding.

Teaching For Understanding and Coverage

So, what is understanding? Grant Wiggins says, “Understanding is not just about coverage of knowledge…but about uncoverage – being introduced to new ideas and being asked to think more deeply and more carefully about facts, ideas, experiences, and theories, previously encountered and learned (Wiggins 1998, 85).” This view of understanding requires complex integration of facts, information, knowledge, and applications. Learners must be able to use their understandings accurately and creatively not only with familiar problems but also with new problems. Recent research and theory by Wiggins have provided a relatively clear picture of what happens in classrooms where students learn to understand.

Educators, psychologists, and neural scientists are especially interested in the programs and methods that result in students learning how they can remember and use their knowledge – commonly called learning for understanding. Over the past eight to ten years scientists, teachers, and behavioral investigators have synthesized research and practice to create principles that explain and promote the development of “the intellectual tools and learning strategies needed to acquire the knowledge that allows people to think productively...(Bransford 2000, 5)”

The core belief of this approach to teaching is that learners construct their knowledge from their experiences with the world. This perspective generates many implications for how we understand learning and what is effective for teaching learners to understand.

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Psychologist John Bransford and his colleagues have analyzed the evidence on how people learn and have abstracted these data into three strongly supported findings:

Preconceptions Influence All Learning

The first finding is that students come to school with well-formed ideas about how the world works. Called preconceptions, these existing ideas are central to constructing new learning and can be very resistant to change. There is consistent evidence that humans begin learning right from birth and that even very young children construct ideas about their worlds from their observations and experiences. These preconceptions have a powerful and enduring impact on the new information students learn and how they will remember and use new knowledge.

One challenge for this approach to teaching is to use these preconceptions as the foundation for helping learners expand or modify their existing understandings. Another challenge is to correct existing misconceptions. Misconceptions cannot be ignored because students’ existing understandings are much more likely to be remembered despite being incorrect. New information inconsistent with these misconceptions is likely to be learned superficially, recalled for tests, and then forgotten.

About bigchalk Integrated Classroom

bigchalk Integrated Classroom is a subscription service to K-12 schools that provides easy access to relevant, expert-selected supplemental content. Resources for classroom instruction include full-text articles, lesson plans, web links, and media clips and images—all searchable by grade, subject, textbook, or state standard. Integrated Classroom is designed to save teachers time and reduce information overload by taking the guesswork out of lesson planning.
Understanding Comes From Knowing Facts and Principles

The second finding from research is that understanding evolves from a combination of learning factual information and general principles. Learning factual information is essential because without facts students have nothing to understand. However, isolated facts are difficult to learn and unlikely to be recalled. Teaching should be oriented to developing conceptual frameworks with which students organize facts into knowledge in their memories much like a well-organized file cabinet makes facts easy to retrieve. When knowledge is well organized, it is more accessible and more accurately used. Conceptual organization also facilitates applying knowledge in different situations and on novel problems, a process usually called transfer.

Teachers guide students to master essential information and to develop conceptual frameworks to understand how facts and principles relate. One challenge for teachers is to recognize common misconceptions and help students navigate the journey from incorrect existing or missing knowledge to accurate understanding.

Metacognition is Essential for Understanding

The third research finding is that it is essential for students to be aware of and to control their thinking. This awareness is called metacognition and implies that students know what thinking processes they are using, that they are purposely choosing these thinking processes and that they are regularly monitoring the quality and results of their thinking. In other words, students are in control of their mental processes when they learn and when they do and do not comprehend.

Learning is a combination of external and internal events. Understanding is most likely when students are cognitively “managing” the interaction between what they know and what they are learning. Because learning begins with learners’ existing conceptions, growth comes from changing those existing beliefs.

Teaching focuses on creating classroom conditions that stimulate learners to examine and challenge their existing beliefs as they study and observe new information. Teachers help students learn to monitor their understanding by using cognitive skills such as reflection and summarizing. In this way, students master the material and the thinking strategies needed to understand.

Findings

These three findings summarize the premise that human learning is a complex interaction between existing understandings and new knowledge. Changing beliefs is often difficult because our inclination is to “fit” new ideas into existing conceptual frameworks. Information, whether observed or presented by a teacher, which does not fit an existing framework is usually relegated to the dustbin of memory as either irrelevant or incorrect.

Successful modification of existing beliefs comes from discovering that a current belief is inadequate to explain new information or as a result of a purposeful quest to expand or to challenge an existing framework. While teachers can devise these events for students, it is essential for students to engage personally in order to modify their existing beliefs. Students who are aware of their thinking strategies and who are open to new ideas are much more likely to understand accurately. Teachers have the challenge of presenting new knowledge in a carefully crafted context that stimulates students to examine their beliefs and revise their thinking based on new facts and an expanded conceptual framework.
Characteristics of Effective Teaching Drawn from Research-based Findings

Characteristics of Effective Teaching

1. **Learner Centered** - Focuses on Students’ Existing Knowledge
2. **Interesting** - Involves Students’ Beliefs and Lives
3. **Real Life Oriented** - Provides Authentic Opportunities to Practice and Demonstrate Learning
4. **Social** - Involves Others in Learning and Practicing
5. **Active** - Engages Learners to Think and to Learn Actively
6. **Time** - Provides Time to Study In-depth as well as Gain Breadth of Knowledge
7. **Feedback** - Informs Students Regularly and Consistently About Their Achievements
8. **Supportive** - Leads and Guides Students as They Learn

Teaching involves assessing individual students’ preconceptions and misconceptions and then devising learning activities that stimulate students to examine their existing knowledge. Teachers carefully and purposefully select materials and classroom learning activities that are consistent with students’ knowledge and developmental abilities. Planning, delivering, and evaluating such a classroom is demanding, to say the least. While the content is important, teaching is equally concerned with students’ intellectual strategies and their development of learning strategies. In concert with understanding, teachers want students to learn to be life-long learners; that is, students learn how to learn. Ideally, learners regularly monitor their comprehension, question inconsistencies, and correct their facts and frameworks when they fail to comprehend.

Below we identify eight characteristics of effective teaching and several examples of how bigchalk Integrated Classroom can facilitate designing and developing classrooms into success oriented learning environments. While we present the characteristics separately, successful classrooms would include all the characteristics in all lessons all the time. An individual characteristic may be more or less evident in any lesson, but the culture of the learning environment of the classroom would regularly include all the qualities described.

The examples are vignettes drawn from classrooms in which teachers have adopted this approach and designed their instruction from a focus on student outcomes. Our purpose is to demonstrate how these teachers have used Integrated Classroom to help them make their classrooms consistent with the characteristics of successful classrooms. The goal of Integrated Classroom is to provide teachers with access to ideas for teaching, to easily relate what is taught to state and professional organization standards, and to support finding and using web-based resources with students.

**LEARNER CENTERED**: Teachers pay attention to the “knowledge, skills, attitudes, beliefs…(Bransford, Brown, & Cocking 2000, 133)” and cultures that students bring to the classroom. Teaching topics and classroom language are oriented to students’ experiences so they can connect their outside of school lives and beliefs to classroom goals. Bransford, et. al used the analogy of teaching as a bridge from curriculum to students. He points out that learner-centered teachers keep an eye on both ends of the bridge. The main point is that learning begins with where students are intellectually and conceptually and then creates a path for them to follow as they examine and develop their knowledge.

Technology can help teachers in two important ways. First, technology can give teachers access to a library of teaching examples and suggestions that can be “tuned” to students’ needs and experiences and unique situations.

Second, technology can provide student materials that can model the formation of concepts and strategies as well as content knowledge and conceptual organizers. When students have many examples available they are more likely to consider alternatives and to build broader frameworks of meaning.
INTERESTING: Activating and maintaining students’ attention is essential for successful teaching. Only by attending to what they know is it possible for students to challenge their existing knowledge and develop expanded conceptual frameworks. Lessons begin with students’ current beliefs, which often become the focus of classroom lessons. Students are intrinsically intrigued to explore their understandings by logical and conceptual challenges through these beliefs.

Technology can contribute to identifying students’ preconceptions and to building projects that pursue new learning. Because identifying current understanding is central to teaching successfully, teachers need tools that will enhance their understanding of these beliefs. Technology-based demonstrations and illustrations can stimulate discussions in which these beliefs are expressed and tested. The wide range of available materials and topics provide opportunities for teachers to allow students to self-select materials that are developmentally and topically appropriate and personally interesting.

REAL LIFE: Genuine activities generate authentic understandings. Teaching incorporates students’ communities as a context for learning. Within the smaller school community, the culture and norms of the environment influence students’ motivation and goals. In the larger neighborhoods, towns, and national communities, learners are influenced by trends, fashions, events, and politics.

The challenge is to align these influences with classroom goals in ways that recognize their impact and encourage students to inform and expand their understandings. Teaching and testing is often referred to as “authentic.” This means that classroom learning is genuinely meaningful and that students demonstrate they have learned in ways that are consistent with how they have learned and how the new knowledge can be used.

SOCIAL: Ideas and understandings are interpersonal constructions that must be examined as part of the process of constructing understanding. By interacting with others to explain, defend, discuss, and assess their own ideas and to challenge, question, and comprehend the ideas of others, students gain confidence in their own understandings. Students learn by expressing their understandings to others.

Teachers incorporate group activities so students can express and develop their understandings with peers as they pursue projects. Learning is incremental and develops over time through conversations that stimulate students to examine and expand their understandings.

There are many clever applications that provide opportunities for students to express themselves in unique ways using networked technologies. One increasingly common strategy is to create online communities of students and educators who “work” together on specific problems.

ACTIVE: Learning involves two kinds of action. One is to gather and consider information. The other is to monitor and choose cognitive actions that lead to understanding. The first consists of visible behaviors such as reading, writing, discussing, and searching. The thinking includes covert actions such as reflecting, considering, evaluating, and monitoring. Teachers are very concerned that students are not passive receivers.

Example: A Seventh Grade Teacher Plans Enrichment

A seventh grade history/social studies teacher plans to involve students beyond the textbook information in studying the Civil War. The teacher knows that local areas were involved in Civil War action and that student interests range from the daily lives of soldiers to how people lived who were not combatants. He plans for students to work in self-selected interest groups, plan a project, prepare a report, and present their findings to the rest of the class.

This teacher needs to provide students with access to sufficient, relevant, current, and immediately available research materials. Using Integrated Classroom, the teacher checks resources connected to the Civil War chapter in the class text. Using an Integrated Classroom feature, bicMarks, that enables teachers to tag, save, and present pre-selected digital resources, he assembles the resources that are appropriate for his class. The teacher checks his state’s standards for Civil War to ensure that the enrichment study will also contribute to student successes on the state’s standards tests.

As he reviews these standards, he also examines resources correlated with the standards by Integrated Classroom. He collects these print and multimedia resources using bicMarks, thus, creating a rich, varied, and convenient resource for his students.
of information. Thus, lessons are structured to generate interaction between students and materials around inquiry and challenging questions.

Equally important is that students develop and use cognitive actions consistent with good thinking and metacognitive actions through which they monitor what and how they have learned. Teachers encourage students to examine their work regularly, propose alternatives, consider options, pose competing explanations, and ask students to explain their thinking. From this approach students learn that understanding comes not only from acquiring information but also from how they think about their knowledge.

Interactivity is an especially attractive feature of networked technologies to promote learning. Interactivity promotes dialog between students and allows for students to reconsider and revise the propositions they present.

**TIME:** Understanding takes time. Time is needed to learn facts but also needed to consider, assess, revise, and develop ideas. Everyone recognizes that understanding takes time and carefully planned experiences to expose students to the breadth and depth of topics. While it is impossible to study all topics in-depth, some topics must receive intense and extensive study.

Teachers generally seek two overarching outcomes from in-depth study. First, students should master the material such that they have well organized and widely linked concepts. This allows them to recall and use their knowledge quickly and appropriately in unfamiliar situations. Second, students learn what Greeno (1991) calls the “learning landscape.” That is, students learn the important questions and cognitive strategies that characterize the disciplines they are studying. They master the intellectual skills that will enable them to be self-directed, life-long learners.

Technology cannot create more classroom time; however, technologies can increase the efficiency and personalization of the time that is available. A key element of developing understanding is that each individual has opportunities to rethink and revise ideas. Technologies can facilitate these recursive processes in several ways.

First, technologies such as word processors and databases can be used to record thoughts and observations so that students can review them regularly and revise as needed. Teachers can embed this individual review in student self-directed routines guided by metacognitive questions such as: Why are you learning this? What do you already know that relates to this information? Why do you need to learn this information? How interested are you in learning this? How difficult will it be for you to learn? Are you checking your understanding as you study? How should you correct errors? Are there other ways you can study that may be better? These questions focus students to use their time well and to maximize success by selecting and applying the most effective learning strategies.

Second, understanding grows from repetition. Students master difficult concepts by studying them several times and in different ways. Technologies can be helpful to foster these recursive learning processes by providing the

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**Example: A Middle School Teacher Connects Classroom Learning with Community Life**

A middle school science teacher wants students to understand that science affects their everyday living. She decides to develop a collaborative relationship with the local wastewater treatment facility to involve students in “everyday science.” Water, she reasons, is taken for granted by students as available and safe without much recognition of the science needed to ensure its supply and quality. She plans to group students with a mentor at the plant and examine how topics they are studying are applied in real life.

Using a “backward design” strategy, she establishes clear expectations for her students by checking the state standards for eighth grade science and reviewing the National Science Education standards.

In Integrated Classroom, she reviews materials, media resources, and lesson plans from topics in the text used in her classroom. In collaboration with the wastewater facility mentors, she decides to investigate how units on motion, materials, electricity, and organic compounds are applied in real life. The teacher uses bicMarks to collect articles and media resources from each topic.

These resources will be shared with the facility mentors and be a focal point for students to prepare for visits with their mentors.
same information in different formats and for different situations.

Third, technologies can help use time more efficiently by giving students more control over their own work and by providing students with tools to organize their learning efforts. One strategy that saves considerable time is for students to use word processing to write and revise following an organized writing process. Another application that can help teachers use classroom time is tutoring programs that respond to specific needs of individual students.

**FEEDBACK**: Learning is a continual process of acquiring new information and reflecting on how the new information relates to existing conceptions. Students must have regular guidance that gives them information on what they are learning and how well. Feedback is a continuing stream of observations from which students can revise their thinking as they work on projects. Feedback is integrated authentically into projects to support and guide learning.

Because contextualized learning often addresses issues that do not have right or wrong answers, Wiggins (1998) suggests that standards provide general goals and that criteria indicate the extent to which goals must be met. Teachers monitor students’ development, model cognitive processes, and encourage students toward standards to reach established criteria. Learning becomes a journey that is constantly being adjusted as students individually and collectively pursue solving a problem or explaining observed phenomena. Computer-based software in nearly all disciplines offers students the opportunity to plug in data or observations and “see” the results of their efforts. This feedback is immediate and focused on the learning at hand. Feedback can be presented in graphs that illustrate the impact of the students’ propositions and by indicating if a “test” question has been answered correctly. Students can test their own understanding independently using a database to generate practice questions. Students can then use the results to manage their own learning by deciding if they have learned well enough or need additional study. Computer simulations can give students realistic problems to solve to judge how well they are able to use their knowledge and understanding.

**SUPPORTIVE**: Teachers lead students to become independent learners by creating instructional “scaffolds.” These scaffolds support students by providing just the right assistance at just the right time for learners to succeed. Scaffolding includes teaching strategies such as reducing the complexity of a task, limiting the steps needed to solve a problem, providing cues, identifying critical errors, and demonstrating how a task can be completed. Teachers are active participants in students’ learning because they understand their students’ needs and “walk” with them as they work to meet learning goals. The well-known Vygotsky concept of the “zone of proximal development” is the intellectual place where learners are ready to advance to a more accurate understanding but do not have the skills or knowledge to do so on their own. In this zone, learners can move more quickly and accurately when assisted with a push or nudge, a kind of intellectual “it’s time to get moving” statement. The role of teachers and others is to determine when

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**Example: A Sixth Grade Language Arts Teacher Plans Enrichment**

A sixth grade language arts teacher is planning an enrichment theme for a term. She generates ideas using the Integrated Classroom lesson plans to browse options associated with the curriculum and the standards she teaches. One topic she discovers is “listening,” a common problem with beginning middle school students in her experience. She decides to use listening as the enrichment theme she will integrate into all topics they study during the term.

This teacher needs resources to connect listening with the topics she will cover in the class. She begins by checking state and professional standards to see what is required/expected for mastery. Finding no expressed standards, she explores several sites to identify criteria she can use to judge students’ achievement as listeners. A first step she takes is to see what lesson plans are included in Integrated Classroom for teaching and evaluating listening by clicking the “best of web lesson plans” option. Here she collects in her bicMarks multimedia, print, and graphic resources for students to do independent work, classroom projects, and presentations on listening. In addition, she finds materials that are correlated to listening lessons outcomes that have been evaluated by educators and experts.

From these resources, she chooses the ones that will best illustrate principles of listening in her teaching. She can save and organize these resources using bicMarks for both herself and for her students.
students are ready for the nudge and then to provide the scaffold that will support them as they make progress. As learners develop the concept, the scaffolds are removed until learners are able to understand on their own.

Technologies like calculators, spreadsheets, graphing programs, and modeling programs can help students as they develop their understandings. Computer programs are available that serve as “mentors” to student “apprentices” as they develop their skills and knowledge.

## Conclusion

Effective teaching encourages students to actively seek understanding. The actions of teaching mirror the learning actions that students must engage in to build the factual foundation and conceptual frameworks essential to use knowledge in creative and problem solving situations. While there may be a struggle between standards-based expectations to cover much material and the need to study in-depth to achieve real understanding, teachers can manage this challenge. Teachers who relate standards to classroom curriculum and teaching strategies are likely to find that they can develop classroom programs that meet the needs of both depth and breadth of learning.

The bigchalk Integrated Classroom can assist teachers as they make decisions about what to teach, how, and when by using technology to relate standards to curriculum materials, to provide access to a rich array of resources, and to support individualized diagnostic and assessment processes. The resulting learning environments encourage students to construct their own learning and promote high achievement on standards tests and genuine understanding. The bigchalk Integrated Classroom is teacher-oriented technology that gives online support to classrooms so that students develop understanding and cover the material required to meet standards criteria.

## Reference/Reading List


