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Confidence-based assessment in Moodle: Insights from teachers, administrators, and programmers

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2010

ABSTRACT

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B.S., Northern Arizona University, 1992
M.A., University of Phoenix, 2005

Doctoral Study Submitted in Partial Fulfillment
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Doctor of Education
Teacher as Leader

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Critical thinking is a skill that school systems are trying to develop in their student populations. Numerous studies have been conducted on developing critical thinking skills such as self-regulation, interpretation, and analysis. However, available data on the use of learning management systems (LMS) as a means to develop critical-thinking skills have been opaque. This study examined the perceptions of local stakeholders and the impact of confidence-based assessment (CBA) on secondary students at one high school. The conceptual framework guiding the study represented a synthesis of theoretical perspectives on critical thinking and its development with the current research on the pedagogical foundations of LMS applications. This qualitative case study project was designed to understand the perceptions of teachers, administrators, and content developers regarding the viability of a LMS with CBA embedded to increase students' critical-thinking skills. The research question focused on the use of Moodle, an LMS option, modified to use CBA to measure, improve, and enhance critical thinking skills. Qualitative data from open-ended questionnaires and interviews were gathered from teachers, administrators, and content developers who had taken a CBA within Moodle, and then coded using typological analysis to explore the respondents' perspectives. Since compelling evidence was found that a cost-effective LMS with embedded CBA may provide a positive benefit to students, a project consisting of a detailed program implementation plan was proposed to the school district. If implemented, the program can be replicated by educational institutions, potentially contributing to social change by democratizing access to a testing methodology that increases students' background knowledge while measuring their critical thinking skills.

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SECTION 1: THE PROBLEM

Introduction

The ABC School District (ABCSD) in a southwestern state has 51,689 students and 3,167 teachers. It is the third largest school district in that state. The ABCSD demographics consist of high-achieving students from mostly affluent families. According to the ABCSD (2007) website, of the 25 measurements on the State Student Assessment Program, the students of the district had the highest scores in 21 of the 25 measurements. To maintain the high levels of accomplishment, the ABCSD has embarked on a path, based upon direction from the local board of education, to develop a guaranteed and viable curriculum (GVC) for all students in all subject areas. The starting point for the GVC is to identify essential learnings (ELs) for each content area that may serve as a guide for the ABCSD educators, so that all students, parents, and educators in the district will know and understand the ELs for each content area. Before ELs can be identified, a key set of objectives need to be defined.

Definition of the Problem

The local problem at the ABCSD is that there has been little investigation into an evaluation system that shows that students have met the defined outcomes in its GVC and have developed the ability to think critically. The problem with the development of critical thinkers relates to the questions that DuFour and Eaker (1998) raised in their ideals of school reform. They discussed ways in which positive change in schools should develop. When institutional changes are focused on student achievement, according to DuFour and Eaker, educators should ask the following questions: (a) What do we want

students to know? (b) How do we know that they know it? and (c) What do we do when they do not get it? These questions are at the heart of the GVC initiative at the ABCSD and are directly related to its end statements.

The ABCSD (2007) has submitted to the public a set of key end statements that each student in the school district will accomplish prior to graduation. The current focus of the local board of education is End Statement 1.1: "Students are able to think critically, using reason and logic when facing decisions about what to believe or do" (ABCSD, 2007, n.p.). This statement encompasses students' abilities assess and define the problem, identify alternatives, consider creative solutions, analyze and synthesize credible evidence, and develop and defend a well-reasoned position (ABCSD, 2007). These positions are the cornerstone of critical thinking.

When working on an assessment development team at a high school in the ABCSD, I was assigned to a group that was studying how to achieve the goals of the board of education while being challenged by the questions posed by DuFour and Eaker (1998). In addition, the group wondered how educators can move students to be effective critical thinkers who can develop well-reasoned positions on issues in class if the teachers do not know whether the students understand what Marzano (2004) described as background knowledge. When students do not understand the background of a subject, they are less likely to comprehend what they are being taught (Marzano, 2004). If students do not understand what they are being taught, they may struggle to think critically about a given subject. Educators must be able to assess students' abilities to think critically, identify students' knowledge, and discern what to do when students do

not master a subject. In order to meet the ABCSD's End Statement 1.1, teachers must be able to assess their students' background knowledge and critical-thinking abilities constantly and consistently, so that the students can move from passive learners to critical thinkers.

Guiding Question

How do teachers, administrators, and Moodle programmers/developers perceive the effectiveness of the use of the Moodle learning management system (LMS) in delivering confidence-based assessments (CBAs) designed to measure, improve, and enhance students' critical-thinking skills, as defined by the ABCSD in their GVC?

Rationale for Choosing the Problem

In the summer of 2006, while struggling with the aforementioned issues, a group of educators were exposed to a concept known as CBA as part of an online summer school program. The testing scheme of CBA evolved from the work of Leclercq and Bruno (1993), researchers who developed a double-matrix response format to evaluate not only learners' correctness in answers but also their confidence about the correctness of their answers. Researchers who have worked on the CBA system as individuals as well as collaborators with Leclercq and Bruno have included Fenna (2004) and Hunt (2003). Fenna and Hunt worked on projects dealing with evaluating learners' confidence in given answers. The researchers tried to develop a system that helps students to self-regulate and to think critically about their understanding of a topic. They developed systems to evaluate students' confidence in their answers.

If learners can identify their levels of confidence and correctness in answers, then they have achieved mastery of a topic. If, however, learners are confident but incorrect in their answers, then extending Leclercq and Bruno's (1993) findings, the learners are misinformed or have confidently held misinformation. Instructors must devote their resources to redirect student learning away from confidently held misinformation toward accurate information. To be accurate in their information, students must take a critical view of their own learning when deciding on their levels of confidence.

These early efforts were built upon the work of de Finetti (1965) and his concept of partial knowledge. He commented, "Partial knowledge exists…to detect it is necessary and feasible" (p. 109). Partial knowledge refers to the fact that, even though the learners may understand the information, they are not confident that their understanding about it is fully correct. Not having a full understanding of a subject inhibits students' abilities to assess a topic critically.

The dilemma for the early researchers was how to test for partial knowledge. Leclercq and Poumay (2006) suggested that a wave phenomenon existed in the research on confidence in the 1970s because of the "opacity of inoperability of many definitions, the absence of consensus on the main concepts, and the lack of valid and efficient instruments and methods high consequential validity, i.e. an important impact on learning" (p. 2). Researchers have not been able to agree about what impacts learning and what evaluation methods are the best to measure learning; in addition, technology has been a barrier to timely information about student learning. Early testing in CBA was done on optical scan markers, which were not as efficient as current technology.

Definitions of Terms

ABC School District (ABCSD): I am employed by this school district.

Certainty-based marking: This type of marking is a variation of CBA used by Gardner-Medwin and Curtin (2007) at University College London. Students are asked to answer a question and then provide a corresponding mark regarding their level of certainty.

Colorado Student Assessment Program: The program is the state-mandated evaluation for students in Grades 3 to 10 in Colorado's public schools (ABCSD, 2007).

Confidence-based assessment (CBA): CBA is a method of evaluation and assessment that asks the learner to answer a question for correctness as well as confidence. CBA is being used to train teachers in Belgium, premedical students in England, and secondary students in Colorado (Florian, 2008).

Degrees of certainty: Degrees of certainty refers to a variation of CBA used by Leclercq at the University of Liege. Students are asked to rank their degrees of certitude in increments of 20. The scale progresses as 0%, 20%, 40%, 60%, 80%, and 100% certain (Leclercq & Poumay, 2006).

Information-referenced testing (IRT): IRT is an earlier version of the CBA used by Bruno prior to changing to CBA (Leclercq & Bruno, 1993).

Learning management system (LMS): LMS can be used to manage the content of a single classroom or a major university. Files can be uploaded for student use, content can be added to give or enhance instruction, and online evaluations can be made. The

LMS is fast becoming a necessary tool in higher education and is filtering down to the secondary education setting.

Moodle: Moodle is a modular-object-oriented-dynamic-learning environment. This is one variety of an LMS available in an open source format. It also is a method of moving slowly around an environment (Cole & Foster, 2008).

Professional learning community (PLC): In a PLC, a group of colleagues work together to make their workplace better or more productive (DuFour & Eaker, 1998).

Significance of the Problem

Given the need for such objectives, the ABCSD developed end statements to guide all instruction in the district. The end statements were developed to enhance the content standards adopted by the state of Colorado. The content standards guide what each student should know and be able to do at each grade level, whereas the end statements were developed to go beyond the minimum level of education and emphasize students' critical thinking. For students to excel beyond school, they must become critical thinkers.

The first area to be addressed by the district as a whole was End Statement 1.0: "[ABCSD] students acquire the knowledge and abilities to be responsible citizens who contribute to our society" (ABCSD, 2007 p. 1). Administration and staff efforts to achieve this directive were focused on developing students' skills so that they could think critically about their learning. Learners had to be able to identify alternatives, consider creative solutions, analyze and synthesize credible evidence, develop and defend well-reasoned positions, draw justifiable conclusions, and self-evaluate their learning. The

purpose of this initial qualitative case study project was to obtain data from teachers, administrators, and developers who had evaluated a sample CBA assessment to inform the decision of the ABCSD to acquire an LMS to help meet the goal of assessment within the GVC. Future analysis may compare the baseline data to student achievement using common assessments created using CBA to evaluate the GVC.

The ABCSD's end statements, which drove the GVC, evolved from recommendations (Partnership for 21st-Century Skills, 2005) into a published set of statements of the goals that the district tried to achieve. The report examined the current state of the education system in the United States for skills and assessment practices to determine the readiness of American students for the 21st-century education and workforce environments. The Partnership for 21st-Century Skills recommended the following changes for educational leaders and institutions:

- The concept of *Global Awareness* acknowledges that students need a deeper understanding of the thinking, motivations, and actions of different cultures and countries in order to successfully navigate and respond to communities and workplaces extending beyond their neighborhoods.
- The concept of *Civic Engagement* recognizes that students need to understand, analyze, and participate in government and in community, both globally and locally, in order to shape the circumstances that impact their daily lives.
- The concept of *Financial, Economic and Business Literacy* responds to the growing demand on people to understand business processes, entrepreneurial spirit, and the economic forces that drive today's economy.
- The concept of *Learning Skills* acknowledges the need for students to think critically, analyze information, comprehend new ideas, communicate, collaborate, solve problems, and make decisions, while ICT *Literacy* (Information Computer Technology) recognizes that technology is essential to realizing these learning skills in today's knowledge economy. (pp. 4-5)

The Partnership for 21st-Century Skills (2005) also recognized that, even though standardized testing plays a fundamental role in the American education system, other

forms of evaluation and assessment are needed to keep pace with an evolving, globally interactive population. The learners of the future will have a mindset that allows them to grow in an ever-changing learning environment (Dweck, 2009). These findings represented the underpinnings of the ABCSD's key end statements. On September 4, 2007, the ABCSD approved these statements, which were adapted from the work of the Partnership for 21st-Century Skills. The district leaders then began to formulate a path for district staff and students to meet the end statements. The first task that the district attempted to address was critical thinking.

Review of the Literature

"Give back what you have learned. Share your experience" (Deng, 1992, p. 286). Even the ancient sages of Tao in 300 B.C.E. knew that, although one could teach the meaning of life several times over, it would remain covert. It is only when information is internalized that it becomes real. However, information cannot be held in forever; rather, it must be experienced, and old assumptions must be challenged if one's understanding of fundamental knowledge is to evolve (Deng, 1992). This is the fundamental nature of critical thinking.

This literature review was designed to show a knowledge base acquisition of critical-thinking theory, critical-thinking research, the role of background knowledge, an assessment of critical thinking, and the impact of critical thinking on the knowledge society, followed by a discussion on content management systems (CMSs). The ABCSD sought a system that would help to guarantee that students met the outcomes in its GVC and developed the ability to become critical thinkers. I conducted an extensive search

using electronic databases such as EBSCO, ERIC, and ProQuest, as well as online and conventional library searches to obtain information for this project. An overriding theme emerged in the preparation of this literature review. The current U.S. education system needs to change to remain competitive in a global economy. The reason for changing how and why a society learns was encapsulated by Hargreaves and Shirley (2008). They discussed the need for educational institutions to change how they educate students, arguing that students need to learn the skills of a "learning economy" to remain competitive in a global marketplace (p. 137). In this emerging global society and marketplace, success will be measured by how one acquires knowledge and how one thinks about this new knowledge. The societies that prosper in this knowledge culture will develop metacognitive skills to assess the new information that is emerging at increasing rates. If the method of education does not evolve to meet this challenge, societies will be left behind in the global social order and the global economy.

To meet the needs outlined by Hargreaves and Shirley (2008), groups such as the Partnership for 21st-Century Skills (2005) have arisen to provide guidance to institutions such as the ABCSD, which has taken a progressive and proactive approach to meeting the needs of the next generation, which are so vastly different from those of their parents. Students who are responsible citizens and who can contribute to society must be able to assess new knowledge critically. They must be critical thinkers.

To develop a strategy to address all aspects of the problem facing the ABCSD, scholars who proposed solutions to the issue of how one thinks about knowledge and engages that knowledge for the purpose of critical thinking and inquiry was discussed.

The problem has been narrowed to the development of a methodology to deliver an assessment process for the guaranteed curriculum, whereby students are confident in their background knowledge in a subject and can apply that knowledge to think critically about a topic. In addition, a tool is needed to link all of the components that the ABCSD asks of its educators. This tool needs to be an instrument that uses technology on par with what students use in their everyday lives and can be modified to fit the needs of teachers, schools, and the school district.

The review of the literature has four parts. Part 1 is a discussion of the necessity for and methodologies of critical thinking, examined through the works of theoretical scholars and research from peer-reviewed journals. Part 2 is an exploration of LMSs and their use in education. Part 3 is an investigation into how an assessment methodology, combined with an LMS, can be used to develop and track the critical-thinking skills and abilities of students. Part 4 looks at how a blended learning environment can move learning and critical thinking beyond the traditional school day.

Critical Thinking: Theoretical and Conceptual Frameworks

The goal of teaching and assessing critical thinking has been at the forefront of education since, at least, the time of Socrates, who stated, “I cannot teach anybody anything. I can only make them think” (469-399 BCE). Indeed, the American Psychological Association (1990) employed experts to conduct Delphi, a project meant to examine what makes good critical thinkers and what educational systems should be promoted to encourage critical thinking. Included in the consensus statement from the project was the assertion that “critical thinking is purposeful, self-regulated judgment

which results in interpretation, analysis, evaluation and inference as well as explanation of the evidence, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (p. 3). In reviewing the literature, it became evident that, even though the words have changed, the basic definition of critical thinking has remained consistent.

In an ever-changing world and the availability of information on the Internet, teaching strategies for critical thinking need to change to meet the needs of students and educational institutions (Luckman, 2009). The critical-thinking model developed by Paul and Elder (2008) was fostered over many years and after a review of volumes of literature. The work was more specifically rooted in an adaptation of the work of Scriven and Paul (2003), who defined critical thinking as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action" (p. 2). This foundational work gave Paul and Elder a platform from which to develop models to assist educators in ways to teach critical thinking in almost any field of study. Their research also led them to identify gaps in students' perceptions of what critical thinking is and what it is not.

Paul and Elder's (2008) argued that the problem with thinking is that most of it is done with "biased, distorted, partial, uninformed or down-right prejudiced" information (p. 4). Paul and Elder stated, "Critical thinking is the art of analyzing and evaluating thinking with a view to improving it" (p. 4). When one has mastered critical thinking,

common traits emerge. The critical thinker raises vital questions, gathers and assesses relevant information, forms well-reasoned conclusions and solutions, is an open- minded thinker, and is an effective communicator (Paul & Elder, 2008). This process is developed by harnessing the elements of thought and applying them to intellectual standards to evaluate thinking about a subject or topic. The ability to think critically and use the traits described by Paul and Elder serves as an essential skill in a variety of environments. For example, in the health professions, specifically nursing, providers need the requisite skills to properly assess and care for patients. In business environments, professionals require analytical skills so that companies can maximize their earning potential during difficult economic conditions. If students at the secondary level can be taught to think critically, they will be better prepared for the challenges in the professional domains and in their personal lives that they face in the knowledge society (Hargreaves & Shirley, 2008).

The Delphi project provided a foundation for what makes critical thinkers. Current researchers have expanded those ideas into dispositions that have built upon that foundation. According to Paul and Elder (2008), the elements of thought are point of view, purpose, question at issue, information, interpretation and inference, concepts, assumptions, and implications and consequences. The elements of thought are used to evaluate one's thinking. The thinking can be about a paper, an activity, a reading assignment, or any topic that a learner is asked to evaluate. The elements of thought, when used as a part of everyday education, provide a foundation from which critical thinkers evolve.

Ennis (1985) described critical thinking as the "reflective and reasonable thinking that is focused on deciding what to believe or do" (p. 45). To achieve this type of thinking, one needs to practice reflective thinking, which is higher order thinking, but to attain higher order thinking remains elusive. To see what propels researchers to explore the skill of critical thinking, one can start with an analysis of Bloom's (1965) Taxonomy of Educational Objectives. Bloom's original work included three domains of educational objectives: affective, psychomotor, and cognitive. The cognitive domain has garnered the most attention in educational settings (Nancy, 2010). The cognitive domain is populated by objectives that move learners from lower order cognitive skills, such as knowledge, comprehension, and application, to higher order cognitive skills, such as analysis, synthesis, and evaluation. Ennis asserted that, although these objectives are an important part of critical thinking, they do not make up critical thinking. To be a critical thinker, one must be a reflective thinker.

To Ennis (1985), a reflective thinker uses such dispositions as open mindedness, situational awareness, and reflective reasoning. He suggested that, to be a critical thinker, one must have an orderly method to make decisions, solve problems, make inferences about a subject, seek bias in information, and be able to infer a conclusion. Using Bloom's (1956) foundations and Ennis's ideas about dispositions, educators have a foundation to teach critical thinking. However, Paul and Elder (2008), Ennis, and Bloom offered no agreed upon definition of critical thinking, nor did they offer suggestions for an easily administered and cost-effective method to assess critical thinking.

Researchers have worked to identify ways to assess and improve critical thinking. Peach, Mukherjee, and Hornyak (2007) struggled to assess critical thinking in general business courses. They noted that the capacity to measure students' abilities to solve unstructured problems such as financial ratio analysis was limited. They needed to understand what they wanted to measure and then find a tool to measure students' thinking. A universally agreed upon definition of critical thinking did not exist and a tool to measure it was elusive. To solve this problem, the faculty developed a rubric to assess critical thinking at the university and then beta tested it to determine whether it measured the desired traits. The following analytical model was developed by the faculty of West Florida College of Business to assess critical thinking in business courses (Peach et al., 2007):

> External environment
> 1. Dominant economic characteristics of the industry environment.
> 2. Competitive analysis–industry forces
> 3. Driving forces
> 4. Competitive position of major firms or strategic groups
> 5. Competitor analysis
> 6. Industry prospects
>
> Internal environment
> 1. Current situation
> 2. Strengths, weaknesses, opportunities, and threats (SWOT)
> 3. Competitive strength assessment
> 4. Strategic issues or challenges
>
> Action plan
> 1. List of possible alternatives
> 2. Recommendations
> 3. Implementation plan
> 4. Control and evaluation plan (p. 5)

When the model is examined closely, traits mentioned by Paul and Elder (2008), such as point of view (dominant economic characteristics of the industry); purpose (driving forces); question at issue (current situation); information (competitive strength assessment); interpretation and inference (strengths, weaknesses, opportunities and threats); concepts (strategic issues or challenges); assumptions (driving forces); and implications and consequences (list of possible alternatives and recommendations) can be identified in it. These traits can be used in education as well as in business in an information-based society.

Huitt (1998) noted that changing to an information society requires transforming how students are educated. According to Huitt, teaching critical thinking should take a greater role than teaching just to achieve scores on standardized tests. Huitt struggled, however with a definition of critical thinking. After examining critical-thinking research from cognitive psychology, Huitt found that the researchers who had studied critical thinking had formulated their own definitions. She cited the following examples: “the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments and solve problems”, behavioral psychology and philosophy the “intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action”, and specialists in content “a conscious and deliberate process which is used to interpret or evaluate information and experiences

with a set of reflective attitudes and abilities that guide thoughtful beliefs and actions", "involving analytical thinking for the purpose of evaluating what is read"(p. 4).

With these different yet similar interpretations, Huitt (1998) formed her own definition of critical thinking. She noted that, once the aforementioned descriptors are examined, one may be able to identify what critical thinking is, as well as what it is not. Huitt proposed that "critical thinking is the disciplined mental activity of evaluating arguments or propositions and making judgments that can guide the development of beliefs and taking action" (p. 3).

For the purposes of this study, critical thinking was viewed as a process that encompasses common traits, such as point of view, purpose, question at issue, information, interpretation and inference, concepts, assumptions, and implications and consequences (Paul & Elder, 2008). Using these common traits, teachers can then train students in critical thinking, as it is understood by Huitt (1998).

Research on Critical Thinking

This study of critical thinking started with an operational definition, moved to an explanation regarding how it is being used and how various disciplines measure it, and ended with the problems that gave rise to the current state of understandings of critical thinking. Ennis (1985), Huitt (1998), Paul and Elder (2008), and Peach et al. (2007) provided concepts and tools for classroom practices. Nosich (2005) provided some theoretical background and added to the work of Paul and Elder while grounding critical thinking in the daily language of educators and learners. Facione (2007) gave direction

for a school or a school district regarding the foundation needed for the successful integration of critical thinking.

In addition, scholars from business and nursing have offered peer-reviewed analysis and insights into how a variety of disciplines view critical thinking (Paul & Elder, 2008; Riddell, 2007). Finally, DuFour and Eaker (1998) and Marzano (2004) discussed ways in which education systems can use new knowledge to transform the workplace so that it can fully integrate critical thinking. The foundational understanding of critical thinking developed by these researchers is rooted in the work of the scholars discussed in the previous section.

Nursing educators have struggled with the concept of critical thinking and strategies to teach and assess it in a consistent manner. CBA may be used in nursing education to bridge the gap in the literature concerning teaching and assessing critical thinking. Riddell (2007) researched the assumptions held by nursing educators concerning teaching and assessing critical thinking at their institutions, arguing that past assumptions of critical thinking in nursing "has led us in many directions, and away from the process [critical thinking] itself" (p. 121). Riddell was not unsympathetic to the method of critical thinking; however, it was an attempt to challenge the assumptions that have guided much of the impetus for this type of assessment.

"If one is to think critically about critical thinking, it is necessary to first examine one's assumptions about the concept" (Riddell, 2007, p. 121). Stating that one is teaching critical thinking does not make it factual. Researchers who promote methods of critical thinking may only be engaging in "pseudo-critical thinking" (Riddell, 2007, p. 122).

Assumptions such as perception, reasoning, analysis, and problem solving are important; however, more information is needed to assess critical thinking. Riddell posited that critical questioning is the key to assessment of critical thinking. Critical questioning motivates learners to dig deep into their personal beliefs and challenges them to evaluate what they know or think they know about a subject.

Riddell (2007) discussed the history and various definitions of critical thinking, stating that it is difficult to "defend our assumptions that critical thinking can be learned and that critical thinking improves the quality of nursing practice, especially when there is virtually no consensus on a definition" (p. 121). The concept of reflective thought, as described by Dewey (1933), is the "active persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (p. 121). Riddell stated, "Dewey distinguished reflective thought as a sequential process that begins with some doubt or confusion. He stated that 'individuals must sustain the state of doubt because it is the stimulus to thorough inquiry and prevents jumping to conclusion'" (p. 123). For Riddell, critical thinking is synonymous with reflective thinking; however, this definition does not hold for others in the nursing field.

When Riddell (2007) interviewed her colleagues in undergraduate nursing education, she found that they had different definitions of critical thinking. For many of the faculty, critical thinking simply meant to "challenge assumptions" (Riddell, 2007, p. 123). Faculty also described critical thinking as "more than problem solving"; "not just accepting the status quo"; and "examining beliefs, values, and assumptions of what they

are" (as cited in Riddell, 2007, p. 123). Although themes emerged in Riddell's work, a working definition that her colleagues in nursing could agree upon was elusive.

Nursing schools are required to demonstrate that they teach critical-thinking skills for accreditation. The issue for Riddell (2007) was whether the national accreditation association requires that critical thinking be taught, but not that it be learned, and that there are no data to support that. Riddell concluded by questioning why nursing professionals engage in the effort of teaching critical thinking when the research on its effectiveness has been inconclusive. The efficacy of clinical decision making has been shown to increase only with clinical experience; therefore, the zeal with which critical thinking in nursing education has been taught needs to be reprioritized.

Nursing educators in Brazil have struggled with the accuracy of diagnoses given by nurses in the medical profession (Cruz, Pimenta, & Lunney, 2009). To address that challenge, the University of São Paulo, Brazil, instituted continuing education courses in nursing education that promoted critical thinking and clinical reasoning. The study was undertaken to determine the effectiveness of diagnosis accuracy in a pretest–posttest case study analysis.

From the literature, Cruz et al. (2009) gleaned three major factors that affected accuracy in diagnostic situations: level of education, use of teaching aids, and cognitive abilities and strategies. They also discussed Lunney's (2001) assertion that basic thinking abilities have the strongest correlation to the examination of patient data and correct diagnosis outcomes. With these data in mind, courses were developed that infused critical thinking as the focus for the students. "The course focused on helping nurses develop the

7 cognitive skills and 10 habits of mind that were considered important for nursing practice and experts" (Rubenfeld & Scheffer, 2006, n.p.). These skills included habits of mind, contextual perseverance and flexibility, and perspective and confidence development.

In the evaluation, each participant was given two case studies to complete in 30 minutes. The students were given 16 hours of instruction during the next 4 days and then reattempted the two case studies from before the instruction. The results showed a significantly higher mean for most participants' scores based on the rubric developed and validated by Lunney (2001). In their discussion of the results, the researchers sought to understand why some of the students did not show a significant increase. Overconfidence, which can lead to errors in thinking and accuracy in diagnosis, was listed as a possible contributing factor (Cruz et al., 2009). Cruz et al. concluded that, although the study was a statistical success, perhaps a higher rate of accuracy could be achieve with increased confidence that may only develop within the capsule of time.

It is necessary for teachers and students to have critical-thinking skills in science education. In this field of study, teachers learn during their college careers critical-thinking skills through the design of their preservice and inservice teaching courses. The dominant skill set in primary science comprises algorithmic, lower order thinking skills (Barak, Ben-Chaim, & Zoller, 2007). Barak et al. examined teaching strategies that affected the critical-thinking skills of high school students in Grades 9 to 11 during 3 years at a school in Israel. The goal was to enhance higher order thinking skills and promote the critical-thinking skills of science students. Higher order thinking is "a non-

algorithmic, complex mode of thinking that often generates multiple solutions" (Barak et al., 2007, p. 355). In the study, the participants were taught critical, systemic, and creative thinking as learning strategies. The study concentrated on teachers who described themselves as currently teaching critical-thinking, including cognitive or thinking skills such as analysis, evaluation, and synthesis.

Barak et al.'s (2007) longitudinal 3-year case study was designed to evaluate the higher order thinking skills of science students. It followed a mixed methods approach within a pretest–posttest experimental design. During the quantitative portion of the study, the researchers studied three groups of students from a sample of 177. Group A was the experimental group of 57 students to whom critical-thinking methods were taught in science class. Group B comprised 41 science students who did not receive specific training in critical thinking. Group C was the control group of 79 students from nonscience courses in which no critical-thinking skills were specifically taught.

Barak et al. (2007) evaluated the students using the California Critical Thinking Disposition Inventory (CCTDI) and the California Critical-Thinking Skills Test (CCTST; Facione & Facione, 1992). These tests were created and evaluated to assess disposition and skills in critical thinking. Slight adjustments in both assessments were made when they were translated into Hebrew. During the study, the students in Group A showed a statistically significant difference in the mean score on both the CCTDI and the CCTST when compared to Groups B and C during the 1st year of the study, $F_{(2)}= 8.62$, $p < .01$. The results suggested a strong correlation when students were taught critical-thinking skills. The results also showed that the students increased their open-mindedness, self-

confidence, and maturity with respect to critical thinking during the evaluation period. The researchers then tried to ascertain the methods used to teach critical-thinking skills to ascertain a direct cause-and-effect relationship.

In the qualitative analysis portion of the study, Barak et al. (2007) found that two of the teachers who reported teaching critical-thinking skills in the class used similar methods. They commented, "For example, they both foster the 'making of connections' between what is learned in class and everyday life; they integrate inquiry-based learning, and present stimulating open-ended questions which encourage students to think" (p. 363). Both teachers taught more than facts and figures in their science courses, and they encouraged their students to connect their learning to the real world and develop multiple solutions to problems. Barak et al. concluded by advocating for more courses in teacher education programs on ways to develop critical-thinking skills among high school students. They stated, "The compelling empirical evidence shows that if one knowingly, persistently, and purposely teaches for promoting higher order thinking among his/her students, there are good chances for success" (p. 367).

Research on critical thinking has included a discussion on whether students have the skills to think critically or the disposition toward this type of thinking. In addition, Ya-Ting and Chou (2008) sought to determine whether a significant difference exists between students from the East, such as China, and students who were educated in the West. They asked, "What does it mean to be a critical thinker?" (p. 667). A good critical thinker has skills in the practice of analysis, evaluation, and self-regulation, but does this mean that a student with these skills has the disposition to think critically? The

researchers provided the analogy of a person who has the skills to drive an automobile, but does not have the disposition at a particular time. The development of assessments by Facione and Facione (1992) of the CCTST and the CCTDI to assess critical-thinking skills and disposition has offered researchers the opportunity to investigate the relationship between the two phenomena.

Ya-Ting and Chou (2008) concluded that students in the East are taught with an instructional emphasis on lectures and rote memorization. Conversely, the West provides opportunities for students to exercise their critical-thinking skills. This difference was noted to modify the way that students in the East are taught so that they may develop the disposition and the skills of critical thinkers. At issue, however, are the cultural differences in education. Ya-Ting and Chou described the dilemma as a "culturally based perspective on cognitive development, because dispositions are acquired in precisely the same way that learning is acquired" (p. 668). In the East, students are not taught to think outside of traditional education. They are not given the opportunity to practice the skills of critical thinkers and are not disposed to this method of thinking. Ya-Ting and Chou asserted that students in the East must be taught how to think critically.

Ya-Ting and Chou (2008) used asynchronous online discussions (AODs) to measure the relationship between critical-thinking skills and critical-thinking disposition. The study was set up as a pretest–posttest quasi-experimental design with a comparison group design. The students were selected from a general education course at a large university in Taiwan. A total of 273 students were selected to participate in the study; they were split into three groups. Group 1 was the control group. The students in this

group had no specific training in critical-thinking skills. Groups 2 and 3 received various levels of critical-thinking skills prior to engaging in AODs. Three online discussion groups were formed, and each group was asked five questions, with 2 weeks to compete each answer. The students were asked to identify good arguments and provide examples to support their positions. They also were asked to respond to their peers' posts and to write reflective paragraphs about what was discussed.

Ya-Ting and Chou (2008) concluded that there is a positive relationship between critical-thinking skills and critical-thinking disposition. The largest gains were in Group 3, whose members were trained in critical-thinking skills, provided examples to recognize good critical-thinking skills, and given feedback on their own attempts at critical thinking prior to the study period. The difference found in the study suggests that the students who had more training in the skills of critical thinking also had the highest change in their disposition toward thinking critically, as measured on the CCTST and the CCTDI.

Duke University was lacking a method to assess students' critical-thinking skills in biology courses. Bissell and Lemons (2006) polled science faculty and found that, even though 98% listed critical thinking as a primary goal of a college education, only 19% could define it, and only 9% reported the teaching of critical thinking in class. The guiding question for this study was "Why is it that so many faculty want their students to think critically but are hard-pressed to provide evidence that they understand critical thinking or that their students have learned to do it?" (Bissell & Lemons, 2006, p. 1). Bissell and Lemons identified two issues, namely, defining critical thinking and

measuring critical thinking. They first steeped themselves in the literature of critical thinking to discover that "generating a consensus definition is less important than simply choosing a definition that meets our needs" (p. 1). The Duke Biology faculty used the tried and true method of Bloom's taxonomy, concentrating on the areas of application, analysis, synthesis, and evaluation.

Once a definition that met the needs of the department members was identified, a method of assessment needed to be investigated. Bissell and Lemons (2006) evaluated past methods of assessment and rejected them in part. Instead, using Bloom's taxonomy as a point to start, they developed an assessment format to evaluate content as well a self-developed rubric to assess metacognition. A four-step assessment development process was initiated:

1. Write a question that measures content knowledge and critical thinking.
2. Document the content and critical-thinking skills needed to answer the question, and develop a scoring rubric to assess the question.
3. Validate the question with colleagues who are subject matter experts.
4. Administer the assessment to students and use the scoring guide to evaluate student performance. (p. 2)

The results of the study brought fourth new understandings from faculty and staff. Faculty found that the process resulted in assessments that evaluated mastery in contend and critical thinking and allowed them to "be explicit with students about the skills they need to develop in order to succeed in the course" (Bissell & Lemons, 2006, p. 2). Also revealed were student understandings of what is necessary for quality answers to critical-thinking questions. As the instructors provided exemplars and explained the rubrics, the students began to show increases in critical thinking ability and reported the transfer of

knowledge to other courses. The outcome was an increased use of this method of assessment in all introductory courses at Duke University

The reliability of data from critical-thinking assessments was explored in Pike's (2001) analysis of several instruments. Pike examined past data from the Waston-Glasser Critical Thinking Appraisal, the Cornell Critical Thinking Test, and the California Critical Thinking Skills Test to compare them to the Reasoning about Current Issues Test developed at the University of Missouri (RCIT). Pike also reviewed research from the National Center for Research on Evaluation, Standards, and Student Testing (CRESST) on which methods are working to evaluate students' ability to think critically.

The RCIT was developed as an alternative to traditional paper tests and assessments based on observation to evaluate critical thinking. It has enjoyed moderate success in its ability to measure student thinking. The results have confirmed other reports that experience is one of the best metrics to estimate student engagement in critical thinking. The CRESST has found that to think critically, one must have content knowledge, strategies to solve problems, metacognition, and self-efficacy. The tools that should be used are knowledge or concept maps to show relationships between content and reasoning, problem-solving strategies of scenarios that involve open-ended questioning, and self-regulation skills that promote metacognition.

Identifying and Developing Background Knowledge

Marzano (2004) outlined the need for education systems to provide structures that emphasize background knowledge. This is especially true in lower socioeconomic areas and areas with high numbers of English language learners. He argued that one acquires

background knowledge through two factors, "(1) our ability to process and store information, and (2) the number and frequency of our academically oriented experiences" (p. 4). Marzano also discussed research that supports the significance of background knowledge and what it means to education.

Marzano (2004) reported on the efforts of Community Consolidated School District 15 in Palatine, Illinois. To be sure that every student had the same background knowledge and vocabulary, District 15 implemented a program called Vocabulary for Increased Achievement, or VIA (Marzano, 2004). The VIA, which is used in Grades 2 through 6, consists of a program of regular evaluations of the selected vocabulary. This system was set up to ensure that each student was introduced to the same set of vocabulary. It took the decision out of the hands of individual teachers who may not have agreed about what terms students must know. Marzano's concern was not the methodology used by the district to develop students' background knowledge. At District 15 in Palatine, Illinois, Marzano's main concern was the assumption that a common background knowledge base existed. However, Marzano left out a method for staff input to develop a culture that values the knowledge base he advocated. To this end, the effectiveness of a PLC model was explored as a way to develop agreed upon background knowledge needed to develop critical thinkers. This will allow individual schools and districts to identify areas of importance that best meet their own needs related to critical thinking.

To continue, the ABCSD uses the PLC method to encourage collegial interaction on decisions involving site-specific curriculum innovations. To promote the development

of innovations as well as community norms around background knowledge, DuFour and Eaker (1998) discussed PLCs as a top-down and bottom-up approach to leadership as one way to transform education. They also commented on the need for collaboration in schools to achieve positive change. Administrators from the district office and at the site level have a role to play in PLCs. The mission and vision are critical roles that administrators play in a PLC (DuFour & Eaker, 1998). They suggested that PLCs should be guided by three questions: (a) What do we want students to know? (b) How do we know whether the students know it? and (c) What do we do when they do not get it? If these questions can be answered, then meaningful change can be accomplished in the educational setting.

DuFour and Eaker (1998) also stated that, if PLC work is to be meaningful, there needs to be a commitment of time and resources. The district needs to put collaborative time in the work schedule. They called this embedding change in the culture of an education system. The time could be whole days that individual PLCs meet, or it can be set time in the workday for staff to participate in PLCs. This leadership and commitment to collaborative work is essential to the success of PLCs.

As educational systems seek to meet the educational needs of the next generation of leaders, current methodologies in education must be challenged. Society needs to seek and embrace new ideas and methods of education so that students remain competitive in what Hargreaves and Shirley (2008) termed the “knowledge economy” (p. 137). In this learning economy, students will compete on a global economic level. Success in this economy is measured by new knowledge acquisition and manipulation.

The project sought to address how knowledge is acquired and determine what an education system can do to maintain a competitive edge in how students gain knowledge. What follows is an overview of the critical components that may expand the current understanding of the impact of systemic change in the delivery, acquisition, and assessment of knowledge on the education system.

Measurements of Critical Thinking

There are several methods by which critical thinking can be evaluated, including general critical thinking, content-specific critical thinking, and the use of assessments that attempt to evaluate metacognition. Brunt (2005) investigated several of the most prominent methods. Marzano (2004) developed a model on the dimensions of learning. Brunt considered the rubric developed in the Marzano model as a method to assess critical thinking, even though the term was not used by Marzano to describe the work. Marzano's dimensions of learning model is a five-step process of critical aspects that he suggested are essential to successful learning. The dimensions of learning model incorporates traits such as attitudes and perceptions, acquisition and integration of knowledge, extension and refinement of knowledge, ability to use knowledge meaningfully, and habits of mind.

For Marzano (2004), habits of mind is the highest dimension necessary for critical thinking. Marzano considered a critical thinker to be one who is accurate in thought, seeks clarity, is open minded, restrains impulsivity, and is self-regulated in his or her thinking. In addition, "One dimension in this model, using productive habits of mind, includes self-regulation, critical thinking, and creative thinking" (Marzano, 2004, p. 255).

Brunt (2005) argued that the dimensions of learning model might not be a reliable measure of critical thinking because the rubric does not clearly define critical thinking.

THINK was the next model examined by Brunt (2005). This model has been used to train preservice nurses with "the assumption that thinking, feeling, and doing are essential components of nursing expertise that work together with synergy" (Brunt, 2005, p. 256). Total recall, habits, inquiry, new ideas and creativity, and knowing how one thinks are the components of the THINK method of assessment. The assessment takes the learner through a process of assessing learning in gradually more complex levels of understanding. This system was refined by Brunt to address the skills of critical thinking more efficiently. The revisions included applying standards, seeking information, using logic reasoning, predicting, and transforming knowledge. This method identifies the process of critical thinking and provides a way to measure the process.

Although prior forms of assessment stressed moving the learner from general knowledge to a synthesis of information, the next critical-thinking model examined nursing curriculum as praxis. "Praxis is a form of action and reflection, which changes both the world and one's understanding of it" (Brunt, 2005, p. 256). Learners use the process of praxis as a method of reflective thought that combines situational information with action that can effect changes in previously held knowledge. This is a time- and labor-intensive process that involves educators and students in dialogue that transforms previous information into new knowledge and understanding of contextual information.

As the field of research has expanded, so, too, have the instruments to measure critical thinking. Brunt (2005) examined standardized assessments that are available

commercially. The Watson-Glaser Critical Thinking Appraisal (Watson & Glaser, 1952) measures inference, recognition of assumptions, deduction interpretation, and evaluation of arguments. This evaluation tool measures logic and creativity, but it is not specific to a discipline. It can be useful to gain a general understanding of how a student thinks; however, it is difficult to determine whether a student can think critically in a discipline such as nursing. The California Critical Thinking Dispositions Inventory (Facione & Facione, 1992) is an evaluation that measures a person's attitude toward thinking critically. Brunt considered this tool useful in a general sense, even though it does not address content-specific critical thinking. She suggested that critical-thinking tests should be more specific to a discipline such as nursing.

Although many of the assessments described by Brunt (2005) have been useful in measuring critical thinking in a general sense, current assessment tools lack content-specific testing. This was drawback for the current testing environment with respect to critical thinking. Brunt suggested that more research be done to determine the usefulness of critical-thinking tools for education and the nursing profession in particular. Training nurses to think critically is important to the care of patients. It is equally important in other disciplines such as business. The business college at the University of West Florida, Pensacola, Florida, for example, was directed by its accreditation agency to increase its assessment of critical thinking. Educational institutions go through a normal and regular process of accreditation to determine whether they are meeting the standards set by the accrediting agencies (Peach et al., 2007). Accreditation agencies recommend changes if

necessary. This process led the University of West Florida to develop outcomes and assessments in critical thinking.

The biggest problem facing the university was that "researchers have attempted to define critical thinking; there is no generally accepted instrument to assess critical thinking" (Peach et al., 2007, p. 313). After much discussion, the faculty and administration developed outcomes and a rubric. This rubric was piloted in 2005, redesigned after the first semester, and fully implemented in the spring semester of 2006 (Peach et al., 2007). In addition, Peach et al. stated that the overriding issue for critical thinking assessment is "assessment without corrective action is an empty gesture" (p. 314). As the process continues in the business college, outcomes and assessments are being refined, and strategies are being implemented to remediate when students do not meet the desired outcomes.

A review of the process at the University of West Florida resulted in several conclusions. First, according to Peach et al. (2007), was that performance levels were below expectations. Student scores were as follows: 28% exemplary, 62% acceptable, and 10% unacceptable. In addition, faculty reported that using the rubric took "significantly longer" to evaluate the students (Peach et al., 2007, p. 314); there were issues about interrater reliability among faculty; and students had difficulty applying the model of analytical thinking used in the assessment.

Once the analysis of the data for the 1st year was completed, a second round of critical-thinking assessment was initiated to assess students' "ability to identify problems, select and apply appropriate problem-solving techniques, and make appropriate

recommendations" as well as "integrate knowledge across business disciplines" (Peach et al., 2007, p. 315). The second iteration of the assessment and rubric proved more successful with respect to student achievement. Student scores were as follows: 58% exemplary, 34% acceptable, and 8% unacceptable. With the increase in scores, it was concluded that no further modification of scores was needed. However, Peach et al. noted that "capturing critical thinking was more time-intensive then determining an overall grade" (p. 315).

Peach et al. (2007) concluded that institutions have little choice in participating in and keeping pace with current trends in assessment. They commented, "Assessment is challenging and assessment of critical thinking in our experience is one of the most difficult. Assessment likely will be a blessing for those who commit to it and view it as positive change" (p. 317). Institutions that do not embrace assessment modifications, or those that do not view critical-thinking assessment as a necessary component, will have a difficult time changing to a new reality in accreditation. An inquiry into the literature related to the project included an examination of various forms of assessments. Leclercq and Bruno (1993), in their discussion of the role of assessment in education organizations, showed how assessment has concentrated on summative evaluations and has ignored the more important formative evaluations.

Summative evaluations are the end-of-course or end-of-unit appraisals of learners' knowledge, but they do not tell evaluators much about students' knowledge of a subject or their levels of understanding of a given topic. Formative assessments are ongoing assessments that provide constant feedback to instructors, administrators, and

learners about the level of understanding that has been reached by the test takers. Leclercq and Bruno (1993) argued that information-referenced testing (IRT), an early form of confidence assessment, can be used in formative evaluations to provide confidence in the information that has been learned. Most students have a tendency to forget information that is not confidently held. The uses of CBA as a formative assessment suggests that the information gained will stay with the learners for longer periods. When learners can use and understand complex concepts, they are approaching the metacognitive level of understanding of a subject or a topic. Thus, they are thinking critically about a subject.

Leclercq and Poumay (2006), like Leclercq and Bruno (1993), discussed the nature of metacognitive understanding and its transformation over time. They suggested that it should be viewed in the context of student evaluation. Leclercq and Poumay defined metacognition as "observable judgments, analysis, and /or regulations effectuated by a learner on his/her own performances (learning processes or products)" (p. 2). They also advocated the concept that by using degrees of certainty, an iteration of IRT, learners can increase their metacognition of a subject.

The methodology used by Leclercq and Bruno (1993) asks the students to answer a question and add a degree of certainty to each answer. As discussed in the literature about CBA, Leclercq and Poumay (2006) argued in support of the need to train students in the use of any evaluation system. In this case, students are trained to answer questions and then provide feedback on the degree of certainty of their answers on a scale of 0%, 20%, 40%, 60%, 80%, and 100%. There is no 50% in this model by design, so the test

takers are forced to be on one side or the other of the confidence spectrum. In addition, once the students are finished with the evaluation, a dialogue starts between the learners and the educator about the students' answers. It always begins with the question, "Why?" Leclercq and Poumay trained students to self-regulate their thinking and to think critically about their learning. Leclercq and Poumay concluded that students can be trained in this type of testing; in past research, they had provided validation for this methodology on summative test scores.

Another form of confidence assessment reported by Fenna (2004) was published in a study of engineering students using a system called enhanced multiple-choice testing (EMCT). The system developed by Leclercq and Bruno (1993) is an MC test that introduces confidence into the testing process. In EMCT, students are penalized for guessing. Students are told at the start of the semester that they will be evaluated in a manner that will penalize guessing. Why is guessing problematic? A prime example can be found in the field of engineering, where guessing on project assessments can lead to costly mistakes. To minimize this factor in the school of engineering, an evaluation was developed to encourage confidence in correct answers. Fenna concluded that this form of testing is applicable to situations where there is a clear right or a clear wrong answer. In addition, a qualitative analysis of students reported that there is no other way to receive high scores on the evaluation than to learn the material. Being able to give an answer with confidence is the only way to demonstrate a clear understanding of the principles of engineering.

To continue, MC testing is a common method of evaluating students in education. Dibattista, Mitterer, and Gosse (2004) promoted MC testing as a learning and evaluation tool. The researchers argued that a well-constructed MC test can be used to evaluate information at elevated cognitive levels. The problem stated by Dibattista et al. is that the "MC format permits students to guess at answers even when they possess no knowledge at all of the topic being assessed" (p. 17). The immediate feedback assessment technique (IFAT) can address this problem.

The IFAT is a commercially available evaluation tool. It is similar to Scantrons in form; however, the IFAT includes the correct answer on the answer form. On a Scantron test, students mark the correct answer, but on the IFAT, students must choose the correct answer by scratching off an opaque waxy coating to reveal the answer. Dibattista et al. (2004) called this method an "answer-until-correct" (p. 18) design. In this method, students will remove the coating to reveal either a star for the correct answer or a blank for an incorrect answer. If an incorrect answer is given, the students must reassess their answer; thus, students are provided with immediate feedback on the assessment. The methodologies outlined by Dibattista et al. (2004) and Fenna (2004) have shown an increase in student achievement. Separately, they both have value in educating students. The missing piece from the research is how to synthesize these methods into an assessment and learning tool.

When learners answer questions in either evaluation system that is incorrect, the result is cognitive dissonance. Festinger (1957) described dissonance as a condition in which individuals are psychologically uncomfortable. Individuals try to avoid

dissonance, but if they cannot avoid dissonance, they will modify their behavior to reduce the level of dissonance. When students are confident but incorrect in their knowledge, they will seek to reduce the dissonance associated with this psychological condition. This is where educators can provide learners with the opportunity to modify their understanding of a subject on an evaluation. This may be an opportunity for learning to take place, and it can be effective if the learning is immediate.

The review of the literature on CBA did not expose any direct contradictions to the use of CBA to enhance student learning. Very few researchers have written about the topic. The issues that do surface around CBA are the time needed to train the teachers and students how to use the system, time involved in interpreting the results of the system, and the cost to implement a system that will train students for confidence and develop their metacognitive skills.

Critical Thinkers in a Knowledge Society

The education system needs to move forward with the development of critical thinkers who can perform in what Hargreaves (2003) described as a knowledge society. "A knowledge society is a learning society. Economic success and a culture of continuous innovation depend on the capacity of workers to keep learning themselves and from one another" (Hargreaves, 2003, p. 18). A school that has a critical-thinking focus is different from one that uses standardized test scores to measure progress. The education system must deemphasize standardized test scores as a measure of an effective institution and advance critical thinking instead as the measure of an effective school.

Developing students who can think critically within the framework of district-defined ELs becomes more difficult among a generation of students who know "when rewards and sanctions are attached to performance on tests become *less* intrinsically motivated to learn and less likely to engage in critical thinking" (Amrein & Berliner, 2003, p. 2). The challenge for educators is to move students from passive learners focused on standardized tests to students who routinely employ critical thinking in life. This transformation will be necessary for the entire generation that is currently being educated for the knowledge society.

Facione (2007) discussed what is necessary for critical thinking to take place. After a review of many sources, he asserted that cognitive skills are the foundation of critical thinking. Facione believed that the skills of "interpretation, analysis, evaluation, inference, explanation, and self-regulation" (p. 4) are the building blocks necessary for the development of critical thinkers. Paul and Elder (2008) looked at critical thinking as "self-directed, self-disciplined, self-monitored, and self-corrected thinking" (p. 2). Standards of excellence must be used in conjunction with communication and problem-solving skills to produce learners who can think critically. When the process of critical thinking is mastered, the skill will transcend the classroom.

Nosich (2005) described critical thinking as "metacognitive—it involves thinking about your thinking" (p. 3). To Nosich, critical thinking does not start until one begins to reflect on one's learning. Once individuals have studied a topic and understand the basics of the discipline, they begin to think within the topic. However, once students evaluate their own thoughts, beliefs, and ideas about a topic, they have started the process of

critical thinking. Nosich wanted learners to examine why they have arrived at a conclusion about a subject. For example, is the understanding of a topic clouded by a preconceived notion or previously learned misinformation? This level of thinking, that is, the metacognitive level, is the process of critical thinking (Nosich, 2005). To develop critical-thinking skills in students, educators must engage in a process by which the learners can begin to think critically. If one examines the skills described by scholars in the field (Facione, 2007; Nosich, 2005; Paul & Elder, 2008), a guide for the education system to developing critical thinkers begins to emerge.

Interpretation is described as a skill that involves the ability to comprehend the meaning of events, data, experiences, and rules; within those criteria are such proficiencies as clarification and categorization (Facione, 2007). Nosich (2005) described this skill as "asking questions within a field" (p. 90). It occurs when critical thinkers develop the skills that query the learners' understanding of the teacher based on his or her own thoughts or beliefs on a subject or a topic. Nosich described interpretation as processes that may be as overt as challenging an educator directly or making students think about currently held beliefs. This skill of interpretation was identified within the Partnership for 21st-Century Skills (2005) concept of learning skills. These traits also are the foundation of Hargreaves and Shirley's (2008) knowledge society in which students will live and work.

Evaluation is the ability to judge another's perceptions, judgments, and potency of logic of an opinion or belief. According to Facione (2007), people with this skill are capable of "judging if an argument's conclusion follows either with certainty or with a

high level of confidence from its premises" (p. 6). In addition, the ability to draw inferences is to identify and conclude from conjectures and theory as well as to reflect on information from evidence, beliefs, and concepts. These skills form the elements of critical thinking, which educators need to incorporate consistently into the curriculum.

Paul and Elder (2008) argued that the "highest order thinking" (p. 7) involves the ability to use critical-thinking tools to analyze and assess one's own thinking. If educators are supposed to develop students who can live and work in a society based on knowledge, as suggested by Hargreaves and Shirley (2008), then educators must develop these abilities within their own school communities. Paul and Elder wanted educators to emphasize the development of intellectual skills and traits to engage in reflective, high-skill level thinking.

When one uses the proficiencies outlined by Facione (2007), Nosich (2005), and Paul and Elder (2008) as a guide, the elements of critical thinking are designed to bring students from passive learners to learners who use a higher level of thinking, that is, a metacognitive level. Students who use the elements of critical thinking have the tools to become learners who think at the metacognitive level and who are actively involved in and controlling the process of thinking. Although it may seem a daunting task to guarantee the development of critical thinkers, it is the task nevertheless. How can a district or a practitioner in the district marshal the resources to tackle this task while overcoming teachers' feelings that this process is a significant addition to their workload? I believe that teaching critical thinking can be incorporated into the curriculum without

any significant addition to teachers' workload by using a research-based assessment tool to develop and measure critical thinking.

To become critical thinkers, students need to be confident about their knowledge. As Facione (2007) suggested, a set of skills such as clarification and categorization, or as Nosich (2005) described, background knowledge, the vocabulary of the discipline needs to serve as the cornerstone for critical thinking. A testing scheme known as IRT, or CBA, is one way to evaluate students' ability to categorize and clarify meaning in content by testing for the correctness of a response as well as the level of confidence or certainty in the response. This is a necessary component that Facione and others described as the cornerstone of critical thinking.

Content Management Systems

CMSs for educational purposes can assume a variety of forms. "In their most basic, CMSs give educators tools to create a course website and provide access control so only enrolled students can view it" (Cole & Foster, 2008, p. 1). A CMS provides the tools that educators can use to create a more dynamic learning environment. Tools common to most CMSs are the ability to upload and share material, forums and chats, and quizzes and test; a place to gather and review assignments; and record grades. Courses developed in LMSs are perceived as static and impersonal by some, but that is not always the case. How courses are developed and used by instructors provides for personal connections in online courses using LMSs (Hye-Jung & Rha, 2009).There are commercial off-the-shelf (COTS) systems, the most common being BlackBoard and WebCT. Both systems offer the user the ability to design course and put content on the Internet for student use. As

with all COTS systems, when needs change for educational options, so, too, do the financial costs of the CMS. In addition, when the need for site-specific modifications and innovation arise, COTS offer modification; however, there is a cost involved with this process. There are alternatives to COTS systems, including but not limited to, Open Source CMS such as Joomla, XOOPS, and Moodle (Pan & Bonk, 2007). The CMS that I use is Moodle.

Moodle

There exist many LMSs for educational purposes. The LMS that I uses is Moodle. Reasons for using Moodle vary; however, the most compelling reason was that a teacher, a school, a school district, or an entire university can use and modify Moodle to meet its needs in a cost-effective manner. Moodle is an acronym for modular object-orientated dynamic learning environment. Dougiamas and Taylor created it in 2002 as part of a doctoral project. It is the engine that drives the form of confidence assessment that is by the ABCSD The philosophy behind Moodle's design is social constructivism, defined by Cole and Foster (2008) as the addition of social grouping to the constructivist theory of learning. Constructivist learning is the ability to gain meaning about a subject or a topic though the experiences of the learner and then produce a product so that a judgment can be made about the learning. Dougiamas (2009) provided the following example for social constructivism:

> A very simple example is an object like a cup. The object can be used for many things, but its shape does suggest some "knowledge" about carrying liquids. A more complex example is an online course - not only do the "shapes" of the software tools indicate certain things about the way online courses should work, but the activities and texts produced within the group as a whole will help shape how each person behaves within that group. (p. 1)

With the use Moodle as an LMS, active learning becomes the focus of all courses. Learning is then shown as an artifact or product for others to use to evaluate the level of competency gained on a unit or a topic. In addition, it is a system provided as an open source software LMS that can be modified to meet the needs of the users (Dougiamas & Taylor, 2002). Moodle's source code is licensed as an open source program through GNU General public license project (Bisson, 2007). The GNU project gives the user access to free copies of the software and all its updates, along with the source code and it modifications. It is technology neutral, meaning that it can be accessed by any computer platform (Coar, 2006). Moodle's capabilities are limited only by the user's imagination. Its ease of use, availability, and capacity for modification make Moodle embedded with CBA an optimal tool to be used by the ABCSD as a consistent, comprehensive assessment instrument that allows the district, administration, teachers, and students to evaluate progress ranging from background knowledge to critical thinking at the metacognitive level with the implementation of its GVC across the curriculum. To summarize, Moodle embedded with CBA is free for districts and teachers to download and use. The only costs associated with this system are server space, time to learn the system, and develop the course.

Moodle provides a platform for students to understand information relevant to a course or a topic. Moodle also offers a social experience that adds meaning to the content for any learner. As already mentioned, Moodle is an open source software CMS that can be modified to meet the needs of the users (Dougiamas & Taylor, 2002). Moodle's source code is licensed as an open source program through the GNU project, which allows the

user access to free copies of the software and all its updates, the source code, and it modifications. In addition, it is technology neutral, meaning that it can be accessed by any computer platform, including PC, Mac, or Linux (Coar, 2006). The ability to modify Moodle easily for use in CBA makes it a viable alternative to any COTS software available.

Implications of the Project

The implications of this project and its effect on the community of learners in the ABCSD (2007) are that CBA within a platform such as Moodle may increase student achievement in the school district at a cost that is affordable for the ABCSD. Until now, LMS has been available only to educational settings that can bear the cost of such a system. The intent of this project was to provide a unified LMS that tracks and assesses district measurements for proficiency and develops critical thinkers for the ABCSD.

In addition, the research showed that an LMS can be modified to use CBA. Once implemented in the ABCSD, there could be a positive effect on student achievement and critical thinking. The perceptions of the different levels of participants were positive toward the use of CBA to develop critical thinkers. The data gleaned from the qualitative research for this paper showed that the program should be expanded in planned phases and offered to all schools within the ABCSD at minimal cost. The process of implementation should be fully evaluated using an in-depth program evaluation to determine the effectiveness of measuring critical thinking using CBA across the ABCSD. The proposed implementation project could democratize the management of content, assess learners in a more effective way, and increase student achievement on a scale that

is greater than one school or one school district. Thus, the potential success of CBA has implications for social change, especially at the local level.

Review and Evaluation Plans

The project was deemed a success because of the new knowledge gained from this exercise. The project had a successful outcome because I was able to maintain ethical standards and guidelines established by Walden University. In the review of the project, ABC high school and the ABCSD community benefited from the knowledge gained, and institutions of higher learning may, in the future find value in the information gleaned from the findings.

Summary

The following section draws upon the review of the literature to guide the initial stage of the research for this project. The problem of developing critical thinkers is discussed by a variety of researchers. The question moving forward is whether a system can be developed to train and assess critical thinking in an affordable LMS. To examine CBA in Moodle, an initial qualitative study was conducted to determine whether Moodle, modified to assess using CBA, is a viable system to train and assess critical thinking. The responses from the three levels of participants were evaluated, and the results are presented in the next section. With the success of the initial qualitative study, a program for implementation was developed (see Appendix A) to implement CBA throughout the ABCSD.

SECTION 2: METHODOLOGY

Introduction

In this qualitative case study, I investigated the CBA tool embedded in the open source LMS Moodle being used by the ABCSD to evaluate critical thinking. To meet the goals of the GVC, an educational methodology for constant and consistent evaluation needs to be developed and assessed. I chose the case study design to explore the perceptions of education professionals and LMS programmers/developers on the viability of CBA in Moodle. The research design evolved logically from the problem in that there has been little research on the topic of CBA within an LMS. The design allowed me to explore the attitudes of stakeholders in my educational setting who can inform the production and development of new systems for evaluating critical thinking in secondary education. The primary form of data collected and analyzed were the responses to open-ended interview questions regarding the stakeholders' perceptions of critical thinking among secondary ABCSD students. The project used a qualitative case study design to determine the stakeholders' perceptions about the effectiveness of CBA in evaluating critical thinking among secondary students in the ABCSD.

Research Design

Creswell (2009), asserted that "qualitative research is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (p. 4). The project addressed the local issue of little investigation of CBA within Moodle as a means to appraise background knowledge and critical thinking, as well as determining stakeholders' perceptions of CBA's effectiveness in evaluating critical

thinking among ABCSD's secondary student population. In using the case study method, the study was limited to what Merriam and Associates (2002) described as a unique bounded unit of analysis, in this case, a Grade 9 CBA in the Moodle LMS platform.

The participant groups were broken down into three levels. Level 1 comprised teachers who used Moodle as part of their courses. Level 2 was comprised of administrators who made decisions regarding resource allocation to further the development and use of Moodle and CBA. Level 3 comprised LMS programmers/developers who allocated resources to the development of Moodle. The sample included 3 individuals from each level. I asked the individual participants to take an assessment using CBA in Moodle. Following this assessment, the stakeholder groups were interviewed and asked to evaluate their experience on the effectiveness of CBA as a tool to evaluate critical thinking. The most appropriate method by which to answer the guiding research question was to interview the stakeholders, a common qualitative research strategy. The teacher and administrator participants were from the ABCSD; the content developers/programmers were from the Moodle project. The qualitative data were collected from interviews with the participants in an effort to identify consistency in the themes that emerged. The qualitative methodology provided information that enabled the educational stakeholders, the ABCSD, as well as myself, to make conclusions about the viability and usefulness of the CBA system.

The other popular qualitative methods of ethnography and grounded theory were not chosen for this study because they lacked the effectiveness of the chosen method. Grounded theory is "derived inductively from data" and is "grounded in the data"

(Merriam & Associates, 2002, p. 9). Because theory was not being created, grounded theory was not appropriate for this study. An ethnographic approach was not warranted because this type of research seeks to understand attitudes and beliefs in human societies and cultures (Merriam & Associates, 2002), which was not the focus of the study. In addition, a phenomenological approach would not have been appropriate for this project because the nature of the study was bounded by the LMS, CBA, school, and school district, whereas a phenomenological study would have used reduction to drill down to specific statements and themes to gain meaning of a phenomenon.

The justification for the chosen methodology can be found in Merriam (1998), who described the case study method as one that "provides a thick description, is grounded, holistic and life like, simplifies data to be considered by the reader, illuminates meanings, and can communicate tacit knowledge" (p. 39). Case studies are encompassed by the activity undertaken, and they are bound by the time in which the event occurs. The case study method allowed me to conduct in-depth interviews to gain a clearer understanding of the process or event. The guiding research question was designed to follow the case study method by identifying and comparing the attitudes of the participants to gain a greater understanding of the use of CBA in Moodle by a variety of stakeholders.

Rationale

The ABCSD is searching for a testing methodology that guarantees the viability of its curriculum in a cost-effective manner. Moodle with CBA is being offered as one method to achieve this goal. The testing scheme for CBA is based, in part, on the

research of Leclercq and Bruno (1993), researchers who developed a double-matrix response format to evaluate, not only learners' correctness in answers, but also their confidence in the correctness of their answers. Researchers such as Gardner-Medwin and Curtin (2007), Hunt (2003), and Leclercq and Bruno have tried to develop a system that forces students to self-regulate and think critically about their understanding of a topic. What they developed was a system to evaluate students' confidence in their answers.

An effective approach to evaluate how the stakeholders perceived the effectiveness of the CBA as a critical-thinking assessment tool was for them to use the tool and then answer questions about their perceptions of its effectiveness. The project was deemed successful because the participants provided me with information on Moodle and CBA's usefulness as well as their tacit understanding of its use in an educational setting.

Participants and Access

The case study employed a stratified purposeful sample. Patton (2002) stated, "Purposeful sampling focuses on selecting information-rich cases whose study will illuminate the questions under study" (p. 230). This type of sample is designed "to illustrate characteristics of particular subgroups of interest; facilitate comparisons" (Patton, 2002, p. 244). The sample was comprised of 3 participants from each of the 3 stakeholder groups of teachers, administrators, and LMS content developers/programmers, all of whom were integral in the development and implementation of Moodle and CBA. The sample was stratified by type (teacher,

administrator, and LMS content developers/programmers) to gain information from each group using CBA and Moodle.

The process of data gathering and analysis began with the identification of the participants. The selection process used was a nonprobability, or convenience, sample (Hatch, 2009). The rationale for this selection process was based on the limited number of available potential participants who worked with Moodle and were familiar with CBA. The participants were stratified into three levels (teachers, administrators, and programmers/developers) for a total of 9 participants.

Level 1 participants were teachers chosen from the school I work at because they are currently familiar with the use of Moodle in their classes. These individuals were able to provide information on the addition of CBA to their current course structure. They were identified using the marker of "T" for teacher and a number such as T1 indicating Teacher 1. Administrators comprised the Level 2 participants, who came from the ranks of the ABCSD because they were tasked with driving the ongoing development of the GVC, specifically focusing on measuring critical-thinking skills. They were identified using the marker of "A" for administrator and a number such as A1, indicating Administrator 1. Moodle content developers/programmers comprised the Level 3 participants, all of whom were engaged in the Moodle project and were tasked with the development of the core .php code that allows CBA to fully operate in Moodle. They were identified using the marker of "P/D" for programmer/developer and a number such as P/D1, indicating Programmer or Developer 1.

I fostered a relationship with the Level 1 and Level 2 participants through my knowledge of ABCSD personnel. The Level 1 participants were selected from a population of 30 core teachers at my school. The specific criteria for selection required that these teachers were using Moodle in their classroom at the time of the study. The Level 2 participants were chosen from the ABCSD's 14 top-level school administrators. The selection criteria for administrators included having knowledge of LMSs and being in a position to effect change in education policy or practice related to the use of assessment methods such as CBA either at the secondary school or district level. To meet the selection criteria, the Level 2 participants needed to be versed in the development of assessments and have knowledge of educational practices with respect to assessments and familiarity with the use of Moodle.

To engage the Level 3 participants, I contacted the Moodle project via e-mail to seek input from the director of assessments to determine the number of programmers/developers engaged in modifying the system. To meet the selection criteria, these programmers/developers needed to be versed in the development of assessments and have knowledge of educational practices with respect to assessments. After contact was made, candidates were then selected to participate in the study. Initial contact with the participants commenced once I received Walden University's Institutional Review Board (IRB) approval (IRB approval #11-11-09-0331497).

Participants' Rights

Before beginning any data collection, I obtained permission to conduct the project from the director of assessment for the ABCSD. An explanation of the project, along with

its implications for student achievement, data to be collected, method of analysis, and significance of the study was provided to the director. I explained the nature of the study to the participants, reviewed the consent form (see Appendix B), and explained how their confidentiality would be maintained. The study began after final approval from Walden University's IRB was obtained. The participants were assigned pseudonyms to maintain their anonymity. All participants provided consent prior to participating in the project.

Data Collection and Preliminary Analysis Techniques

My role in this project was to select the participants, conduct the interviews, record the data, interpret the results of the data, and make recommendations for future use of CBA. Purposeful sampling (Patton, 2002) was used to select cases that provided information to generate data useful to the project. Data collection took place during the interview sessions. I made initial contact with all participants and gained their written consent to participate in the study. I made Contact with the Level 1 and Level 2 participants in person. Contact with the Level 3 participants were made via e-mail because they reside in Australia, Russia, and Afghanistan. All participants were given the same letter (see Appendix C) concerning their participation in the study.

Once first contact was established via e-mail with each sample group, I sent a follow-up e-mail describing the project and the procedures for taking an assessment using CBA. Once the participants took the assessment (see Appendix D), they were interviewed about their experience using CBA (see Appendix E) and the data were coded and analyzed to determine patterns or large discrepancies among the participants (see Appendix F).

Once the participants had read and understood the scoring mechanism, they took the CBA assessment, similar to one that a Grade 9 science student would take at any high school in ABCSD. All of the participants were encouraged to attempt the assessment three times. After this process, the participants were interviewed and asked to provide information about the viability of using CBA as a tool to train critical thinking among students in the ABCSD. The data collected from the assessment were evaluated for patterns or differences in how each level perceived the CBA assessment. The process of coding helped me to identify logical places to continue the understanding of the typology from which further research can be done.

Limitations

When looking at the design of the study, several limitations emerged. First, the ability to draw conclusions from the data was an issue. The participants' levels of familiarity with using an LMS and CBAs constituted a distinct limitation. A lack of understanding of how CBA scoring works in Moodle also was a limitation. Access to Moodle designers who resided in Australia was a concern. Transferability of findings to a larger population with respect to the use of CBA in training secondary students to think critically was an issue in this study. The limitations were minimized by the presentation of the uses and scoring method of CBA within an LMS to the participants.

At the time of this project, I was a teacher with a master's degree in curriculum and instruction who was employed by the ABCSD. I was in the process of fulfilling the requirements to obtain a doctorate in education. My qualifications included 15 years as an

educator in secondary education and 1 year as a faculty member in a university teacher education program.

Bias is an issue in any study, more so when I, as the researcher, am the primary agent for data collection. Generalizing the research findings in favor of the expected outcome was an issue. To provide evidence of quality and to assure the accuracy of the findings, I employed the methods suggested by Merriam (1998), namely, member checking, by asking the participants to comment on their contributions to the project; peer examination, by having colleagues comment on the collected and analyzed data; and self-reflection, by identifying my role as the researcher to disclose any potential bias.

Interviews

The purpose of conducting interviews, according to Hatch (2002), is "to uncover the meaning and structures that participants use to organize their experiences and make sense of their worlds" (p. 91). Each interview question was designed to determine the teachers, administrators, and CBA programmer/developers' opinions about the effectiveness of using the Moodle LMS in delivering CBA to improve and enhance students' critical-thinking skills. The interview process for this project also sought to understand the experiences of the participants in using CBA.

Once identified, the participants were sent a letter of consent, an explanation of the CBA process, and a link to the CBA quiz. The teachers and administrators returned the consent forms and took the assessment within 1 week of initial contact. However, the programmers/developers proved a more elusive group. Initial contact with the lead programmer working on the Moodle assessment engine was successful. I was given the

contact information for other individuals who were working on assessment modifications. I was successful in contacting them, but getting them to complete the required paperwork, take the CBA quiz, and answer the interview questions proved an insurmountable task. As a result, an advertisement was placed on the Moodle website to solicit participants who had experience modifying Moodle at the core code level. This initiative generated more participants who were able to complete the requirements of the study.

After the participants selected for the study had taken the CBA quiz, I arranged an interview with each of them. The Level 1 and Level 2 participants were interviewed at ABC high school. Each interview lasted between 30 and 45 minutes. The Level 3 participants were much more difficult to identify as well as interview. The search for Level 3 participants was widened from the initial group of Moodle programmers or developers because only one person responded to the invitation to participate in the study. After placing an advertisement on the Moodle job board seeking programmers or developers to participate in this research project, I did have several people respond. Once their credentials were verified, namely, that they had to be programmers actively using and modifying the Moodle code, I had the participants take the CBA quiz. Because these programmers or developers lived outside of the United States, I used the Internet to interview them. Initial and follow-up questions were sent via email to all Level 3 participants.

One hour was allotted for each interview. All of the participants were asked nine questions based upon their knowledge and experience from taking the CBA quiz. The

process of data collection began with the interview process. The interviews were transcribed and analyzed using Hatch's (2002) typological approach. Each level of participant response was separated using different colored ink on the transcribed paper. For teachers, blue ink was used; administrators, green ink and programmers/developers, by red ink.

Interview Data Collection and Analysis

During each interview, I documented the responses and followed up with probing questions to gain a deeper understanding of the data. I then recorded the data. Because the guiding question was narrow, a typological analysis of the data, as suggested by Hatch (2002), was used in the interview phase of the project. The nine questions were designed to help the stakeholders understand the local problem that there has been little investigation into an evaluation system to show that students have met the defined outcomes of the ABCSD in its GVC and have developed the ability to think critically. If students do not understand what they are being taught, they may struggle to think critically about a given subject. Educators must be able to assess students' ability to think critically, identify students' knowledge, and discern what to do when the students do not master a subject.

The postinterview coding process used typological analysis, as proposed by Hatch (2002). The typological analytical approach helped me to understand the viability of an assessment that asks learners to think critically. This method was the most appropriate because the project was limited to what Hatch described as "a fairly narrow set of research questions" (p. 152). In addition, questions that sought to understand the

perspectives of the participants regarding the viability of CBA to answer the singular guiding research question were used in the interviews.

Hatch's (2002) typological analysis approach was used to identify topics used in the study. During the interviews, five typologies presented themselves: confidence, evaluation, knowledge, feedback, and usefulness. These topics provided data from the interviews about the participants' perceptions. Once typologies were identified, the document was reread while keeping each typology in mind as it was read. Each typology was highlighted in a different color for usefulness. I then read the color-coded entries by typology and record the main ideas in entries on a summary sheet for each respondent. In addition, each time an identified topic presented itself from the interview transcript, it was noted it on the summary sheet.

The patterns for this phase of the study emerged once coding of the interview data was completed. These patterns identified similarities within and among the groups. For example, all participants found this type of assessment very useful to assess students and train them as critical thinkers, whereas the typology of evaluation showed that the Level 1 and Level 3 participants had a stronger bias toward the ability of students to use evaluative thinking using CBA. Conversely, the responses from the Level 2 participants did not show a strong correlation.

The data were then read according to the patterns identified, and notations were made and recorded to identify data that correlated with elements of the patterns. Data patterns were then coded and marked as to their place in the interview transcript for later reference. Each level of participant generated data suggesting that patterns were evident

in the responses to the interview questions. The patterns that related to the five typologies were coded and identified as data. The pattern data were then correlated to level and participant, respectively. Once this task was completed, I determined whether the patterns were supported by the data and then searched the data for nonexamples of the patterns, that is, where data not coded might have presented a pattern of their own. This stage solidified my assertion that the identified data were appropriate for inclusion in the study.

I then looked for relationships among the identified patterns. Once the data were color-coded and placed on separate sheets for analysis, a visual blueprint of the data emerged that helped me identify patterns with each participant as well as at each level. Then patterns were written as one-sentence generalizations that helped me to think about the relevance of the data. This process allowed me to generalize the data in terms of how the different levels of participants viewed the use of the Moodle LMS and the ability of CBA to train secondary students to think critically.

Finally, I used excerpts of the interviews to support the generalizations that were evident in the data. The quotes that follow were identified through the coding process and are included in this section to provide depth to the findings. The open-ended interview questions provided opportunities for the participants to provide rich answers. The participating teachers, administrators, and programmers or developers provided details from the interviews that are included in the following text.

Interview Question 1

Question 1 asked, “What is your understanding of CBA?” in an attempt to understand whether the participants had read and understood how CBA works and what

its benefits were reported to be, and whether after taking the assessment they could describe CBA in their own words. The Level 1 participants had a varied level of understanding based on their exposure to CBA understanding of CBA. The first teacher, T1, reported using CBA for more than 1 year with some success when asked this question. T2 and T3 had just been introduced to CBA through their involvement with this project. The Level 2 participants, all of whom were administrators, A1, A2, and A3, reported having a minimal understanding of CBA beyond what was introduced in this project. The Level 3 participants, all of whom were programmers, also had varied levels of understanding based upon their use of CBA. One participant, P/D1, reported having worked with Dr. Gardner-Medwin and being in the final stages of a Moodle core code upgrade to add CBA as an assessment option in a future release of the LMS; as a result P/D 1 was very familiar in his understanding of CBA. P/D2 and P/D3 had experience in modifying Moodle code, but they had not been exposed to CBA as an assessment tool.

Interview Question 2

Question 2 asked, "How would you describe the assessment within the Moodle LMS?" in an attempt to gather information about the assessment system. The Level 1 participants described the Moodle LMS as a user-friendly online system to enhance and engage students in learning. The Level 2 participants saw the Moodle LMS as a resource for teachers to better engage students and enhance their communication with students and parents. They also reported it as a user-friendly system. The Level 3 participants also reported that Moodle was an easy-to-use and easy-to-modify system for educators, students, and families to employ as a communication tool.

Interview Question 3

Question 3 asked, "How would you assess the usability of the LMS as it relates to CBA?" in an attempt to identify the perceptions of all participants with respect to its ease of use. The Level 1 participants stated that using CBA in Moodle was easy and the expectations were clear. They also reported that instant feedback and available use outside the school day made it more useful. The Level 2 individuals also commented on the ease of use in comparison to other COTS LMSs. They also commented on the instant feedback as well as the ability to tailor the assessment to meet the needs of a variety of subjects. The Level 3 participants found CBA easy to use, but because it differed from the one currently in development within Moodle, they found that they had to overcome a slight learning curve before they were comfortable with its use.

Interview Question 4

Question 4 asked, "Based on the description provided and your experience using CBA, how effective do you think the scoring matrix will be at improving student's ability to think critically?" in an effort to evaluate the scoring matrix as an explanation of the role of CBA in learning and identify its benefits. In addition, the question sought an identify whether the participants, after taking the assessment, could identify how the scoring matrix could make participants practice the traits of critical thinking such as self-regulation. Most Level 1 participants answered this question similarly. They noted that students would improve their "self-assessment," CBA would "require a student to dedicate a level of understanding of each question," and "they are evaluating their knowledge." The Level 2 individuals responded similarly to the Level 1 respondents. They thought that CBA would force students to self-assess when answering a question and that the instant feedback would force and reinforce the understanding of a concept. The Level 3 respondents reported low efficacy with respect to classroom teaching. Their primary duties were limited to programming computer code and modifying Moodle as needed for their clients. However, all of the participants reported that they thought CBA has the potential to promote critical thinking.

Interview Question 5

Question 5 asked, "Critical thinking is often thought of as evaluative thinking. With this in mind, did this tool accomplish the goal of evaluating your knowledge of the subject?" as one way to have the participants assess their critical thinking while using CBA. The Level 1 participants discussed the CBA experience in terms of understanding

how to take the assessment when they first started the quiz. Once started, they reported that they it was not like taking a traditional MC assessment. CBA forced them to think about each answer and if they really thought that it was correct. For one respondent, the process involved eternalizing the concepts, a crucial part of critical thinking. The Level 2 individuals had varying responses on this question. One respondent did not agree with the assertion that critical thinking was evaluative thinking, but did respond that CBA helped the respondents understand that they were thinking critically about the subject leaned. The others described the experience as one that increased their subject matter confidence as they completed more iterations of the assessment. The Level 3 respondents thought that CBA did meet the goal of making them think critically when they took the quiz.

Interview Question 6

Question 6 asked, "How useful do you think CBA will be in training and evaluating students' ability to think critically?" Inquires about to how this evaluation tool may be useful in training students to think critically as a part of their education. The Level 1 participants reported that CBA would be a useful tool to train students to think critically about a subject or a topic. The Level 2 participants described the ability of CBA to teach critical thinking in terms of one piece of a broader part of an instructional practice. Students need to have the opportunity to apply what they have learned and demonstrate it in other assessments. The Level 3 participants reported that they were too far removed from the everyday classroom to respond to this question.

Interview Question 7

Question 7 asked, "How familiar are you with the CBA assessment style and format?" Two of the Level 1 participants had no familiarity with CBA prior to this exercise, and one participant reported having used CBA in his class for about a year. The Level 2 participants reported very little exposure to CBA prior to this introduction. One of the Level 3 participants was very familiar with CBA. In the capacity as lead programmer for the Moodle quiz engine, this individual had been writing code to make CBA part of the core of the LMS. The other programmers/developers reported no familiarity with CBA.

Interview Question 8

Question 8 asked, "What broader applications do you see for the use of Moodle and CBA?" The Level 1 participants suggested broader applications for CBA's use in vocabulary acquisition, writing skills, and teacher evaluations. The Level 2 participants recommended broader applications for CBA such as adult training, use in medical training, human transportation fields (such as airline pilots), and formative assessments in teacher training. The Level 3 participants suggested that CBA use should be limited only by the intellectual sophistication of the user. It may not be applicable for primary grade students, for example.

Interview Question 9

Question 9 asked, "What modifications would you suggest to the CBA tool?" The Level 1 participants all did not think there was any modifications were necessary. The Level 2 participants were mixed in their response to this question. Two individuals stated

that they did not have enough information to make an informed decision on possible modifications, and 1 participant suggested that the CBA tool should be modernized to reflect the visual needs of the audience. Another suggestion was that younger users would like to see more colors, graphics, and "cool" buttons, whereas older users might like a more Internet-like feel to the CBA tool. The Level 3 participants were mixed in their responses. One participant was currently working on CBA's integration into the core of Moodle. The other 2 made suggestions about the grade output, noting that students should have a score that is easier to understand.

Findings

The problem addressed in Phase 1 of this study was to determine the extent to which a sample of teachers, administrators, and Moodle programmers/developers perceived the effectiveness of the use of the Moodle LMS in delivering CBAs designed to measure, improve, and enhance students' critical-thinking skills, as defined by the ABCSD in their GVC. This phase sought to provide relevant data to help the stakeholders of education in the ABCSD in their quest to have a system that assesses and trains students in critical thinking. The data were collected through open-ended interview questions. A discussion of the data follows, and the themes that emerged are identified.

As mentioned previously, the data were coded using Hatch's (2002) typological approach, a multistep process that evaluates the data from interviews and codes them by type. Once coded, the data were evaluated to find the major themes presented in the interviews. The themes that emerged in the coding process included the following: confidence, knowledge, evaluation, feedback, and usefulness. Although the concept of

critical thinking was detailed in the interview questions, most of the participants did not discuss it in their answers. The participants in the assessment were from various disciplines: 3 teachers and 3 administrators were from the ABCSD, and 3 programmers/developers, all of whom had experience in writing core code for the Moodle project, were from locations around the world.

Of the 9 participants, 7 had little or no experience or knowledge of CBA. The 2 participants who did have prior knowledge of CBA were a teacher and a Moodle programmer/developer. The teacher had been using CBA for more than 1 year in the classroom. One of the programmers/developers had been introduced to Dr. Gardner-Medwin previously and was implementing CBA in the core code of Moodle as an assessment option at the time of the study.

Themes

Theme 1: Confidence

Eight of 9 participants discussed how confidence played a part in the use of CBA, with most of them mentioning that CBA would help students to understand what they have learned. When asked if they thought that CBA accomplished the goal of evaluating their knowledge of a subject, several respondents answered using themes of confidence. Confidence was discussed in a variety of ways, including student confidence, testing for confidence, and having the ability to express one's confidence. A good example was Participant T3's comment that "thinking critically is a range of competency levels. Being able to apply what a student is learning is most important. CBA shows a student's confidence level within a subject."

Many participants discussed how CBA evaluated student confidence in a subject. They described how CBA tested knowledge along with confidence. When taking the science test, Participant T2 stated, "CBA offers the opportunity for students to express their level of confidence and their understanding." Participant A2 discussed how the tool helped to evaluate his or her learning:

> It [the CBA tool] made me go through each answer to evaluate if it matched up with the question asked. Some felt confident [about their answers], while others [were] not so sure. Being able to review [my answers provided] clarification on doubt for a stronger confidence score with latter attempts.

The dialogue of student confidence even included the topic of a lack of confidence. "If there is no confidence then a student hopefully is resourceful and inquisitive enough to [sic] finding the answer, to be confident" (Participant A2). Confidence, or lack thereof, can be used as a motivator to explore concepts and ideas. When someone is not confident about a topic and is asked to give his or her level of confidence, it causes the dissonance discussed previously. When a student is in a state of dissonance over an answer to a question, certain motivating factors, such as higher grades or greater understanding of a subject, may lead the student to study a subject harder to be able to answer with full confidence, thereby reducing or eliminating the cause of the dissonance.

The discussion on confidence echoed the findings of Leclercq and Bruno (1993) in that learners can use and understand complex concepts, they are approaching the metacognitive level of understanding of a subject. They are thinking critically about a subject. The experience of the participants was similar to the findings of Facione (2007) and Nosich (2005) in that when students evaluate their level of confidence on an

assessment, they are self-regulating their thought process. They may be confident in an answer, or not confident, which should move them to search for the answer to a question. When they engage in this search, they are thinking and reflecting on their learning and thought processes.

Theme 2: Knowledge

This theme was present in all of the interviews. The respondents at every level commented on how CBA helped the learners gain or reinforce knowledge. All 9 participants discussed knowledge and levels of understanding in their answers, for a total of 34 instances of this theme's occurrence in the interviews. Knowledge was described during the interviews in terms of effectiveness, ability to encourage students, and ability to help students assess their understanding of a topic.

The participants provided rich information. Participant T3 stated:

> I think that it would be very effective at improving students' ability to think critically. They have to reflect on their level of knowledge about the subject. By doing this they are evaluating their knowledge and may be more reflective about their level of knowledge.

Participant P/D3 stated, "They thought that CBA has great potential to encourage students to reflect on the extent of their knowledge" [of a subject]. In the interview with Participant A1, CBA and its usefulness in assessing knowledge moved from the ABCSD to a broader application of adult training:

> I believe that a CBA tool can be and should be applied anywhere knowledge is being assessed. Most importantly, it should be utilized in areas where life and death are factors in success: the medical field, human transportation, police, and fire departments come to mind first.

Participant A2 reinforced this, stating that CBA can be used in "training where we want someone to be confident in the information they learned then be able to apply that information." Many of the participants discussed the use of CBA and knowledge in general terms, such as testing one's knowledge, improving knowledge and thinking, and assessing students' knowledge and understanding of a subject. CBA's ability to assess knowledge aligns with Marzano's (2004) description of the need for educational systems to emphasize background knowledge.

When students reflect on their thinking, the process of critical thinking has begun (Nosich, 2005). This is the process that Hargreaves and Shirley (2008) indicated schools need to emphasize to master the knowledge society that students will be thrust into upon graduation from secondary school. Knowledge of a subject and the ability to evaluate the understanding of the subject critically will be necessary either in the workforce or at a postsecondary level of education. The participants' comments on knowledge reflected those from the research mentioned previously (Facione, 2007; Nosich, 2005), that is, to become critical thinkers, students need to be confident about their knowledge, and they need to be trained in the dispositions of critical thinking (Nosich 2005) so that they will be prepared to work and live in a knowledge society (Hargreaves & Shirley, 2008).

Theme 3: Usefulness

This theme also was popular among the participants' responses. The literature around critical thinking and assessment described usability as a defining feature of a good assessment system. Usefulness and usability also were discussed in terms of the Moodle LMS. When the data were analyzed, it was clear that all 9 participants had discussed the

usefulness of CBA in Moodle. The theme was mentioned 34 times, equal to that of the Knowledge theme. The participants discussed CBA in terms of its ease of use, user friendliness, and integration into the learning environment.

Participant T2 stated:

> I think it will be an extremely useful tool. CBA offers the opportunity for students to express their level of confidence in their understanding as well as the chance to instantly learn from their mistakes. I found it [CBA] to be user friendly, and I would assess the usability [of CBA] as very high.

Participant A3 discussed the theme by saying, "It will be useful because it provides tailored feedback for the student." Participant A1thought that CBA "should be utilized in areas where life and death are factors in success." This topic was of the utmost importance to me. Past attempts to make a CBA system useful and widely available have been elusive. Receiving positive feedback about usability validates this particular system of CBA. Participant T3 described CBA in Moodle as "effective at improving student's ability to think critically."

When discussing the Moodle LMS apart from the CBA quiz, Participant T2 said, "I found it [Moodle] easy to use and inviting to students. It does not seem overwhelming when you first login." The Moodle interface is designed by the Moodle project, and I select the style of the interface, I am not involved in the design of the system itself. Having an interface that is easy to use makes the experience better for the students, as discussed in the interview. "I would describe Moodle as a user-friendly interface system. I believe Moodle, or a similar platform, to by a key component of a successful CBA [system]" (Participant A1).

Usability was one of the factors that I found problematic with other forms of confidence testing. Technology has surpassed the previous methods of confidence testing and critical-thinking assessment (Florian, 2008). When Brunt (2005) evaluated methods of assessing critical thinking, he concluded the current methods are not user friendly and lack the ability to provide data to students or instructors in a timely manner. Dibattista et al. (2004) suggested that MC tests can evaluate students, but not at a metacognitive level. They suggested the IFAT as an alternative. However, the IFAT is a paper test that needs a teacher to grade and provide feedback. In addition, the original IRT assessments of Leclercq and Bruno (1993) used optical scan readers to individually score correctness and confidence, and the teacher had to compile the results. The system of CBA in Moodle would seem to address the previous issues of usability and usefulness when testing for confidence. It is a system that is user friendly and affordable for educational institutions.

Theme 4: Evaluation

Evaluation was combined with assessment after an initial appraisal of the data because the participants used the terms interchangeably. Some participants described the quiz as an assessment; others described it as an evaluation. The interview coding showed that 7 of the 9 participants discussed evaluation and assessment; it also was mentioned a total of 20 times during the interviews. Of interest to this topic is that using CBA as an evaluation tool was mentioned in the context of secondary education as well as in its uses beyond the classroom.

The participants described evaluation in the following terms: Participant T1 stated that CBA is a “great idea to help kids self-assess and take ownership of their own

education, which should give them more success the rest of their lives." Participant P/D2 stated, "I know that it [CBA] helps ascertain a student's background knowledge of a particular concept, which in turn helps one evaluate their confidence level within that topic or concept." Participant A1 gave an interesting answer when discussing the evaluative nature of CBA:

> I do not fundamentally believe critical thinking is evaluative or can be measured as evaluative of one's thinking. However, I believe the tool [CBA] helps an individual to understand that they were thinking critically about the subject they were learning.

Discussion of uses outside the classroom varied. Participant A2 stated, "It could be good for adult training" as a "formative method to assist teachers in methods of instructional design" and "it would be effective in hybrid online learning classes, evaluation of students, and evaluation of teacher" (Participant T1). The interview responses suggested that CBA has the ability to assess for more than just classroom knowledge at ABCSD. The participants saw value in the use of CBA to assess student knowledge as well as knowledge of the adult learner.

The aforementioned responses lent support for the need of new evaluation systems in educational systems. The Partnership for 21st-Century Skills (2005) recognized that other forms of evaluation and assessment are needed to keep pace with an evolving, globally interactive population. The participants in this study thought that although CBA can be a viable method of evaluation, it may not be viable in every testing situation. Participant 8 emphasized a lack of viability by describing a situation in which CBA may not be appropriate:

> CBA has great potential in many settings. I can only see two limits to its applicability. In some situations, it may distract from the main purpose of the assessment, in which case it should not be used. It requires a certain intellectual sophistication to understand the concept. For example, I would be surprised to see it used in primary schools.

It may be suggested that one could provide some push back on this notion that CBA cannot be used in primary school. With the ease of modifications of the Moodle LMS, CBA can be modified to an image rather than a word or number. Surely, a primary school student can differentiate a happy face from a sad or straight face, which can represent a level of confidence that is age appropriate. If the scope of evaluation is going to be pushed, then all possibilities should avail themselves to change. There may need to be a reconfiguration of how a CBA quiz is generated for younger students, but this is a concept that may warrant further research.

Theme 5: Feedback

The interview data suggested that feedback was essential in any of the assessment methods mentioned in this paper. Discussions of this theme ranged from feedback to the learner, feedback that reinforces student learning, and feedback tailored to specific learning needs. The respondents discussed how the feedback should be customized to the needs of the learner. In coding data, it was revealed that 6 of the 9 respondents discussed feedback, for a total of 13 instances.

Participant A2 discussed the layout of CBA and liked that it "gives quick feedback to the learner." Participant T2 indicated that he or she "liked the instant feedback, it is critical for student success" and that the feedback from CBA provided students with "the chance to instantly learn from their mistakes." Participant 6 described

the feedback in CBA as a "tool that supports and enhances student growth and learning." In a traditional assessment where answers are only correct and incorrect, individual feedback is dependent upon instructor input. The participants discuss the instant tailored feedback as vital to student success. Participant T3 summed up the general feeling around feedback with the statement, "I also liked the instant feedback. It is critical for student success." Participant T2 commented, "Instant feedback is so enlightening!"

Participant P/D2 was the only one to discuss feedback in terms of the scoring matrix. The scoring matrix was included in the data that the participants received prior to taking the test. The matrix describes how a CBA score is derived when test questions are answered for correctness and confidence. "The scoring matrix is a student's key to visually understanding how he or she is being successful" (Participant P/D2). It was also discussed in the interview that the matrix "gives students feedback in a way that forces the understanding of a concept" (Participant P/D2). Students are made aware of the matrix when they take a CBA quiz, and there is a persistent link to the matrix on every quiz so that it is possible for them to review how a score is calculated once they complete a quiz.

The ability to evaluate, give feedback, and reassess makes this type of assessment a valuable tool for any learning environment. Content specific feedback was discussed by Brunt (2005) previously in this paper. She looked at a variety of methods to assess students and found that feedback was an issue in most of the assessments. Students should be trained in the use of a CBA system (Gardner-Medwin & Curtin, 2007; Leclercq & Poumay, 2006). Because this type of assessment is new to students, they need to fully

understand how it functions and that negative marking is involved (Dibattista et al., 2004). Based upon the participants' perceptions, CBA in Moodle may address the feedback problem discussed in the literature.

Evidence of Quality

Evidence of quality from the interviews was necessary to provide confidence in the findings of the study. "All researchers aspire to produce valid and reliable knowledge in an ethical manner. And both producers and consumers of research want to be want to be assured that the findings of an investigation are to be believed and trusted" (Merriam & Associates, 2002 p. 22). The study relied upon interviews from various parties interested in the use of CBA within Moodle. Triangulation of the data from the interview questions was useful in developing the themes that were generated from the data.

Other evidence of quality in the study included member checking. When participants are allowed to review the transcripts of statements made in the interview they can comment on the accuracy of the data (Creswell, 2009). Member checking acts as another indicator of validity. After the data were collected from the interviews, they were transcribed and coded, and themes were identified. The transcripts were then sent via e-mail to the participants to review for their review to check the accuracy of the transcription and the themes that emerged from the analysis. The participants were asked to review the transcripts as well as the themes that resulted from the analysis as a check for accuracy. Once the responses from the participants were received, a follow-up discussion was initiated to talk about the accuracy of the findings. All of the participants reported that the findings were accurate and the themes were appropriate. The use of

member checking to ensure validity grounded the study by ensuring the truth and accuracy of the findings.

Summary

After an extensive review of the literature concerning critical thinking, LMS, and effective school change, it became clear to me that there was a need for a viable method of assessment and evaluation that is different from traditional sources. CBA, powered by Moodle, is a testing method embedded in an LMS that cannot only evaluate the background knowledge of a subject but also train students to think critically within that discipline.

When students are evaluated using CBA, they must be engaged in disciplined mental activity to answer questions for correctness as well as confidence. They must choose a point of view while judging their own beliefs, and they must then take action. If they are not correct in their answers, CBA will give them the opportunity to correct misinformation. As a result, students will achieve at a higher rate and retain information for longer periods. This should be the goal of any educational institution because it will better prepare learners for a society that will employ them in jobs that may not even exist today.

The evaluated data suggested that using CBA to train students to think critically was supported by all participants. When taking the sample quiz three or more times, the participants developed more confidence as they learned the material. New knowledge was transferred when the participants took the CBA quiz, and all of them reported knowing little of the material prior to taking the assessment. The usefulness of CBA was

reported by all participants; however, some participants had difficulty with the initial login experience. A desirable quality of the CBA in Moodle was the ability to evaluate different levels of confidence when answering a question. The evaluation helped the participants to focus their learning on the questions that they had the least confidence in when taking the quiz. Their confidence was increased when they reviewed the feedback for each question and modified their answers when taking the CBA. When a review of the interview transcripts was completed, five themes emerged as ways in which CBA in Moodle benefited the evaluation experience and helped the participants to think critically about the material in the sample quiz.

The interviews (see Appendix G) gave the participants the opportunity to describe their experiences when they used CBA in Moodle. They mentioned that CBA can help students to gain knowledge, evaluate their thinking, and become more confident in their thinking about a subject. They considered CBA a user friendly tool that is easy to integrate into the classroom; therefore, moving forward with full integration in a high school is the next logical step. Section 3 describes the proposed project, which begins with CBA in Moodle integrated in Grade 9 classes at ABC High School (ABCHS) as Phase 2 of the proposed project. This project will be presented to the ABCSD administration as a possible next step in the GVC process. The next phase describes how the ABCHS can begin the process of implementing CBA and recommending a method to evaluate the implementation.

SECTION 3: THE PROPOSED PROJECT

Introduction

The proposed project builds upon the research completed in the first part of this study. The proposed project consists of a program implementation plan of the implementation of the Moodle-based CBA in the ABCSD. The project is designed to start at one high school and build to include all high schools in the district. The project starts by training students and delivering staff development to teachers in the use of Moodle and CBA in Grade 9 science courses. The course was developed to train teachers and instructs them in the use of Moodle and how to create CBA quizzes; students are then instructed in the use of Moodle and how to take CBA quizzes. The project is designed to assess the stakeholders' perceptions of the use of Moodle-based CBAs on an annualized basis. Student progress using CBAs is documented through formative assessments as well as the summative assessments of the Colorado Student Assessment Program (CSAP) test and the ACT test results. Modifications to training and the use of CBA are evaluated and documented on a yearly basis using the results of the perceptions survey and the student test results to drive any modifications to the proposed project.

The goal of the project is to give the ABCSD a model for implementing and evaluating CBA. Research has suggested that, when outlining an evaluation, a logic model is a valuable resource. A well-structured logic model helps programmatically with the implementation of a project (Loots, 2008). A logic model will guide the training and evaluation of teachers and students to incorporate Moodle-based CBA in classrooms across the district. Based on the information from the interviews discussed in section 2,

using CBA in an LMS such as Moodle is perceived as a positive move for the ABCSD. When interviewed about the local problem of training students for critical thinking, teachers and administrators acknowledged the usefulness of CBA as an evaluation system to measure students' knowledge and confidence. Students who can increase their confidence about a subject self-regulate their thought processes and think about their thinking (Errington, 2009; Facione, 2007; Nosich, 2005). They think critically, and the project seeks to further this process.

In addition, the project addresses the goal of the district End Statement 1.1: Students are able to think critically, creatively, and reflectively. The goal goes beyond merely knowing and extends to using knowledge and skills productively. The goal of the ABCSD is met through the use of Moodle-based CBA in secondary school classrooms. The use of CBA to achieve these goals is summarized in a statement by Participant T3, who described how it will affect his or her classroom: "It is one thing to answer a question; it is something else to say, I am sure that I am right about this. I have studied it, I have learned it, I understand it, and I know that I am correct." This level of confidence will show that students are able to display a metacognitive understanding about a subject, as described by Leclercq and Bruno (1993).

Rationale

The ABCSD has identified a set of end statements that tell the stakeholders of its district that the students have a base level of knowledge. The ABCSD is designing a GVC to meet the outcomes set out in the end statements. At the local level, the ABCHS has embraced End Statement 1.1 as its first step in assuring the GVC. To meet the

outcome of End Statement 1.1, a new method to assess students in critical thinking is being piloted to train and evaluate students in critical thinking. A program and evaluation is being proposed to determine the overall effectiveness of the use of CBA. The program provides evidence that CBA in Moodle has a positive effect on students' abilities to think critically.

The results of the qualitative data in section 2 support the use of CBA as a tool to train students to think critically. All levels of participants in the qualitative interviews suggested that CBA could be a viable option for the ABCSD with respect to critical thinking and GVC. Teachers, administrators, and programmers/developers all provided rationales for the use of CBA. For example, Participant T3 stated, "I think that it would be very effective at improving student's ability to think critically."

In addition, Gvozdenko and Chambers (2007) suggested that the use of CBA in education is a key factor in "developing confidence that is based on carful, critical analysis of the information available is found likely to produce superior performance, especially at the vital higher levels of comprehension and projection" (p. 206). The value of this type of assessment becomes evident when students answer with a level of confidence. The self-regulating nature of CBA shows students their true levels of understanding of a subject, thereby training them to be critical thinkers.

The project is an implementation program for the CBA assessment tool that has not yet been put into practice. This plan, which starts in Grade 9 at ABCHS, has three stages: activities, intermediate outcomes, and long-term outcomes. Phase 1 of the program engages Grade 9 students in science classes. The activities involved in Phase 1

are formative assessments using CBA. This phase develops the critical-thinking skills identified in End Statement 1.1. The intermediate phase involves the training of science teachers in the use of CBA as an assessment tool. By utilizing the training modules detailed in the appendices, teachers develop efficacy in the use of Moodle and CBA. This training shows the teachers how to create and interpret CBA results. In this phase, there is an opportunity to review the data from the assessments and modify any assessment or approaches to assessing students as needed. The long-term outcomes will be to employ CBA throughout the ACBSD as the assessment tool of choice and to improve the critical-thinking skills of all students in the district. The foundations for the use of CBA and the methods to evaluate the implementation of CBA throughout the district are discussed in the literature review.

Program Evaluation Literature Review

This literature review was designed to critically summarize and analyze the existing knowledge base of logic models and program evaluations, and apply the techniques learned to the work on CBA. The topic was limited to program evaluations and logic models because they offer a path to implementation and evaluation of a CBA-based program and a method to make changes to the program as it is implemented in the ABCSD. I conducted an extensive search of the terms confidence-based assessment, participatory action research, and logic model using such electronic databases as EBSCO, ERIC, and ProQuest, as well as online and conventional library searches, to obtain information for this project. The review of the literature was an attempt to bring together ideas and methods that will inform the CBA Moodle Project in the ABCSD. The first

topic described in this section is an overview of how CBA is used to evaluate critical thinking. The next section looks at how participatory action research is used in various program evaluations. Next is an examination of the use of logic models to set up and manage programs. These topics address the rationale for setting up a program evaluation for the implementation of Moodle-based CBA in the ABCSD.

Confidence-Based Assessment

One of the challenges of learning in the 21st-century education system is to find ways to integrate critical-thinking assessments into the classrooms (N. Greenberg, 2009). The use of CBA testing is offered as one method to assess critical-thinking traits. MC tests are traditionally thought of as assessments that do not utilize higher order thinking skills. Dibattista et al. (2004) promoted MC testing as a learning and evaluation tool. They argued that a well-constructed MC test can be used to evaluate information at elevated cognitive levels. The problem, as stated by Dibattista et al., is that the "MC format permits students to guess at answers even when they possess no knowledge of the topic being assessed" (p. 17). The development of a tool that can identify students' weaknesses, modify the learning for their specific needs, and not disrupt their learning was explored.

> A confidence-based assessment (CBA) question is unique in that it captures what you know, and how confident you are in what you know. It does this by asking you to select not only the correct answer, but also how sure you are that your selection is the correct answer. (Leclercq & Bruno, 1993, p. 45)

In the previous section, a qualitative study on the use of CBA was conducted with a sample of 9 educators, administrators, and programmers/developers. The study had each level of participant take the same quiz using CBA. The model that was used was

developed by Gardner-Medwin and Curtin (2007) and includes negative marking in an answer (see Table 1). The reason this model was selected is that Gardener-Medwin and Curtin produced the code that integrates this version of CBA with Moodle. Moodle also is the LMS used by the ABCSD.

Table 1.

CBA Scoring Matrix

Degree of certainty	C = 1 (low)	C = 2 (mid)	C = 3 (high)	No reply
Mark if correct	1	2	3	0
Penalty if wrong	0	-2	-6	0

The scoring polygon (see Figure 1), based upon the scoring matrix in Table 1, was designed by myself and used to assess the Moodle quiz taken by the study participants. It was designed to assess the participants' motivation to mark the correct level of certainty or confidence to maximize their scores. This marking scheme was designed to reduce guessing. If students guess on a CBA quiz, they will receive negative marking for questions that they are confidently incorrect about. The scoring schematic is an important feature of CBA. Participants needed to know and understand how CBA functions in order to identify correctly their level of confidence in any given answer.

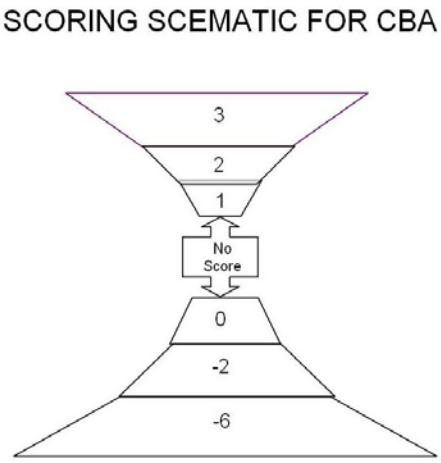

Figure 1. Scoring schematic for CBA.

Each participant was given a copy of the scoring polygon and an explanation of how a score was derived from the answer choices. If the participants answered a question correctly, and if they were very confident, they received a score of +3. If the answer was correct, and if the answer was somewhat confident, then a score of +2 was recorded. Finally, a score of +1 was given for a correct score with a not very confident response (see Figure 2).

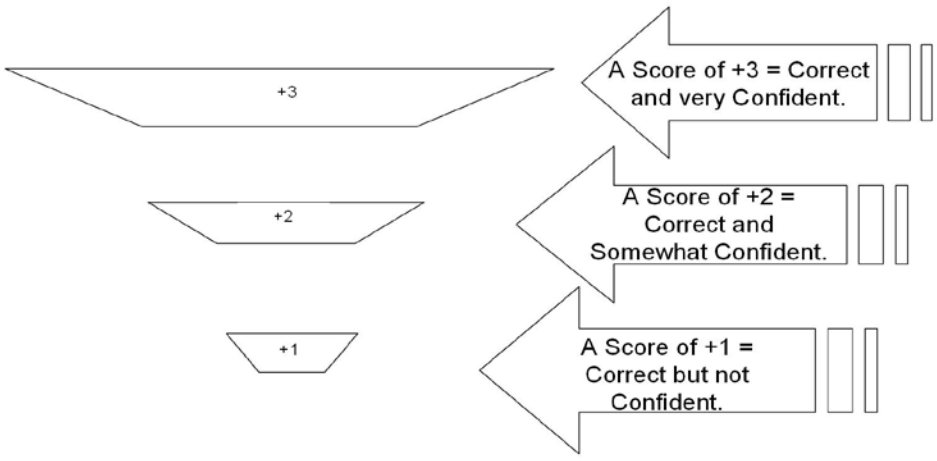

Figure 2. Top of the scoring polygon.

If an answer was incorrect with no confidence, a score of 0 was given. No points were given because the participant showed no understanding of the material, in addition to no confidence in their answer (see Figure 3). This answer could be a guess, and no points were awarded for guessing in this system. Next, if an answer was incorrect with a measure of somewhat confident, a score of -2 was given, indicating that the participant had some information about the subject, but the information was incorrect. Finally, if an answer of incorrect and very confident was given, the participant received a score of -6. This was the most important score in the system. It shows that the student had confidently held misinformation and had learned the material incorrectly. This is where remediation should be targeted in future assessments.

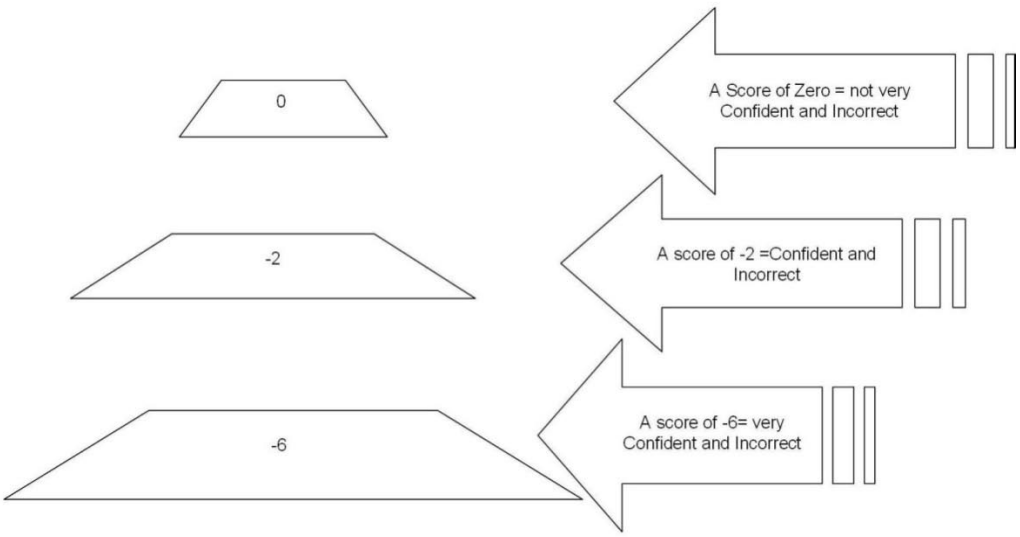

Figure 3. Bottom of the scoring polygon.

When the participants were presented with a question for which they feel they had no prior knowledge, the option of "no answer" may have been appropriate. This option was the least desirable because it provided no information about the thoughts of the

participants. It was an option that reduced the participants' anxiety when they believed that they did not have enough information to make a selection (see Figure 4).

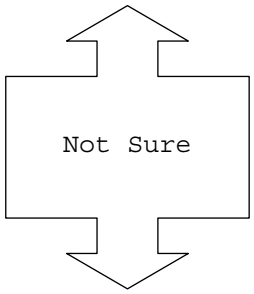

Figure 4. Least desirable scoring option.

I looked to de Finetti (1965) to inform the work in CBA in this paper in his discussion of probabilistic knowledge. For any system that tests confidence,

> It must be kept in mind, above all, that the probability we are concerned with in what follows is always the degree of belief of an individual about the correctness of each of the alternatives at the moment he is facing the problem of how to answer a specific item in a questionnaire. (de Finetti,1965, p. 27)

When answering a CBA question, the level of partial knowledge is easily determined by the correctness of the answer, combined with the level of confidence. With this knowledge, it is possible to determine what information the participants know with confidence and what information they were lacking.

When students self-regulate at the time of answering, they are thinking in a metacognitive state (Wasserman, 2010). This is the goal that many of the researchers previously mentioned in this study have stated. When the participants answered a question and then evaluate their level of confidence, they were self-regulating their thought process (Facione, 2007). They were thinking about their thinking and reflecting on their learning (Nosich, 2005).

If the participants were confidently incorrect, the CBA scored the answer as a -6. the maximum penalty associated with an answer. This score told me the participants had confidently held misinformation. When participants have confidently held misinformation, a cognitive dissonance is created in the learner. This is exactly when a correct explanation of the incorrect response should be given for maximum effectiveness (de Finetti, 1965). It provides the participants with the opportunity to evaluate their learning and thought processes within the given set of criteria while challenging their current set of beliefs and ideas (Nosich, 2005). The timing of the assessment is critical (Chun, 2010). This is the power of using CBA to assess learners. As Facione (2007) suggested, it provides students with the opportunity to "judge if an argument's conclusion follows either with certainty or with a high level of confidence from its premises" (p. 2). The elements of critical thinking, as well as engraining the vocabulary of a discipline, are used in CBA powered by Moodle.

Participatory Action Research

Participatory action research (PAR) is a "is a form of inquiry that holds to a participatory view of knowledge generation" (Young, 2006 p. 499). According to this view, knowledge of a subject is best generated with the researcher interacting with the stakeholders of the topic being studied (Elwood, 2009). This method of research "extends the traditional role of the researcher to that of an agent collaboratively and actively engaged in the construction of local knowledge and theory with a particular group of research participants" (Benat, 2009). The organization Information Technology for Social Change (ITSA) sought to provide IT access for people with disabilities as a way for them

to connect to society though social networking sites and increase access to information otherwise not available to this segment of the population. Mirza, Anandan, Madnick, and Hammel (2006) used a PAR approach to evaluate the ITSA program. Following is a brief discussion of the ITSA program to be used as a framework for the discussion of how and effective PAR is developed, implemented, and gives possible guidance to the CBA evaluation in the ABCSD.

The ITSA sought to affect disabled people who wanted to transition from nursing homes back into society. Once trained, the participants had open access to computers at universities and community centers. Because the training is a key dynamic of the implementation of any program, care was taken in the selection of the participants, who would oversee the project implementation (Brydon-Miller & Maguire, 2009). The program goals also corresponded with the purpose of the host organization (Greenberg, Domitrovich, Graczyk, & Zins, 2005), which in this case was the nursing homes' desire to move individuals to a point of self-sufficiency.

Dariotis, Bumbarger, Duncan, and Greenberg (2008) described recruitment as another critical point in setting up a sustainable program; enrollment of program participants was key to its success. To improve the success of the ITSA program upon completion, each participant was given a computer and Internet access for 6 months. The final phase of the program was to work with the participants so that they could find resources to continue to use the IT skills they had learned as well as receive continued support in finding community resources such as libraries, community centers, and other places where IT is easily accessed.

The PAR model used to evaluate the ITSA has three main components: "(1) identifying the goals of the evaluation; (2) developing the logic model; and (3) identifying the evaluations questions and appropriate methods for evaluation" (Mirza et al. 2006, p. 1189). Research or guiding questions were developed based on the goals of the community partners and included:

> a. evaluate short-term and intermediate outcomes of the ITSA program; b. identify the barriers and challenges faced during the implementation process; and c. explore the potential role of IT access as a social networking, community living, and advocacy tool for persons transitioning out of nursing homes. (Mirza et al., 2006, p. 1189)

Mirza et al. (2006) reported that using the PAR approach when evaluating the ITSA program proved valuable. When trying to bring IT to a population that previously had very little access, this method helps to "increase our understanding of the dynamics behind the digital divide (Mirza, et al. 2006, p. 1197); in addition, the participants had the opportunity to give voice to their concerns, provide input in the process and outcomes, and assess the quality of the project, which helped to guide future social programs such as ITSA (Orland-Barak, 2009). Using this type of evaluation had drawbacks. The design was conceived as a formative evaluation; however, some of the assessments instruments were developed after the first few rounds of training, which resulted in inconsistent pre- and post feedback in the surveys. For the evaluations to be credible in the long term, they must become a recurring part of any program and must be written into the policies of the organization (Taylor-Powell & Boyd, 2008). Over all, Mirza et al. proposed that when a program is evaluated properly, it can provide information to others seeking to implement

and measure the success of not only the ITSA program but also community-based programs in general.

The CBA implementation will need to be an effort in collaboration between implementers and students similar to that of the ITSA program. The PAR approach may be appropriate for the proposed CBA evaluation. As a method of social change, PAR has been implemented in a variety of settings: the health care field, the study of indigenous populations, and changes in postindustrial Europe (Braithwaite, Cockwill, Neill, & Rebane, 2007; Evans, Hole, Berg, Hutchinson, & Sookraj, 2009; Young, 2006). The method of PAR is to effect social change from within a program or movement. When using the method of PAR, the participants are not separate from the research; rather, they are part of the change they want to see in the community that is being researched. In the ABCSD, I am the primary proponent of CBA in the system. The PAR method "extends the role of the researcher to that of an agent collaboratively and actively engaged in the construction of local knowledge" (Benat, 2009, p. 103).

Logic Models

Another example of effective program evaluation systems is logic models (Lisowski, 2006). These models are used in a variety of settings, including community-based programs and the evaluation of philanthropic organizations (Strickland, 2009). The uses of logic models can enhance the credibility of a program implementation (Cato, 2006). Logic models also can be used on a smaller scale to map critical thinking strategies in a classroom (Ellermann, Kataoka-Yahiro, & Wong, 2006).

A broader view looks at logic models with respect to program implementation at the local community level. These programs offer resources such as adult education and after-school programs. Community-based programs provide services that run the gambit of positive youth development to clean water programs (Hutton & Bartram 2008; Mahoney, Larson, & Eccles, 2005). When a program is being funded by an outside source, an evidence-based evaluation usually is required to examine its effectiveness and worth for continued operation or explanation (Taylor-Powell & Boyd, 2008).

Evaluations should provide the data of the outcomes that lead to identifiable policies and sustainable programs, not just pilot programs (Pattanayak, Poulis, Yang, Patil, & Wendland, 2009). When looking at community-based art programs that provide a structured environment for children and improve school performance, Wright (2007) looked at a method to assess the factors that identify the best practices that can be used to create policies and sustainable outcomes that work in promoting education in the arts that change student behavior. Following is a brief discussion of the ways in which logic models can be an effective tool for program evaluation

The United States and Canada have taken different approaches to educating young people in the arts. Canada has support from national cultural policy; whereas the United States relies on self-funded community organizations to a greater extent (Wright, 2007). Programs in the United States range from neighborhood beautification projects to professionals who help people with emotional problems and are largely funded through grants. Fueling this impetus to educate young people in the arts in both countries was the work done by Gardner (1993) on multiple intelligences (MI). The discussion around MI

has suggested that individuals should be assessed and educated in a variety of methods that allow the learners to demonstrate knowledge and understanding based on their strengths, not methods forced on them by educators. It is in the context of the discussion of the impact of MI, in this case the arts, on academic achievement where Wright proposed a method of evaluation in Canada and the United States to recognize programs that impact student achievement and identify best practices.

In the study were programs that showed "promising albeit limited evidence that the community-based arts programs surveyed had some positive effects on children" (Wright, 2007, p. 126). The evaluation process to provide evidence of best practices was limited at best. A problem in identifying best practices is that few organizations, states, or provinces have full-time evaluators who have the training to assess programs (Guion, Boyd, & Rennekamp, 2007). This problem is compounded by fiscal issues in Canada and the United States. The recent recession that has plagued North America has made governments ask for accountability in programs such as the methods Wright is advancing. What is needed is a theoretical framework guided by empirical evidence that can provide a conceptual and methodological approach to setting up art programs that can guide fiscal and managerial decisions for the priorities of these programs (Wright, 2007).

The first method used to evaluate art programs was identified by Anderson (2005) as part of the theory of change model. The main points of this theory are that change is part of a relationship between outcomes and a long-term goal of a program, specific items can be a measurement of success, interventions are used at each step of the process of change, and the hypothesis makes sense for the interventions. For Wright (2007), this

theory makes sense because it does not limit nature of the evaluation to one of a summative nature. Wright commented, “For example, an art program may not have succeeded in achieving its long-term goal of reducing juvenile delinquency, but may significantly increase youth’s conflict resolution skills” (p. 127).

The second method proposed by Wright (2007) was the logic model for program planning and evaluation designed by Hulett (1997). A logic model was chosen because of its ease of use and also because it was perceived as more informative than other choices (Flemming & Easton, 2010). Factors present in a logic model include conditions (demographics, program activities, direct outcomes, intermediate outcomes, and long-term outcomes. Conditions are the demographics of the study. It is a necessary component to determine whether the targeted population is in the study. If not, the study may need to find more participants who meet the needs of a funding source that may be asking for the evaluation. Program activities are identified as art instruction and attendance by the participants. These activities are necessary to show what is happening in the program being evaluated as well as how often the participants are engaging in the activities, in this case, the instruction of art skills. Direct outcomes are considered the knowledge of art skills identified by an arts quiz as well as a demonstration of the skills acquired in the class. The direct outcomes in logic models should be designed to show the change that will result from the program (Hense, Kriz, & Wolfe, 2009). The outcomes in this logic model include participation, task completion, conflict resolution, communication, cooperation, and public recognition (Wright, 2007).

What determines success in a program evaluation? “In general, program evaluation examines programs to determine their worth and to make recommendations for programmatic refinement and success” (Spaulding 2008, p. 5). This definition is broad and shows how difficult it may be to quantify success when evaluating a program. In the logic model described by Wright (2007), outcomes are identified as intermediate and long term. The intermediate outcomes are broken down into attitudes and behaviors. The attitudes are measured by an opinion survey. The second part of the intermediate outcomes is behaviors. These also are measured by a survey. The last part of the model is the long-term outcomes. These are identified as improved academic behavior, reduced delinquency rates, and increase extracurricular activities (Wright, 2007). The evaluation system proposed by Wright (2007) can be implemented and appraised easily by program officials where there are incentives for evaluation. The incentives should be enough for program managers to assume the task of evaluation to continue programs that are worthy of funding (Cousins, 2007).

Summary

As I began to develop the project that was be proposed to the ABCSD, research in the areas of CBA, PAR and logic models bring together three areas of literature that provided valuable guidance to the proposed project. The review of the literature presented information on the development theory of CBA in education. The study provided insight into research from the original work of de Finetti (1965) on probabilistic knowledge and ways to use that knowledge to assess students. His initial research guided other researchers such as Bruno and Leclercq (1993) and Dibattista et al.

(2004) in their endeavors to develop methods to assess this partial knowledge. The literature further suggested that although Gardner-Medwin and Curtin (2007) approached CBA from a different perspective, they reached the same understanding as other researchers: the use of CBA can benefit students and instructors by identifying what students know confidently and, more importantly, what they do not know confidently. By having students assess their level of confidence in their answers, they are thinking critically about their own knowledge of a subject and this is an outcome that is favored by the ABCSD when trying to meet its End Statements.

When developing a project to propose to ABCSD, two approaches from the literature seemed appropriate to develop and evaluate CBA implementation. The first method of project development that incorporates an evaluation was from an area of study known as participatory action research (PAR). Because I work at the school where the proposed project will be initiated, PAR offers some guidance on how to proceed with the proposed project. I will be intimately involved in the process of changing the assessment environment, and working in the classroom with students, a unique opportunity exists in to participate in the research and extend the knowledge gained in research process (Benat, 2009). Guidance from PAR will prove valuable as the proposed program is set up. Incorporating aspects of PAR in the proposed project will keep the scholarly rigor of research while actively participating in the project.

The literature on logic models also proved valuable for the proposed CBA Moodle implementation project. Logic models provide not only a visual description of how the process will unfold but also let the stakeholders know where changes can be

made in the process of implementation. As Wright (2007) asserted, a logic model helps to define the target population, the outcomes, and the areas where change can be made in the implementation of a program as it is being developed. The areas of inquiry in this review of the literature helped to guide the overall development of the proposed project, which also includes an evaluation plan. The use of the logic model will allow not only the ABSCD a visual reference of the proposed project, but it give others who may want to replicate the implementation of the project in their institution a model to start the planning and evaluation process.

Proposed Project: Program Implementation Plan Overview

The ABCSD has set out a set of key end statements that guide the delivery of education to students in the district. The first end statement focuses on the concept of critical thinking: “Students are able to think critically, using reason and logic when facing decisions about what to believe or do” (ABCSD, 2007, n.p.). To work toward this goal, the program developed for this project will be proposed to the chief information officer at the ABCSD as a model to be implemented in the entire school district. If approved, the ABCHS will start the implementation of the assessment program using CBA in the LMS Moodle. The program is designed as a pathway to district-wide implementation of Moodle with CBA embedded. The outcomes of the logic model provide a visual representation and are intended as a guide for the proposed implementation (see Figure 5).

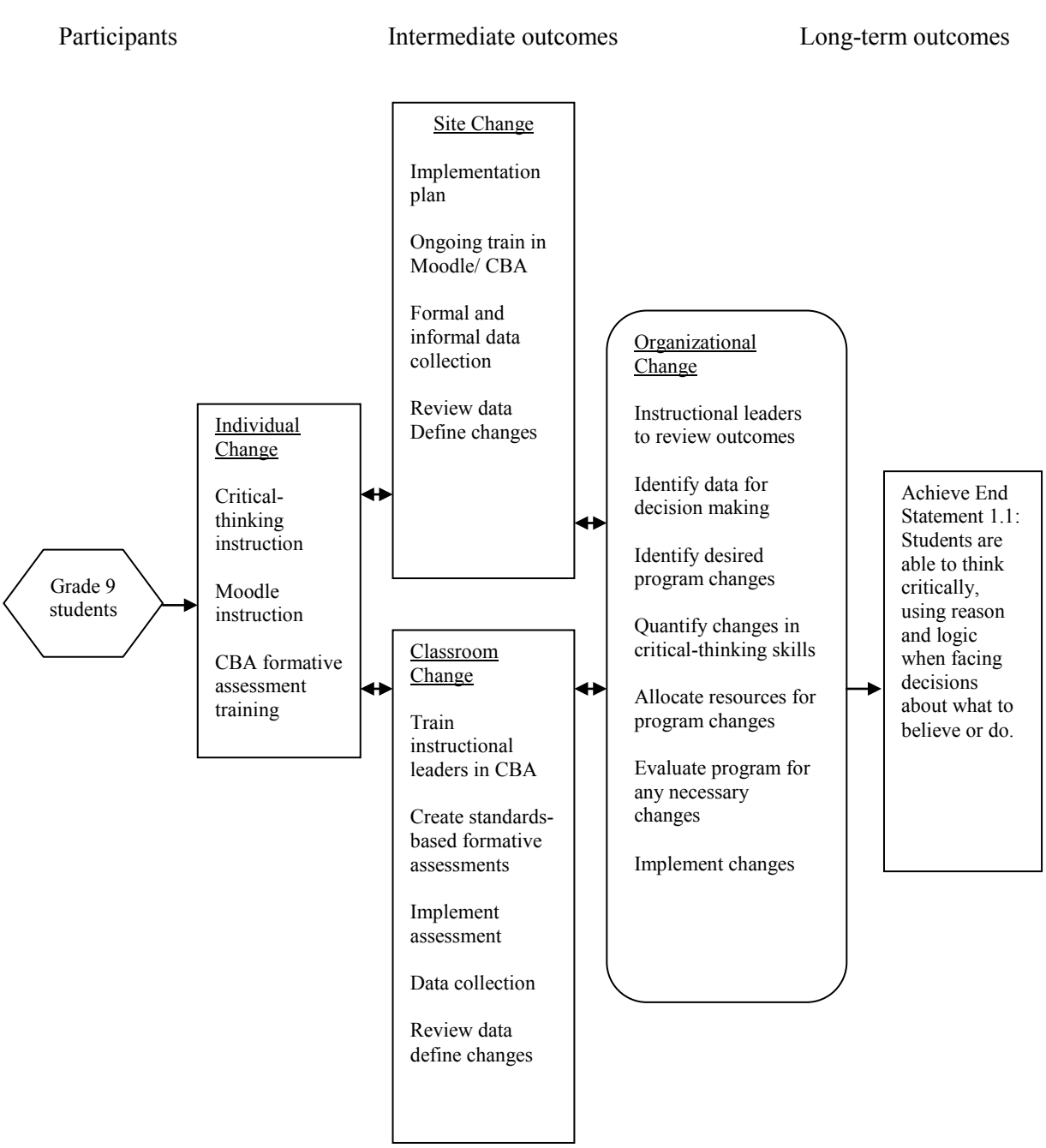

Figure 5. Logic model for ABCSD CBA implementation.

Stage 1 of the model will be to identify and document the activities that will occur as part of the proposed project and evaluation plan (Spaulding, 2008). The project will start with Grade 9 at ABCHS. In the fall of 2010, staff will begin identifying and developing the activities, or assessments and instructional changes, needed for Grade 9 students that can be modified into CBA style assessments. Students and teachers then will need to be instructed in the use of Moodle.

In Stage 2 of the program, the intermediate outcomes will be to articulate the guiding theory and general practice of CBA implementation define the outcomes of this change in pedagogy and explain the plan for specific CBA implementation as well as how the data will be collected and evaluated. This stage also will define changes needed in individual assessment techniques necessary for effective CBA integration.

In Stage 3, the long-term outcomes will be characterized by identifying instructional leaders who can review the formative and summative data, and then use the data to make programmatic decisions about current and future modifications to the program so that students meet End statement 1.1 and are able to think critically.

Stage 1: Activities

This stage identifies the activities necessary for a successful CBA program to be implemented. It involves training students and teachers at ABCHS in the theory and use of CBA to increase the critical-thinking skills and dispositions of the students. Teachers will dedicate 1 day prior to the start of the school for the initial staff development of CBA and Moodle. The format will be hands-on training in a computer lab where the teachers can practice building courses in Moodle and creating CBA assessments. The outcome

from this stage, defining activities for teachers, will be achieved through a professional development session that will provide the necessary information about CBA to the teachers. The professional development and assessment instruction are part of a Moodle-based course.

Using Moodle to train teachers and students is done for two reasons. First, teachers and students will be using Moodle, giving them more experience on the system, and second, it will increase the efficacy of teachers and students in using Moodle and CBA, thereby reducing any dissonance that users of the system may have about using technology to instruct students or take quizzes. This plan includes theory, assessment development, and sample assessments. Teachers will be working in a computer lab with an instructor to create the courses that they will continue to build and use after the initial training.

This stage also will include information for students, who will be instructed on the purpose and desired outcomes of the use of CBA, as well as how to access assessments through the Moodle LMS. A sample lesson in the Moodle course will be sent to teachers as a guide on how to train students in the use of CBA. The students will be taught using a computer lab setting similar to the way the teachers were taught. They will also need to be taught how a CBA quiz is scored. Students will need to understand the scoring matrix and how to maximize their score on a CBA quiz. This can be done in a single session, with students being offered independent practice to become more comfortable using CBA and Moodle.

Stage 2: Intermediate Outcomes

The focus of Stage 2 is take a more in-depth look at the changes necessary at the site level and within the classroom to make informed decisions regarding student performance using formative data from CBA. This process will be part of the embedded staff development time built into the educational calendar of ABCHS during the course of the year. In this stage, the teachers will develop and implement CBA in their classes and begin collecting data. Teachers will have trained students on the use of CBA by this time and will have data from quizzes to analyze. From the data, the teachers will be able to identify trends in student knowledge. Initially, these data will be formative because no long-term data will be available until the next school year, when standardized assessment results will be reported. Once the data are evaluated, the program will be assessed.

The assessment of the program will be both formal and informal. The formal process will be captured through a survey of student and teacher on the use of CBA in the classroom. The informal process will be the interactions of faculty and students during the course of normal school interactions. These interactions may be as simple as conversations between teachers and students or a ticket-out version of informal assessment to evaluate attitudes of students during that may show a change in perception of CBA over time.

In an attempt to capture the informal interactions as the evaluation process of the proposed project, faculty will be encouraged to discuss and share their experiences, as well as the attitudes of their students, using CBA during embedded staff development time. The staff development time happens during the school day twice each month.

Teachers meet during one of their planning periods to discuss the progress of CBA thus far. Notes from the meetings will be distributed to the entire faculty, best practices will be indentified, and faculty will be encouraged to implement them as part of their ongoing use of CBA. Formal and informal data will be reviewed, and recommendations for change will be evaluated as an ongoing part of the program implementation.

Stage 3: Long-Term Outcomes

This stage identifies instructional leaders of CBA, expanded implementation of CBA, summative data collection and analysis, programmatic changes identified and implemented, and resource identification and allocation for continued expansion of the CBA program. The instructional leaders will be faculty from ABCHS having demonstrated success in the initial implementation of CBA. These future leaders will be able to identify best practices and provide professional development to other schools in the ABCSD as the use of CBA expands. These leaders will show how to develop and use CBA assessments. The cadre will also share the successes and failures of the ongoing project implementation and be able to show others how to avoid any problems. Once identified, the instructional leaders will make up a cadre of professionals from various disciplines that will be made available to schools across the district. They also will discuss how student data through CBA scores and faculty data through formal and informal data collection are collected and analyzed to achieve the best results in training students to think critically.

The CBA cadre also will be involved in ongoing program analysis. As more data are generated across the ABCSD, the cadre will continue to identify best practices and

make recommendations for change as needed in the implementation and progression of the CBA program. The cadre will meet on a semiannual basis and be responsible for analyzing summative data from a variety of sources such as CSAP results and ACT testing results to identify areas of progress. Where progress is identified, it will be publicized through the district via electronic mail and posted on the district's website. The district-level cadre will also make recommendations for resource allocation to further the success of the CBA program implementation.

The final outcome will be that the cadre can report to the stakeholders in the ABCSD that the information from surveys, standardized tests, informal meetings, and discussions showed that students are achieving the GVC as it relates to critical thinking. The cadre will have formative data compiled through the interactions of the cadre with teachers and students, as well as summative data from end-of-course evaluations, surveys, and standardized tests to demonstrate progress as well as identify areas of need so that resources can be allocated based on data rather than assumptions.

Needed Resources

This proposed project plan will require financial, technical and personnel resources. The move to CBA as a method of assessment will require all schools to implement the LMS Moodle with CBA capabilities. The ABCSD will need to investigate the cost of housing its own instance of Moodle for the entire district or contracting with a Moodle partner that specializes in Moodle hosting for schools.

Technology as a resource will be necessary for students and teachers to access CBA for teacher creation and student assessments events. The ABCHS is set up with six

fully functioning computer labs of 35 computers as well as four mobile labs of 35 computers to meet the needs of 1,700 students. In addition, each teacher has one desktop computer and access to teacher workrooms with at least three computers each. This seems to be adequate for the CBA assessment needs. In additional to these resources, the ABCSD has made an investment in a WAN capable of allowing students to bring personal computing devices to school for educational purposes. With these resources available, the technology needs for use of CBA seem to be addressed. However, this situation will be reviewed in the ongoing evaluation process as part of the proposed project.

Personnel resources will be addressed through the initial implementation process. In Stage 1 of the project, I will train the first group of teachers to implement CBA in their classes by using staff development time prior to the start of the 2010 school year. I will create a course in Moodle to instruct faculty how to use Moodle and create CBA assessments. Once trained, these teachers will become the cadre of instructional leaders for the entire district. The ABCSD will need to provide release time for these educators to travel to other schools to instruct faculty on the use of Moodle and CBA. In addition, current embedded staff development time will need to be allocated for faculty to create and evaluate the data from CBA assessments.

Problems Addressed

The problem addressed in this project is that of resolving the deficit of a method to train and assess students in critical thinking. The ABCSD is promoting a curriculum that will guarantee that students will be able to think critically upon graduation. To date,

there is no low-cost method to consistently train and assess students in the skills and dispositions of thinking critically.

Potential Barriers

Barriers to a successful implementation exist, but they are not insurmountable. The program is dependent upon stakeholder acceptance of the ability of CBA to train and assess critical thinking. Teachers, administrators, and students must have an understanding that CBA implementation is a process. Identifying strategies of best practice is a process. The implementation of a quality program is dependent upon a process of data collection and review. The review may suggest modifications to the ways in which CBA is being used or implemented in a school. Educators and students need to be open to the possibilities of modification to how they are managing assessments as well as data to create a system that effectively trains and evaluates students to think critically.

Proposed Project Implementation Plan

Phase 1 will begin prior to the 2010 school year. It will incorporate Stages 1 and 2 of the implementation plan. Initial staff development will take place in the week prior to the start of classes. Faculty at ABCHS will create assessments, collect and review data, and make recommendations for modifications to the program in an ongoing basis throughout the 2010 school year. During this time, Grade 9 students also will need to be introduced to CBA. The students will be taught how to take a CBA quiz and will be shown how the score is related to subject knowledge.

The success of this project will not be seen for many years. However, one needs an outcome to measure the success of a project. In Phase 1, the intermediate stage of the

program implementation of the logic model, the outcomes will be successful if faculty cadres are identified and they have developed an implementation plan, CBAs are created, data are collected, and changes to the implementation are recommended when necessary. These outcomes will be quantified in the survey of the program. The result of the changes should be evident when one looks at how the ABCHS trains and assesses student in the dispositions of critical thinking. At the end of the 2010 school year, faculty will be creating CBA assessments, and students will be taking these assessments and using the information to evaluate their thinking about the various subjects.

Phase 2 of the project plan will take place during the 2011 school year. In this phase, Stages 2 and 3 of the implementation plan overlap. This phase will be marked by the identification of a faculty cadre who can train other teachers in the district to create, use, and interpret data from CBA assessments. The overlap occurs in the review and evaluation of the implementation plan. During the first year, formative data were collected by faculty. This process continues in Phase 2. The data also are correlated with summative data such as CSAP or ACT scores to assess the effect of CBA on these tests. Stage 3 events also will seek to address how the overall program implementation is progressing and will make changes necessary to implement CBA in schools across the district. The implementation will follow recommendations made based on Stage 3 results and recommendations.

In Phase 2 of the project, some of the long-term outcomes will be evaluated. In this phase, the cadre of faculty will be evaluating data to determine how the program is being used and make recommendations for changes. The proposed program will be

successful if the outcome of the evaluation of resources has determined that the proposed program's success warrants continued funding and resource allocation. This phase also is marked by a systematic change in how the organization of the ABCHS trains and assesses students to think critically. As in Phase 1, the cadre will continue to look at data from surveys as well as students' CBA scores from multiple school sites and then make any recommendations for change so that program implementation will be a continued success.

Phase 3 will occur during the 2012 school year, and it will be a progression of all the stages of the implementation plan. All schools that have implemented CBA will continue to collect and evaluate data on students. In this phase, the faculty cadre will continue to expand to train new teachers and schools to use CBA and to evaluate data on an ongoing basis. In this phase, the cadre will continue to evaluate the implementation and make recommendations for changes that may be necessary to the program. In this phase, all schools will have fully implemented CBA as part of the assessment regiment. With CBA in place throughout the ABCSD, the goal of End Statement 1.1 will be realized, and data will be available to prove to the stakeholders of the ABCSD that the GVC is a reality.

Phase 3 of the project will be evaluated by the long-term outcomes. This phase builds on the previous phases, and any modifications to the program implementation will be made in the first two phases. This phase also overlaps with Phase 2 in that cadre members are continually meeting to review the progress made and make recommendations for change as the implementation of CBA continues throughout the

ABCSD. The cadre will also make recommendations for resource allocation to the district.

This phase will see the introduction of summative data to be reviewed. In Phase 3, data will be available from Colorado's CSAP assessment and the ACT test that is required of all Colorado Grade 11 students. Data from previous years' CBA assessments also will be available for the cadre to review. Based on the data, the cadre will be in a position to assess the use of CBA in the schools. If the data show an increase in the scores of the standardized assessments, where critical thinking is imperative to higher scores, then the goal of End Statement 1.1 will be realized. The students will have been successfully trained to think critically and use logic and reason on assessments.

Project Implications

The CBA implementation project addresses the need to train the students of ABCSD in the disposition to think critically. This is the goal of the ABCSD's End Statement 1.1. Using CBA will give the teachers, administrators, school board, parents, and community a method to assess how the district trains its students. It will be a concrete measurement of critical thinking. Using CBA not only will provide a less ambiguous method of telling the stakeholders how critical thinking is being taught but also will provide data to monitor the progress of the schools in achieving the goal of End Statement 1.1.

When the project is implemented, it will have an impact on the stakeholders of the ABCSD. Developing a program that promotes critical thinking prepares the students for the society that awaits them upon graduation. Students need to be prepared for a society

in which the skills of critical thinking will be necessary to compete economically on a global scale. By implementing the program described in this project, the ABCSD will be making a statement about how schools of the future should be run and how those schools should prepare students for future success.

The implementation and continued development of the project shows that the stakeholders in the ABCSD are committed to changing the ways in which students are taught. This study will provide a platform for positive social change that can be followed by other school districts. Changing the thought process of students toward a disposition of critical thinking will change the paradigm of society. A future generation that has the capability to navigate a workforce in which the jobs they will be working in have not even been conceptualized yet puts them at a competitive advantage. The CBA project may be a good next step in the future of education.

Summary

The CBA project provides a vital next step in a process of developing critical-thinking skills and dispositions for not only the ABCSD but also for the entire education community. The project outlines a three-step process for the implementation of CBA. Through a continued process of data collection, review, recommendations for improvement and implementation of the recommendations, educational institutions have a guide to develop their own version of a CBA program. The work that will be done by the ABCSD when the program is implemented will be significant for the future development of students in the district and will serve as a platform for future schools to implement similar programs.

SECTION 4: REFLECTIONS

Project Strengths

The strengths of this project are its ease of implementation, ability to train and assess for critical thinking, and ability to be replicated in other educational institutions. The project was designed so that educators and students can have input in all stages of the process. The students' input is in the form of assessment data and the educators' input is enabled by the formal and informal data gathered through discussions and surveys. User input and the ability to modify the implementation during the roll-out process is a strength of this project that will help to ensure its success by giving the people who use CBA a say in the future of how students are assessed. Using CBA as method of training and assessment will add value to the education received, not only by the students of the ABCSD, but also by other institutions seeking to increase the capacity of their students to think critically. The logic model and program guide will provide a path for other educational institutions to follow. As the need for a cost-effective method to assess students grows, institutions will look for products to fill that need. This program offers a system that others can replicate and modify to fit the needs of their institutions.

Project Limitations

The proposed project is grounded in theory, but it does have limitations. Faculty and student buy-in, the availability of available resources, and continued implementation stand out the most. In any new program, there will be push back on the function and ability for the program to achieve its intended goals. Educators can be a skeptical group, and skepticism is understandable when one looks at the many instances of a new method

or program that is introduced and fades away when another new product is introduced. The project rationale relies on limited research on the topic of CBAs relative to other areas of education. Because CBA has had limited exposure in secondary education institutions, there may be a misconception that it is another new program that will be gone in short fashion.

Students are another critical component to the success of the program. If students are not active participants in the evaluation system, it will be difficult to demonstrate progress through positive CBA quiz results. The initial training and introduction to CBA needs to be a positive experience. During the beginning stages, students need to understand that this is a new method of assessment. It will take time for them to understand how to take a CBA and to use the information that it gives each student.

The project implementation also relies on the perceptions of the limited number of participants in the initial research. Although a diverse cross-section of educators and programmers/developers took part in the research described earlier in this paper, only nine individuals were selected for this study. As more educators are exposed to the CBA project, divergent views about ways to assess critical thinking may arise. A failure to introduce educators to the research of how CBA can have a positive effect on students' ability to think critically will be a limiting factor to the success of this project.

Recommendations for a Different Approach

In addressing the different ways to approach the problem, it may have been prudent to use more data to assess the outcome of becoming a critical thinker. Scores from standardized assessments give schools a snapshot in time of how a student performs

on a particular day. In an attempt to demonstrate the long-term outcomes, more data points may need to be introduced to effectively state whether a student is a critical thinker. Perhaps summative assessments need to be developed by the ABCSD to provide more data points from which to assess the effectiveness of the use of CBA by its students.

Another method to address the problem may be to interview the students at various points along the progression of the program implementation. For ease of program implementation, there is a reliance on formal data from students in the form of test scores. Quantitative data are necessary to evaluate programs because they provide depth to the information. However, qualitative data in the form of interviews of students may offer breadth to the evaluation of CBA that may be missed if one relies only on quantifiable data.

Scholarship

This process introduced me to a greater understanding of what scholarship means. Scholarship is a process that involves research, writing, program development, and a set of skills from which to approach a topic such as teaching. The doctoral process requires skills in the areas of analysis, synthesis, and the decision-making process. Scholarship is a method of thinking, learning, and doing; it is a skill that has been refined during the process of developing the doctoral study. In the process of deciding on a topic to research, I was exposed to the concept of CBA. I could have looked at my initial training in CBA as one of the new programs that come and go in education. Instead, I saw an opportunity to embrace the concept of scholarship, so I began research into the viability

of developing a system to assess critical thinking that is practical for students in the ABCSD.

When I began researching the topic, I was frustrated that not much literature was available on the topic of CBA. It would have been easy to stop and not pursue a greater understanding of the subject. However, I took the challenge and continued researching the topic. In the process, I discovered the two people who have conducted extensive research on the topic of CBA. Both are at the twilight of their careers as researchers. This serendipitous meeting with them gave me an opportunity to attempt to fill the void in the research. The skills that I have gained in the process of developing an implementation program for CBA will allow me to demonstrate scholarship on the topic of CBA. To do this, however, I needed to learn the skills of a scholar.

Scholar

As a scholar and a teacher leader, I have a responsibility to learn, as well as to lead. When I approached various people at our institution about assessing students differently using CBA, there was much interest. Initially, no system that was easily accessible or cost effective was available. I could see how the benefits of CBA could be useful to the ABCSD, so I knew that the barriers to the use of CBA had to be overcome.

My research on the topic exposed a gap in the current research of using CBA to assess critical thinking. CBA as a topic for research was more prevalent in the 1970s and 1980s; it has tapered off since then. To conduct this research, I had to expand my knowledge base of CBA, and I needed to find a method to deliver the assessment tool to intuitions at an affordable cost. When Moodle was presented as an option, my level of

interest was elevated. As an open source software system, it was possible for me to modify the code to change the question type so that it could measure CBA. I had had some exposure to programming computer code from past courses in college; however, I would not call myself a programmer. As a scholar, though, I could not let this become an insurmountable hurdle. I needed to learn to program in .php.

It was no small task to modify code in Moodle to meet my needs. I knew that it was possible but I did not yet have the skills to be a .php code programmer. In addition to researching critical thinking and program design, I had to teach myself how to write code to make the modifications I needed for the program to continue. Fortunately, during my time learning how to program, I located someone who was working on the same task in Moodle; unfortunately, he was across the Atlantic. With time and patience, I was able to work through the code that I needed and produce a modified version of the Moodle LMS that performed the assessments that I wanted. The experience in its totality has improved my level of scholarship. I know now that I can conduct research, write at a scholarly level, and successfully teach myself a complex skill such as computer code programming.

Practitioner

Becoming a better practitioner of education involved using research to support my initiatives and practices at the local level. Prior to starting my doctoral program at Walden University, I allowed others to tell me how educational research impacted me in the classroom. I was a tacit educator. Initially, I concentrated only on methods to improve critical thinking using technology. As I developed my skills of scholarship, I began to

become intellectually inquisitive about other aspects of teaching that went beyond my study of CBA.

I was asked this year to teach in a new program that would help to provide an education to students who have failed classes or have been suspended or expelled from school, but for whom we are still responsible. In years past, I would have tried to put together a system based only upon my past knowledge or from input gathered from teachers within my school. This time was different. When asked to develop this program, I started with a research of the literature on alternative education programs. I discovered many successful programs that helped inform the initial development of the program. As a significant addition to this program that the ABCSD has been reluctant embrace in the past, a general equivalency degree (GED) preparation program was initiated as an option for a select group of students who may otherwise have not been successful in education at our institution. As a high-achieving district, the ABCSD puts 80% of its students in colleges and universities, so having a GED program did not fit into the narrative of the successful student. With research on my side and the institutional knowledge that little was being done for students at risk of not completing high school or for whom high school was not a good fit, an alternative route to a diploma was needed. I was able to successfully advocate for these students because of my training in this program.

Project Development

In developing this project, I learned that there is no substitute for research when trying to influence decision makers. Decision makers in education, as well as in other fields, may have preconceived ideas of how to implement programs and ABCSD was no

exception. Administrators advocated many methods to achieve the GVC they were directed to implement. I had the opportunity to present my program as a proposal to district leaders and found a receptive audience. The time that I took to develop research-based solutions as well as the development of a logic model that shows the organic nature of the implementation of the program provided a point of agreement on how to proceed with in training students to think critically. There will be changes to the program as it moves forward; however, with my work over the past two years, I was able to give teachers a voice in the process of change that has previously been lacking.

Project Developer

The goal of this project is to implement a program that helps students develop the skills of critical thinkers. This project has developed over the last two years. Although I was able to use ABCSD's end statements as a guide, there was no clear vision of how to train students to think critically. To achieve this I needed to research options and develop a plan to implement a program that trains students to think critically. The research, development, and implementation of a program proved to be an arduous process, but the rewards made the process worth the time and effort I put into it.

Reflection

The overall project was personally and professionally fulfilling. I found that I can be a positive force for change in my school and district. My work has led the ABCSD to start the integration of the Moodle LMS. Prior to my work, the district was planning on implementing a commercially purchased LMS. This decision changed as a direct result of my work.

As the developer of this project, I had the opportunity to talk to many district administrators about how Moodle works and why it should be a viable option for the ABCSD. I knew that I was interacting at a scholarly peer-to-peer level with others in education when I started to receive phone calls and e-mail messages about how I was integrating Moodle into our school. One morning, I came to work to find the director of assessment and the director of curriculum and instruction waiting for me in my classroom. They wanted a presentation of Moodle and the CBA that I was working on for this project. The presentation took an hour and a half with questions. The next day, my administrator told me that we were being called to the district office for the same presentation. Because of my work and research, I was interacting at a scholarly level with others who had achieved doctoral degrees. I did not shy away from this challenge.

The fact that others were discussing my work and were actively seeking my guidance on the direction of assessment in the ABCSD suggested that CBA has applications in education. In addition, one of the programmers/developers on the Moodle project has completed the full integration of CBA. It will be available in the next version of Moodle, and it will have a great impact on the future of CBA.

As societies continue to develop, and as knowledge societies emerge around the world, the need for critical thinkers will expand. Those individuals who are able to develop the critical thinkers of the next generation will be poised to succeed in an ever-changing world. The use of technology to train the students of the future will only increase. It is my hope that the work done in this project will offer others the opportunity to examine CBA-type systems and develop a greater understanding and new methods to

train students in the skills and dispositions of critical thinking. The research conducted and the program proposed will promote social change by developing a greater number of critical thinkers who will be better prepared for the challenges of living in a knowledge society.

Implications, Applications, and Directions for Future Research

This project has academic implications for many educational institutions that are focused on training students to think critically. The project has the potential to successfully integrate critical-thinking assessments using Moodle. The first step should be to implement the program not only at ABCSD but also at a variety of urban, rural, and suburban educational institutions. Future researchers may seek to determine whether the program is effective in any population and at any school. All students need to learn how to think critically as we move to a knowledge society.

The application of this study may show that using Moodle to train critical thinkers is applicable in a variety of settings. Because Moodle is an Open Source system that has minimal cost associated with its use, any institution, be it government or private, that may be in need of a system that trains people to use critical thinking will have one available to it. The implications for the future may be that not only students in education settings but also businesses can train their people to be more productive by thinking critically on the job. This process would be beneficial to aid in the transition to a knowledge society.

Future research on CBA and Moodle will be needed to better understand how students are affected when using this system. As the use of CBA progresses, there will be opportunities to study a variety of research questions: Is CBA appropriate for every

course? Can this assessment method be modified to achieve better results on standardized tests? Based upon the results of this project, do students show a significant long-term gain in achievement from having used CBA in their classes? As the CBA program continues more questions and opportunities to conduct research will present themselves. As one who has completed this Doctoral program I will be in a position to suggest further research as well as conduct the research myself. This provided me an opportunity to share my research in a variety of settings from publishing my research and presenting at appropriate professional conferences. This will allow CBA to continue to grow and develop as a viable and useful method to train and assess critical thinkers both in education and business and become an avenue for social change.

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APPENDIX A: THE PROPOSED PROJECT

The Integration of Moodle with Confidence-Based Assessment to Improve Critical-Thinking Skills in Students at ABCSD

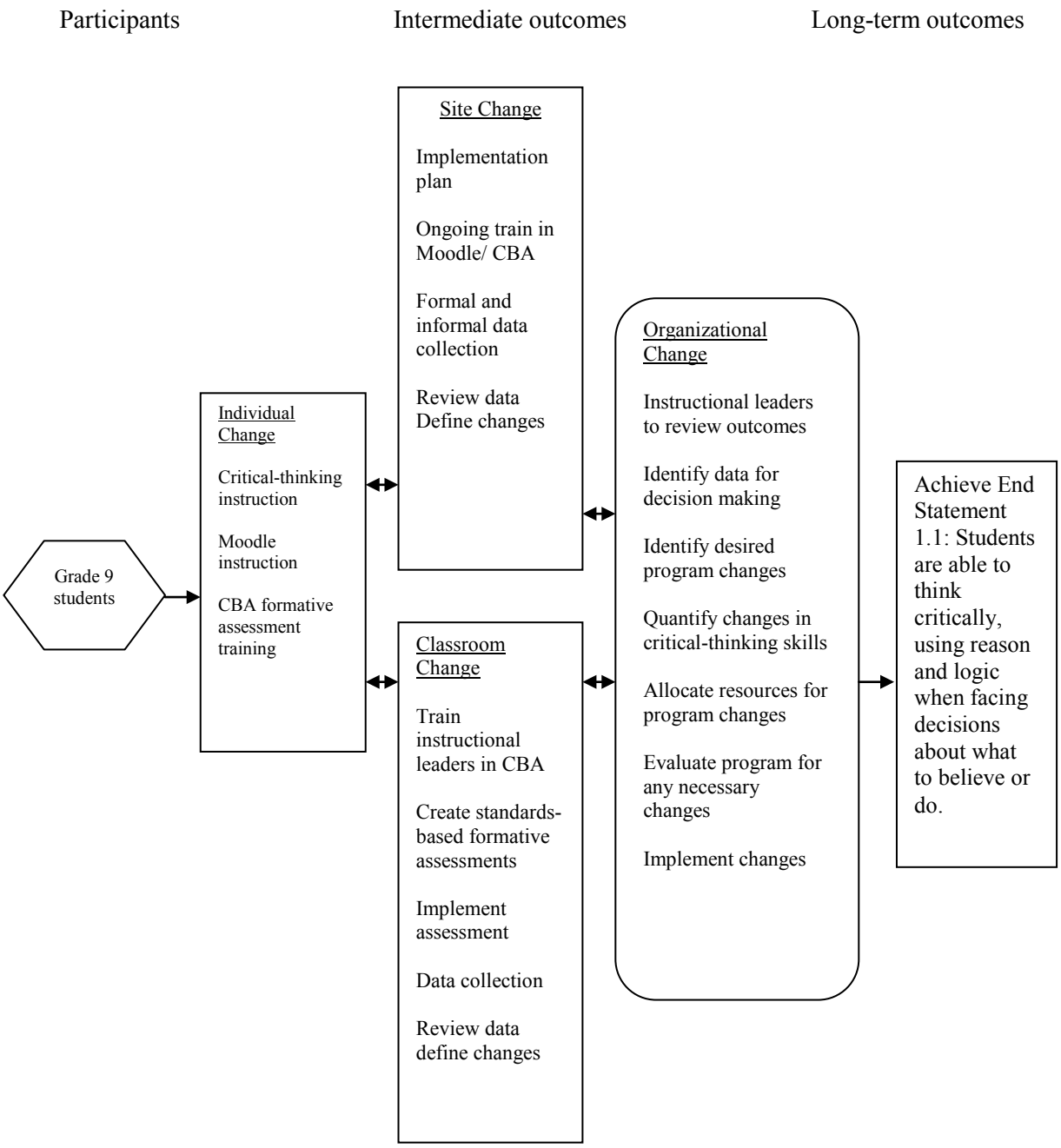
Proposal Contents Outline

1. Introduction and overview
2. Logic Model
    a. Visual overview of proposed project
3. Sample faculty development plan
4. Moodle course used to train teachers on the use of Moodle and CBA
    a. How to login to Moodle
    b. How to set up a course using CBA
    c. How to use resources in Moodle and CBA
    d. Individual work time to test familiarize teachers with Moodle
    e. How to use the calendar to plan events and CBA quizzes
    f. How to make and give CBA quizzes using Moodle
    g. How to create other types of assessments
    h. How to manage the gradebook in Moodle
    i. Survey of the training session
5. Sample Lesson Plan
    a. A sample that can be replicated to train students in the use of Moodle and CBA
6. Sample Survey

The proposed project is a program implementation plan of the Moodle-based CBA in the ABCSD. Included in this material is a professional development plan to be used for initial training of faculty. This is followed by an image of the Moodle course used to train teachers during the professional development training. Next is a sample lesson plan to be used a model to train the students in the use of CBA in their education. Finally, two questionnaires are included for the program. One questionnaire is to be taken by students after they have been trained on the use of CBA. The other will be taken after teachers have completed the initial staff development for the implementation of CBA.

The nature of Open Source material is that it is modifiable by anyone who might want to make changes to a program. On the content side, when items are created using the Creative Commons Licensing format, individuals are free use and make changes as needed without violating copyright laws. The course developed to train teachers uses the model of Creative Commons. Parts of the training were imported from Moodle.org's training course. Videos in the training course are from Two-Minute Moodles, a site dedicated to the creation of video representations of how to use Moodle. I created the website by incorporating material from the aforementioned sources with the content of CBA. The staff development portion is intended as 1-day training with continued access to the training site for future reference. Copies of the course are available in a .zip file from the ABCSD.

Logic Model for ABCSD CBA Implementation.



Moodle/CBA Professional Development (Faculty)

Essential Learnings:

- Introduce faculty to the use Moodle
- Introduce CBA theory and Assessments

Understandings:

By the end of the training you will Understand

- How to access Moodle
- Why CBA is used for critical thinking

Essential Questions:

- How can we use technology to train our students in the skills and dispositions of critical thinking?
- Can technology help me to train my students?

You will know…

- What Moodle is and what a CBA quiz is.
- The theory behind CBA

You will be able to…

- Start to create your course using Moodle and be able to create a CBA quiz
- Examine and interrupt the data generated from CBA quizzes
- Teach students how to use CBA
- Explain the theory of CBA to students

Assessment Evidence

Performance Tasks:

- Each Faculty member will log in to the Moodle/CBA training course.
- Training will start on setting up a course to house CBA quizzes as well as other pertinent course material.
- By what criteria will performances of understanding be judged?

Other Evidence:

- Through what other evidence (e.g., quizzes, tests, academic prompts, observations, homework, journals) will students demonstrate achievement of the desired results?
- How will students reflect upon and self-assess their learning?

Learning Plan

Learning Activities:

- The day will start with an overview of Moodle and confidence based assessments
- Take a CBA quiz to give an experience for faculty
- How to log into Moodle
- What Moodle can do for your class
- What a blended learning class is like
- Follow the course material in the Moodle course
- CBA quizzes
- How to make a CBA quiz
- Take a quiz developed by another teacher
- Look at data from quizzes taken
- Interpret data from quizzes
- Develop content area CBA quizzes
- Take survey on CBA

Titan Teacher Training

You are logged in as Tim Florian: Student (Return to my normal role)

Titans▸ TTT

Return to my normal role

Menu

- Home
- * Show all *
- Getting Started: Longin...
- Settings
- Resources: Files
- Calendar
- Quizzes
- Assignments
- Gradebook
- Moodle/CBA Training Survey
- Participants
- Profile
- Calendar
- Courses

Activities

- Assignments
- Questionnaires
- Quizzes
- Resources

Course categories

- English
- Health

Topic outline

How to be a Moodle/CBA School

Within this course you can explore basic Moodle features needed for a Moodle Classroom with in a Moodle School. Basic functions covered in the course will give you the tools to develope and administer your own course. Topics also addressed are the use of confidence bases assessments in your classroom to train and develop critical thinkers.

1 **Getting Started: Longin and Verification**

- Overall design of Moodle
- Site management
- User management
- Course management
- Log in: Video

2 **Settings**

- Turn Editing On: Video

Calendar

◄ March 2010 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Events Key

Global Course Group User

This course is designed to guide you through the process of set up and management of your own course.

- Literacy
- Math
- Performing Arts
- Physical Education
- Science
- Social Studies
- Student Government
- Technology
- Visual Arts
- World Languages
- Tech Center @ Legend
- Staff
- Technology Community
- Training
- LINK

All courses ...

3 **Resources: Files**

Resources can be prepared files uploaded to the course server; pages edited directly in Moodle; or external web pages made to appear part of this course.

- A Text Page
- A Text Page (markdown formatting)
- A Web Page
- A Web Page (opens in a new window)
- A Web Link (opens in a new window)
- A Web Link (framed)
- A Web Link (with parameters)
- A Directory
- A Label

Links to uploaded files (Moodle automatically assigns the icons according to the file type):

- An image
- An MP3 file
- A Flash file (opens in a new window)
- A Windows Media file (opens in a new window)
- An Office file
- A PDF file

Individual Work Time

- Imbed Videos: Video
- How to add files: Video
- How to add a web page link: Video

4 **Calendar**

- Calendar information

5 **Quizzes**

This module allows the teacher to design and set quiz tests, consisting of multiple choice, true-false, and short answer questions and more. Each attempt is automatically marked, and the teacher can choose whether to give feedback or to show correct answers.

This section also has and exteded discusson on how to create a CBA quiz and why you should be using them to develop critical thinking skills in your classes.

- How to Make a CBA quiz.
- A short quiz about Moodle (with timer)
- Example Listening Quiz
- A quiz with a password
- Make a Quiz Video

6 **Assignments**

Assignments allow teachers to grade electronically submitted material or 'offline' submissions such as paper-based assignments or class presentations.

- An Upload File assignment
- An Online Text Assignment
- An Offline assignment
- How to work with assignments: Video
- Assignment 1
- Assignment 1 to be uploaded

7 **Gradebook**

- The Gradebook

8 **Moodle/CBA Training Survey**

You are logged in as Tim Florian: Student (Return to my normal role)

Home

<table>
<tr><th colspan="2">Moodle/CBA Lesson Plan (to teach students)</th></tr>
<tr><td colspan="2">Essential Learnings:
• Introduce students to the use Moodle
• Introduce CBA theory and Assessments</td></tr>
<tr><td>Understandings:
By the end of the lesson students will Understand
• How to access Moodle
• Why CBA is used for critical thinking</td><td>Essential Questions:
• How can we use technology in the skills and dispositions of critical thinking?
• Can technology help me to train think?</td></tr>
<tr><td colspan="2">Students will know… Students will be able to…
• What Moodle is and what a CBA quiz is.
• The theory behind CBA
• How to take CBA quiz
• Examine and interrupt the data generated from your own CBA quizzes</td></tr>
<tr><th colspan="2">Assessment Evidence</th></tr>
<tr><td>Performance Tasks:
• Each students will log in to the Moodle/CBA course for their specific class.
• How to access course material</td><td>Other Evidence:
• Assess through observations for understanding
• Assess data from quizzes to see if students understand how to take a CBA quiz</td></tr>
<tr><th colspan="2">Learning Plan</th></tr>
<tr><td colspan="2">Learning Activities:
• The class will start with an overview of Moodle and confidence based assessments
• Take a CBA quiz to give an experience for faculty
• How to log into Moodle
• What Moodle can do for you the students
• What a blended learning class is like
• Follow the course material in the Moodle course
• CBA quizzes
• Take a sample quiz developed by the teacher
• Look at data from quizzes taken
• Interpret data from quizzes</td></tr>
</table>

View Advanced settings Questions Preview

Student Attutudes Toward the of CBA Survey

*1 Did you take one or more quizzes using CBA professional development?

○ Yes ○ No

*2 Answer the following questions about the use of CBA and taking tests in general.

	Almost Never	Seldom	Sometimes	Often	Almost Always
When I take tests I am afraid I will fail.	○	○	○	○	○
I used the Moodle CBA quiz to study for exams.	○	○	○	○	○
The use of Moodle CBA quizzes helped my grade.	○	○	○	○	○
After a CBA quiz I had more confidence in answering questions on an exam.	○	○	○	○	○
When answering written response questions I was able to provide more concrete evidence to support my	○	○	○	○	○

arguments because of the use of CBA quizzes.					
Knowledge of the content in this professional development course increased because of the use of CBA.	O	O	O	O	O
The use of CBA may help me understand complex issues.	O	O	O	O	O

*3 When you took the CBA sample quiz...

	Almost Never	Seldom	Sometimes	Often	Almost Always
I questioned my confidence.	O	O	O	O	O
I questioned the correctness of the answer.	O	O	O	O	O
I knew I was correct so I did not think about the answer or the confidence level.	O	O	O	O	O
I wanted the highest score so I took the time to be sure I was correct and provided the level of	O	O	O	O	O

confidence appropriate to to my understanding.

*4 When you think of your experience at Legend High School this year, is this the first time you have used the internet to take a test or quiz for school?

○ Yes ○ No

5 If you answered no on the previous question, when have you used the internet for educational assessments and how is this experience difference?

*6 What worked best for you when you used the CBA quizzes?

*7 As the district continues to expand the use of CBA, what suggestions do you have to improve the expansion?

*8 When you think about using CBA in your classroom to train and assess student critical thinking skills, what changes can you suggest to make this process better?

9 ABCSD is in the process of implantation Moodle and CBA in all high school in the district. As we progress we want to involve people in the process. Would you be willing to be apart of a cadre of teaches who inform and train new schools in the

use of Moodle and CBA?

○ Yes ○ No

Moodle Docs for this page

You are logged in as Tim Florian (Logout)

Anc Civ H

View All responses (140) Advanced settings Questions Preview

Student Attutudes Toward the of CBA Survey

*1 Did you take one or more quizzes using CBA?

○ Yes ○ No

*2 Answer the following questions about your Moodle CBA experience.

	Almost Never	Seldom	Sometimes	Often	Almost Always
When I take tests I am afraid I will fail.	○	○	○	○	○
I used the Moodle CBA quiz to study for exams.	○	○	○	○	○
The use of Moodle CBA quizzes helped my grade.	○	○	○	○	○
After a CBA quiz I had more confidence in answering questions on an exam.	○	○	○	○	○
When answering written response questions I was able to provide	○	○	○	○	○

more concrete evidence to support my arguments because of the use of CBA quizzes.					
Knowledge of the content in this course increased because of the use of CBA.	O	O	O	O	O
The use of CBA helped me understand complex issues in this class.	O	O	O	O	O

*3 When you think of your experience at Legend High School this year, is this the first time you have used the internet to take a test or quiz for school?

O Yes O No

*4 If you answered no on the previous question, when have you used the internet for educational assessments?

*5 What worked best for you when you used the CBA quizzes?

6 When you think of the CBA quizzes that you took for this class, what changes would you suggest to make the system better?

Moodle Docs for this page

You are logged in as Tim Florian (Logout)

Anc Civ

APPENDIX B: CONSENT FORM

You are invited to take part in a research study of an assessment method that may be used to assess critical thinking in education. You were chosen for the study because of your current role as an educator, administrator, or programmer/developer. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Timothy Florian, who is a doctoral student at Walden University.

Background Information:

The purpose of this study is to evaluate the viability of an assessment system within a content management system. The assessment system will ask learners to identify their knowledge and their confidence in their answers.

Procedures:

If you agree to be in this study, you will be asked to:

- Take an assessment using the confidence based system
- Answer a nine question interview about your experience using the assessment

Voluntary Nature of the Study:

Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to participate. No one at ABCSD will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind during the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:

Benefits of the study may be a method of assessment that can train students to think critically and increase student achievement in an affordable manner.

Compensation:

No compensation will be given to participate in the study.

Confidentiality:

Any information you provide will be kept confidential. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study.

Contacts and Questions:

You may ask any questions you have now. Or if you have questions later, you may contact the researcher via phone: 303.949.4404, or mail: 11640 Crow Hill Dr, Parker, CO 80134. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210.

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I am agreeing to the terms described above.

Printed Name of Participant _____

Date of consent _____

Participant's Written or Electronic* Signature _____

Researcher's Written or Electronic* Signature _____

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

APPENDIX C: INITIAL CONTACT LETTER

Dear Fellow Educators,

I would like to introduce myself to you. My name is Timothy Florian. I am a Teacher in ABC School District as well as a student in the EdD Teacher as Leader program at Walden University. I would like to invite you to participate in an exciting study designated to evaluate an assessment method that may be used to assess critical thinking and background knowledge. This research is part of my dissertation project and its purpose is to understand how to move confidence based assessment beyond initial steps of development to implementation in the classroom. I purposively selected you because of your position in ABCSD and current work with the content management system Moodle.

Your role in this study will be to take a short assessment using Moodle with CBA imbedded, answer nine interview questions on your experience. I have selected three teachers, three administrators, and three programmer/developers to participate in the study. The benefits for you would be that you will gain knowledge of whether an assessment method may be beneficial to you and your students in developing critical thinkers. You will receive a copy of the final report from me that include the findings from the program of study.

Confidentiality will be addressed by providing all of you with a coded number. All references to your district or jobs will be addressed by using the designated number and confidential district name. Demographics will be used in reference to your district and job to help understand the nature of the position you hold. All data will be securely locked in a file.

Please contact me by e-mail, telephone, or postal mail by September 30.

Thank you for your time,

Educator

APPENDIX D: CBA

Florian CBA site

You are logged in as Tim Florian (Logout)

Titans ► CBA ► Quizzes ► CBA Evaluation Assessment ► Attempt 1 Update this Quiz

Info Results Preview Edit

Preview CBA Evaluation Assessment

Start again

This exercise uses **Certainty Based Marking.**
Click here for Explanation and Help, in a separate window.

1 **3**

ID=2280
Weight: 1

If a reaction in one direction takes in energy, the reaction in the opposite direction

Choose one answer.
- a. destroys energy.
- b. cannot occur.
- c. takes in energy.
- d. releases energy.

Confidence : No Response C 1 Not Very C 2 Somewhat C 3 Very To Do

2 **8**

ID=2283
Weight: 1

Which of the following is an example of a renewable resource?

Choose one answer.
- a. nuclear.
- b. coal.
- c. sun.
- d. oil.

Confidence : No Response C 1 Not Very C 2 Somewhat C 3 Very To Do

3 **11**

ID=2285

Which of the following makes its own energy?

Weight: 1

Choose one answer.
- a. mammal
- b. bird
- c. insect
- d. plant

Confidence : No Response | C 1 Not Very | C 2 Somewhat | C 3 Very To Do

4 **10**

ID=2291 Weight: 1

Which of the following is NOT an example of a consumer?

Choose one answer.
- a. wolf
- b. lion
- c. wheat
- d. deer

Confidence : No Response | C 1 Not Very | C 2 Somewhat | C 3 Very To Do

5 **6**

ID=2290 Weight: 1

Which of the following is an example of a decomposer?

Choose one answer.
- a. mushroom
- b. leopard
- c. grass
- d. human

Confidence : No Response | C 1 Not Very | C 2 Somewhat | C 3 Very To Do

6 **5**

ID=2286 Weight: 1

Which of the following is an autotroph?

Choose one answer.
- a. falcon

answer.

○ b. flower
○ c. snake
○ d. bear

Confidence : ○ No Response ○ C 1 Not Very ○ C 2 Somewhat ○ C 3 Very To Do

7

ID=2289
Weight: 1

7

Which of the following is an example of a herbivore?

Choose one answer.

○ a. camel
○ b. shark
○ c. human
○ d. grass

Confidence : ○ No Response ○ C 1 Not Very ○ C 2 Somewhat ○ C 3 Very To Do

Save without submitting | Submit all and finish

Moodle Docs for this page

You are logged in as Tim Florian (Logout)

CBA

APPENDIX E: CBA INTERVIEW

Participant type: _____ Participant number: _____

Date of interview: _____

Interview questions	Participants' responses	Coding
What is your understanding of Confidence-Based Assessment (CBA)?		
How would you describe the Moodle LMS?		
How would you assess the usability of the LMS as it relates to CBA?		
Based on the description provided and your experience using CBA, how effective do you think the scoring matrix will be at improving student's ability to think critically?		
Critical thinking is often thought of as evaluative thinking. With this in mind, did this tool accomplish the goal of evaluating your knowledge of the subject?		
How useful do you think CBA will be in training and evaluating students' ability to think critically?		
How familiar are you with the CBA assessment style and format?		
What broader applications do you see for the use of Moodle and CBA?		
What modifications would you suggest to the CBA tool?		

APPENDIX F: CODING DATA

Interview Question Number		Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Notes
Typology	Group Level										
Confidence											
	L 1			x	x	x	x				Directs user to higher level of understanding
	L2	xxx		x		x	xx		x		
	L3	xx	xx			xx					
Knowledge											
	L1	xx		x	xxx	xxxx	xx			x	Should be applied everywhere
	L2	xxx	x		xxx	x	xx		x		
	L3	x	xx		xx	xxxxx					
Evaluation											
	L1				x	xx	x		xxx		
	L2	xxx							xx		Applications outside of classroom
	L3	x	x		xx		xx	xx			
Feedback											
	L1		xx	x							Feedback is tailored to learning needs
	L2			x	x		x				
	L3		xxx	xx		x		x			
Usefulness											
	L1		xxx	xxxx			Xxx	x		x	Ease of use common theme
	L2		xx	xxx	x		Xx	x	x	xx	
	L3	x	xx	xx	xx				xxx		Identified limitations as well as usefulness

The (x) indicates the number of times the typology was identified in a response within a question. Questions are noted by the identifier (Q).

APPENDIX G: INTERVIEW TRANSCRIPTS

What is your understanding of Confidence-Based Assessment (CBA)?

T1- CBA is designed to help students learn information while 1) becoming more confident in themselves, 2) identifying personal areas of weakness (misinformation) and strength and 3) learning how to address teachers/peers when they know they have correct answers even they are told they are not correct.

T2- My understanding is that students earn higher scores for answers they are positive are correct...fewer points are earned for answers students are not sure about, or for guessing.

T3- It is a way to test student's true understanding of a concept. It helps eliminate guessing and helps the student develop a better understanding of the content

A1- I know CBA to be a tool for assessing not only a students' knowledge about the content of a subject but also assessing a student's confidence level in knowing the content of a subject.

A2- You are testing your knowledge along with your confidence within the CBA format.

A3- I have a very basic level of CBA's; I know that help ascertain a student's background knowledge of a particular concept, which in turn helps one evaluate their confidence level within that topic or concept.

P1- I have read some of Tony Gardiner-Medwin's papers on the subject, and I have a math degree, so I feel I have a good understanding of how the score adjustments promote reflection.

P2- I have a very basic level of CBA's; I know that help ascertain a student's background knowledge of a particular concept, which in turn helps one evaluate their confidence level within that topic or concept.

P3- CBA is a methodology that provides the student the ability to not only increase their background knowledge but to reinforce the correct knowledge and immediately correct confidently held incorrect knowledge. It provides the teacher insight into the depth of knowledge and the confidence with witch that knowledge is held by individual students and the class as a whole. The data may then be analyzed by school and at the district level.

How would you describe the Moodle LMS?

T1- It is a way for online learning to become part of everyday education.

T2- Once I figured out the login, I found it to be user friendly. I liked the immediate feedback. I instantly learned what I did and did not know. That is so useful as a student, or as someone who likes to learn.

T3- Easy to use. Easy to learn. It is inviting to students. It does not seem overwhelming when you first log in. I found it very easy to navigate and to find the quiz that I was to take. I also liked the instant feedback. That is critical for student success.

A1- I would describe Moodle as a user friendly interface system that allows instructors to simply share content. I believe Moodle, or a similar platform, to be a key component of any successful CBA.

A2- Moodle is an educational platform that allows educators to use it as a communication and learning device for students and families.

A3- Moodle is an excellent medium of communication and resource tool that supports and enhances student and teacher growth and learning.

P1- Moodle is an excellent medium of communication and resource tool that supports and enhances student and teacher growth and learning.

P2-Moodle is an educational platform that allows educators to use it as a communication and learning device for students and families.

P3- Moodle is an open source LMS that allows educators to increase students' background knowledge, evaluate the depth and confidence with witch that knowledge is held and levels the playing field with respect to resources.

How would you assess the usability of the LMS as it relates to CBA?

T1- Very high, easy to incorporate into daily work in school or as a practice/homework tool for students to accomplish or use at home or outside of the school day.

T2- I would assess the usability as very high. While I was nervous about the content, as science is not typically a strength of mine, I felt confident in knowing that I

could use the program, and that I would learn something new. I also realized that I remembered more than I thought I would. Instant feedback is so enlightening!

T3- Very easy to use and the way it was set up made it clear what was expected.

A1- I would say that of the numerous LMS systems available, Moodle is the most easily adaptable and assessable confidence based assessment tool/system.

A2- It is very user friendly. Gives quick feedback to the learner.

A3- I have not had the opportunity to explore the use of LMS as it pertains to CBA, however I believe LMS could be a great medium to use when utilizing CBA. Through the use of Moodle, CBA's will be timely, practical and tailored.

P1- I found the CBM interface easy to use.
The only part that gave me any problems was that it took me a while to understand what the 'TO DO' buttons were doing.

P2-I found the interface very clear, except that it took me a moment to notice what the TODO buttons were doing.

P3- The interface was easy to use, it provides the students access to learning content outside of the classroom and with respect to CBA, it provides instant feedback to the user so that confidently held misinformation can be corrected quickly.

Based on the description provided and your experience using CBA, how effective do you think the scoring matrix will be at improving student's ability to think critically?

T1- I feel it will cause students to ask more questions about why they are incorrect. It will also cause them to improve self-assessment and encourage collaboration with others to find answers.

T2- I think that requiring students to dedicate a level of understanding of each question requires a higher level of commitment to the task. It is one thing to answer a question; it is something else to say to the teacher, "I am sure that I am right about this. I have studied it, I have learned it, I understand it, and I know that I am correct."

T3- I think it would be very effective at improving student's ability to think critically. They have to reflect on their level of knowledge about the subject. By doing this they are evaluating their knowledge and may be more reflective about their level of knowledge.

A1- When implemented and used with fidelity, the scoring matrix will vastly improve a student's ability to think critically and improve his or her own learning. The scoring matrix is a student's key to visually understanding how he or she is being successful.

A2- I think it forces a student to really think if what they are answering is really correct. It also gives students feedback in a way that forces understanding of the concept.

A3- CBA's could be practical if they are a part of the teacher's instructional practices. CBA's should help teacher's differential their instruction with greater clarity, however student must be vividly reminded and shown how CB's and Moodle are enhancing heir learning.

P1-Not being a teacher, I don't feel qualified to answer what students will do. However, I think CBM has great potential to promote critical thinking.

P2-Not being a teacher, I don't feel qualified to comment on what students will think. However, I think CBM has great potential to encourage students to reflect of the extend of their knowledge.

P3- The key to the success of a CBA is the student's understanding of the scoring matrix. As long as they grasp the concept of assessing one's confidence in the knowledge they have and it is integrated into the classroom and school setting I think it would be successful. I question whether younger students would easily grasp the scoring matrix.

Critical thinking is often thought of as evaluative thinking. With this in mind, did this tool accomplish the goal of evaluating your knowledge of the subject?

T1- yes, it caused me to think about each answer before responding. Then after each answer, I had to go figure out why I got an answer wrong, which would cause me to collaborate with others and by definition improved knowledge and thinking. I think once students understand how to take the assessments then the collaborative piece will fall into place. It will be exciting to follow this process in my classroom given the opportunity to implement CBA.

T2- I like the term evaluation, because I think it directs the learner to a higher level of understanding.

T3- Yes. I had little knowledge of the science in the quiz. Once I took the assessment a few times I was able see what I got wrong and why. It made me think about what I was learning and if I could internalize the concepts. All crucial parts to develop a critical thinker.

A1- I do not fundamentally belief critical thinking is evaluative or can be measured as "evaluative" of one's thinking. However, I believe the tool helps an individual to understand that they were thinking critically about the subject they were learning.

A2- It made me go through each answer to evaluate if it matched up with the question asked. Some I felt confident, while others not so sure. Being able to review provided clarification on doubt for a stronger confidence score with later attempts.

A3- It supported my current level of learning.

P1-On the whole yes.

P2-I think so.

P3- Yes, because the content can be tailored to different learning levels.

How useful do you think CBA will be in training and evaluating students' ability to think critically?

T1- Very useful.

T2- I think it will be an extremely useful tool. I believe in teaching kids about the kind of thinking and learning they are doing...from simple knowledge questioning skills to skills involving synthesis and evaluation. I think it benefits students to write and answer various levels of questions, and CBA offers the opportunity for students to express their level of confidence in their understanding, as well the chance to instantly learn from their mistakes.

T3- Incredibly useful.

A1- I am anxious to see the nexus to a rubric or score which could be directly correlated to a student's critical thinking. Philosophically, we can assume that a student "thought critically" because of how he or she answered with confidence to an assessment or how he or she "thought critically" as they gradually improved their understanding of a subject, but the quantitative connection is not robust.

A2- Thinking critically is a range or competency levels. Being able to apply what a student is learning is the most important. CBA shows a confidence level within a subject. If there is no confidence then a student hopefully is resourceful in finding the answer. Knowing what to do, when you don't know what to do is a skill for thinking critically.

A3- It will be useful because it provides tailored feedback for the student; however, the teacher must embed the use of CBA's into their instructional practice.

P1-Again, I don't feel qualified to answer.

P2-Not having regular contact with students, I do not feel qualified to comment.

P3- Yes, because the content can be tailored to different learning levels.

How familiar are you with the CBA assessment style and format?

T1- Highly familiar. I have been using it in my classes for just over a year with great success.

T-2 I m not very familiar with the CBA assessment style and format. This assessment is my initial exposure to this topic.

T3- Before this I was unfamiliar with CBA

A1- Very, I have been following the progression of the worldwide research for several years.

A2- Very little. Other than, what has been shown at our school over the last year. I have been loosely following the progression of this project and have talked to students and teachers who have tried the system and have found most people have responded to CBA positively. I did have a call from one parent who did not see how this could help their student in any way. I directed them to Mr. Florian and have not been contacted by them further.

A3- I have a very basic level of understanding.

P1- Very, as I stated earlier, I am a developer working on Moodle core code.

P2- Very familiar.

P3- I am familiar with the concept but I do not have interaction with students.

What broader applications do you see for the use of Moodle and CBA?

T1- Hybrid online learning classes. Evaluation of students. Evaluation of teachers

T2- Ummmm...well Moodle seems to be a tool that can be adapted and molded to almost any kind of assessment. I would expect that it could be used to assess students' confidence and skills in their writing as well.

T3- Reading comprehension. Vocabulary building.

A1- I believe that a CBA tool (run through a LMS like Moodle) can be and should be applied anywhere knowledge is being assessed. Most importantly, it should be utilized in areas where life and death are factors in success: the medical field, human transportation, police, fire, etc.

A2- Not sure. It is an interesting question. I guess it could be used for adult training. Training where we want someone to be confident in the information they learned then be able to apply that information correctly.

A3-CBA's can be utilized for a formative use and could assist teachers with the UbD instructional design.

P1-Moodle is already used in many contexts.

CBA has great potential in many settings. I can only see two limits to its applicability:

1. In some situations, it may distract from the main purpose of the assessment, in which case it should not be used.
2. It requires a certain intellectual sophistication to understand the concept. For example, I would be surprised to see it used in primary schools.

P2-I think it could be applied anywhere where students have the necessary cognitive skills (that is, it would not work in primary school), and where it does not distract from the other goals of the assessment.

The biggest potential problem is where the student misread the question, and are certain they know the answer to the question they thought the read. Then they will be heavily penalized for a small error, not for incorrectly reflecting on the degree of their knowledge.

P3- I think that the CBA assessments can be modified to evaluate any learning level with the cognitive ability to understand the purpose of CBA. Potential is limited only by what may be conceived by the users. It could also be used to track success in individual classrooms, by school and at the district level. It may be used to evaluate the viability of a program or an individual teacher.

What modifications would you suggest to the CBA tool?

T1- None yet.

T2- I can't think of any necessary modifications. It's all good!

T3- I can't think of any at this point

A1- In this day and age of amazing technology, color, graphics, "cool" buttons and gadgets, I think the CBA tool can look and feel more modern and should be developed to meet the visual needs of any given audience. More colors for younger users, more "internet like" qualities for 20-40 year olds.

A2- none.

A3- I am not sure that I have the depth of knowledge to transfer my understanding to a useful suggestion.

P1-Should be in Moodle main release - I'm working on it, but my interface is slightly different at the moment.

P2- I would add it to the official Moodle release - and I am working on it. http://docs.moodle.org/en/Development:Question_Engine_2

P3- The interface should be versatile to address the different needs of the users and it should be added to the official Moodle release.

CURRICULUM VITAE

Educator
Any Town, USA

Education

Walden University, Baltimore, MD — Expected 2010
Doctoral Candidate **(ABD) –** Teacher Leadership

University of Phoenix, Denver, CO — 2006
Masters of Arts, Curriculum and Instruction

Northern Arizona University, Flagstaff, AZ — 1992
Bachelor of Science, Economics and Political Science

Professional Experience

Legend High School, Parker, CO — 2008 to present

Moodle Coordinator
Facilitated training and staff development for all teachers at LHS
Developed and implemented new instructional technology for staff and students
Instructor of US Government, World History, World Geography

Mountain Vista High School, Highlands Ranch CO — 2004 to 2008

Department Chair 2005-2007
Facilitated training and staff development for all teachers at MVHS
Developed and implemented new instructional technology for staff and students
Freshmen transition educator 2006-present
Instructor of Economics, US Government, World History, World Geography
Technology Committee member

University of Phoenix — 2009 to present

Action Research Committee Chair
Adjunct Instructor

Douglas County Learning Services — 2007 to present

Training Directors of Schools and Douglas County Administrators in the implementation of online Confidence-Based Assessments to evaluate effectiveness of training and facilitation of staff development

Learning Bridges 2006 to present
Staff Development Instructor in Virtual environment

eDCSD 2006 to 2008

Head Teacher
Online instructor, US Government and Economics

Teacher, Buena High School, Sierra Vista, AZ 1997 to 2004

Instructor of Economics, US Government, Sociology, and Youth and the Law
Student Government Advisor, Assistant Soccer Coach
Technology Committee Member
Curriculum Committee Member

Lead Teacher Boot Camp, First Corrections Corp. Phoenix, AZ 1996 to 1997

Member of the start up team for new school
Provided staff development for new teachers and staff
Instructor of GED preparation courses for diverse student population in a juvenile correction facility
Member of the Management Executive Committee

Teacher, Sanders Middle School, Sanders, AZ 1995 to 1996

Instructor of Business Education and Computer Application to at-risk student population on the Navajo Reservation

Licenses and Certifications

Colorado – Professional Teacher License, Exp. May 2008
Arizona – Professional Teacher License, Exp. May 2009

Professional Presentations and Paper

National Council on Economic Education, EconEdLink.org
Keynes vs. Hayek: The Rise of the Chicago School of Economics
Capital Investments: Human v. Physical
What Causes Inflation?
History of Monopolies in the United States.
China: Where will it fit in the World Economy?
National Council on Economic Education, New York, NY 2005

Honors and Rewards

DCSD Apple Digital Educator
Intel “Teach to the Future” Technology Educator