Spring 5-17-2013

The Brutal Reality of Bringing Kids up to Level: Are Critical Thinking and Creativity Lost in the World of Standardized Testing?

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“The Brutal Reality of Bringing Kids Up to Level”: Are Critical Thinking and Creativity Lost in the World of Standardized Testing?

A Thesis

Submitted to the Graduate Faculty of the
University of New Orleans
in partial fulfillment of the
requirements for the degree of

Master of Arts
in
Sociology

by

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B.A. New York University, 2008

May 17, 2013

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Abstract

Since the passage of No Child Left Behind, the output of education has been measured through student achievement on standardized tests. School ratings, student graduation, teacher jobs and school charters are all tied to these tests. This study analyzes the extent to which math and science public high school teachers in New Orleans focus on critical thinking and creativity, skills needed to be successful in the future. Through a framework of Richard Paul's model of critical thinking and Theresa Amabile's social psychology of creativity, this study evaluates support for critical thinking and creativity through classroom observations, analysis of instructional materials and teacher interviews. Findings indicate that teachers at academically selective schools are more likely to support critical thinking and creativity in their classrooms than teachers at open enrollment schools. Classroom tests of participating teachers mainly focus on assessing basic knowledge and skills, not critical thinking and creativity.

Education, Sociology, Creativity, Critical Thinking, No Child Left Behind, Standardized Testing, Social Psychology of Creativity, Teacher Evaluations, Math and Science

Introduction

Mr. Hedberg[1] puts a list of problems on the board. They start out easy, but end with three "Challenge" questions. He says nothing as the Algebra II students work in groups of four to solve these problems. A steady level of chatter fills the classroom. "How did you get that?" one student asks his teammate. "Why is that the answer?" another student argues with her teammate. Mr. Hedberg, from the side of the classroom where he has been perched, observing group interactions, announces, "After problem 8, write your rule, your problem and your title." "Coach, check our rule," a student asks, referring to the teacher's afterschool coaching position, but more accurately describing his teaching role in this classroom. "Check your rule with the challenge problem," Mr. Hedberg responds. "There are multiple ways to do this," he continues, helping students design strong rules through leading questions. "Work hard for three minutes, then we will take a break." During the "break," students stand in a circle around the room and throw a plush baseball while announcing perfect squares in order. "Be careful, you might get hit," a student warns me as I slink in the corner, hoping I'm not going to have to remember my times tables.

Mr. Blout greets students at the door as they walk silently into the room and work on the "Do Now" on the board. A timer reminds students to work quickly while the teacher softly whispers help to students who raise their hands. "You should be done in 30 seconds," Mr. Blout announces. When the countdown ends he says, "Pencils in the air!" and all students hold their pencils up, slam them on the desk and clap their hands above their heads making a shape of a triangle. The teacher calls students out to answer the problems on the board, having one student answer, and then another explain. Students snap when they agree with an answer. The students explain to Mr. Blout each step of writing an equation while he writes the answer on the board.

[1] All names included have been changed to protect the identity of participants.

"It's been a week and a half since we've done this material," Mr. Blout says. "If you remember this, you will remember it on the EOC [End of Course Exam]." He swiftly moves through the problems, having students snap to show they got the right answer. When doing an inequality problem he asks, "Do we have to do the big flip?" after students snap in response he asks them to turn and talk to their neighbor to explain why. The silent classroom becomes a muddled rumble for 30 seconds. For the next problem, he asks, "Show me on your arms, is it going to be a union or intersection? Ready and show." All of the students put their arms in the air to show the inequality will be a union. "On your paper, write down union. I want us to write these all over again because we are forgetful, but because we are nerdy in our mastery, we just do stuff over and over and practice to get it right. You have 30 seconds to get that all done." The students silently copy down the rules to solving and graphing inequalities.

Education reform since passage of No Child Left Behind in 2001 has focused on the output of learning measured through standardized test scores. School ratings, school funding, student graduation, school charters and, through the addition of Race to the Top, teacher jobs and salary are all linked to these tests. The state written, federally mandated tests focus on testing student knowledge and application of concepts, not on the process of learning. The above examples show just how different classroom environments, instructional strategies and student and teacher interactions can be. While Mr. Hedberg stresses student centered learning and play in his classroom, Mr. Blout emphasizes memorizing concepts and learning steps. The process of learning varies greatly depending on the focus of education. The process of instilling in students a love of learning and the thinking strategies needed to be successful in the future is minimized in an environment saturated with standardized testing as the output.

Standardized tests reduce student achievement to an output of test scores, belittling the process of learning. The emphasis on standardized tests creates students who are skilled test takers, not productive citizens ready to advance our culture and society (Alcazar 2006). Our society today demands high levels of literacy and critical thinking to be successful (Dorman et al. 2006). Along with being able to read and write, students have to think critically, participate in a global economy, use technology and apply skills to the real world (Adam et al. 2009). These are the skills needed to be innovative problem solvers in college and beyond, and are the skills employers emphasize, but not the skills standardized tests are best suited to evaluate.

Teachers are thrust into the middle of this debate. Their job evaluations, their students' graduation, their school ratings, their school charters and their school funding are tied to standardized test scores. The tests may offer concrete evidence of learning through a number of questions that students answer correctly, but learning is a process only inferred through assessment (Ambrose et al. 2010). Teachers decide the process of learning in their classrooms, but work within the constraints of assessments. According to the *MetLife Survey of the American Teacher*, teachers, parents and executives surveyed believe that higher order thinking skills (such as critical thinking and problem solving), cross-disciplinary learning, self-motivation and team skills are essential for college and career readiness (Markow & Pieters 2011). The role of a teacher in supporting critical thinking and creativity is more subtle and much more difficult to measure than basic knowledge and skills measured in standardized tests. Despite the difficulty to measure these goals, they are the heart of education: creating productive citizens who are critical thinkers and creative problem solvers.

The purpose of this study is to evaluate the extent to which New Orleans high school math and science teachers focus on critical thinking and creativity in the classroom in an environment saturated with standardized testing. Using social psychology, business management and education strategies, I plan to measure the techniques teachers use that align with increasing critical thinking and creativity. Emphasizing student achievement on tests is not entirely compatible with increasing critical thinking and creativity skills. Through the literature, a framework emerges that details the intervening factors of standardized testing, basic knowledge and skills and control mechanisms that negatively affect critical thinking strategies and an environment that supports creativity. Through understanding what critical thinking entails and the environmental factors that influence creativity, we can analyze and evaluate classrooms through how well teachers prepare students for the future, not how well students perform on standardized tests.

Literature Review

Schools are organizations, systems of complex elements that intersect in a patterned set of activities to produce a common output (Johnson 1970). Schools as organizations are evaluated through how well they achieve their intended output (Johnson 1970). In 1971, the American Council of Education released a collection of research on educational measurement that defines the general process of education: "providing a series of environments that permit the student to learn new behaviors or modify or eliminate existing behaviors to the point that he displays them at some reasonably satisfactory level of competence and regularity under appropriate circumstances"(Krathwohl & Payne 1971, pg. 17).

The teacher's role in such a definition is to create and sustain the environment that brings about the desired changes. High quality teachers can offset other negative impacts on education, including socioeconomic status, large class size and limited school resources (Rivkin et al. 2005). Teachers matter most when predicting student learning. Of all the educational interventions to serve poor and minority children the one with the strongest evidence behind it is effective teaching (College Ready 2009). According to the Academic Impact Model, supported by Teach for America, teachers' mindsets determine teacher actions, which directly influence student actions and student achievement. A teacher's mindset thus impacts student achievement.

The desired behaviors teachers foster are divided between immediate objectives – ones incorporated in a school program, such as subjects, classes and lessons – and ultimate objectives –the development of an educated person through those objectives. Immediate objectives are content-driven goals of basic knowledge and skills. Ultimate objectives are cross-disciplinary skills that help students be successful citizens in the future. E.L. Lindquist outlined in 1951 how difficult it is to directly match the immediate objectives with empirically proven ultimate

objectives: “many detailed elements which have no relationship whatever to the ultimate objectives have entered the curriculum simply because they ‘belonged’ in the same broad category of knowledge”(Lindquist 1951, pg. 121). The objectives in curricula should be designed to prepare students to be successful in the future, not just ensure that they understand certain basic ideas, according to Lindquist. For example, the immediate objective of knowing a cell’s organelles is loosely tied to an ultimate objective of critically thinking about how parts of a system relate to the whole. The basic knowledge and skills included in curriculum materials are content-focused, immediate objectives, but in some circumstances are barely related to cross-disciplinary, ultimate objectives of education.

If the output of schools is to create productive citizens, what does that mean in the 21st century? What skills are going to make students successful in the future? Changes in education policy need to evolve with changes in the economy (Fatt 2000). The skills students need today include high levels of literacy, critical thinking, use of technology and media, applying skills to the real world, creative problem solving and coming up with alternative processes (Fatt 2000, Adam et al. 2009, Dorman et al. 2006). A productive citizen has the critical thinking and creativity skills needed to be innovative and successful in the idea economy. Bill Gates challenged American high schools as obsolete in a speech in 2005:

> “By obsolete, I mean that our high schools – even when they’re working exactly as designed – cannot teach our kids what they need to know today. Training the workforce of tomorrow with the schools of today is like trying to teach kids about today’s computers on a 50-year-old mainframe. It’s the wrong tool for the times” (College Ready 2009).

According to *Grading Education*, there should be eight different goals of education: basic academic knowledge and skills, critical thinking and problem solving, appreciation of the arts and literature, preparation for skilled employment, social skills and work ethic, citizenship and

community responsibility, and physical and emotional health (Rothstein 2008). Along with these goals, research sponsored by the Bill & Melinda Gates foundation found that the following habits of mind contribute to academic success and college readiness: willingness to put effort and discipline into work now to achieve long-term success, and the ability to study independently, sustain concentration on a task, use evidence to defend a point of view, and self-correct in response to feedback (College Ready 2009).

The educational goals that are the focus of this research are basic knowledge and skills, critical thinking and creativity. These goals encompass preparation for skilled employment, social skills, work ethic and habits of mind, including independence, using evidence to defend a point of view and self-reflection. Evaluation of school output is measured through standardized testing, which focuses on basic skills and knowledge. The process of learning critical thinking and creativity, a critical long-term goal of education, is evaluated through teacher observations. But standardized tests determine teacher evaluations, student graduation, school ratings, school funding and school charters. In high school classrooms, ultimate, cross-disciplinary goals are pushed aside to focus on immediate, content-specific goals, measured through standardized tests.

Basic Knowledge and Skills and No Child Left Behind

The immediate objectives of basic knowledge and skills include recall of basic facts, such as terms, processes and ideas, and application of basic skills, such as steps of math problems and science processes measured through standardized testing in schools. No Child Left Behind (NCLB) is the federal program that requires all public schools to administer standardized tests to grade levels (Ravitch 2010). These tests measure basic levels of proficiency (Rury 2012) and determine what it means to be successful in the classroom (Ravitch 2010). In Louisiana, the standardized tests are the LEAP (4^{th} and 8^{th} grade) and End of Course Exams (high school). The

LEAP tests measure proficiency in English, Math, Science and Social Studies, but only require students to pass English and Math to graduate to the next grade level. End of Course Exams are computerized standardized tests with multiple choice and constructed response questions given in May during the school year a student takes Algebra 1, Geometry, English 2, English 3, Biology and American History. To graduate from high school in Louisiana a student needs to score fair or above on one math test, one English test and either history or science. The Louisiana Department of Education determines a numerical and letter grade for each school based on attendance, dropout rates, graduation rates and these assessments. The majority of the score (90% for schools K-8 and 70% for schools 9-12) is based on how well students perform on the state's standardized tests. The scores range from 0 to 200 and schools below 65 are considered failing (Louisiana Department of Education 2012). Each school is also required to meet its Adequate Yearly Progress (AYP), an increase in score set by NCLB. If schools are labeled as "failing" or Academically Unacceptable and do not meet their AYP, they are in jeopardy of losing funding, being taken over by the state and losing their charter. Funding through Title 1, given by the federal government to urban, minority and lower income schools, is connected to SPS and AYP values (Ravitch 2010). If a charter school receives a D or F SPS score grade after three years of operation, its charter will be transferred to another organization and the school will be closed (BESE 2013).

Standardized tests are limited in what they can measure. The bulk of standardized tests – 50 out of 53 questions in Louisiana – are multiple choice because of the simple method of grading and reporting results (Koretz 2008). Thomas Haladyna outlines the difficulty in writing multiple choice questions that measure higher order thinking skills, such as critical thinking, problem solving and evaluation. In multiple choice questions, tests only measure the right or

wrong answer, not the thought process the students use to answer it. Thus, if students are coached on how to answer multiple choice questions, or are presented the questions in a similar fashion before the actual test day, they will use memory, not critical thinking, to approach the problem (Haladyna 1999). To understand this disconnect, one study asked students who passed their state standardized test to take a comprehensive exam with the same questions presented as essay questions. The students had to explain why they chose the multiple choice answers in the comprehensive exam. Seventy-one percent of the students who passed the standardized test failed the comprehensive exam, indicating that students are trained to answer multiple choice questions, but cannot explain their choices (Berube 2004).

Tests that do claim to measure critical thinking ask students to explain their thought processes while answering questions. Students read and evaluate arguments through written essays (Yeh 2001). These tests may be effective tools to measure critical thinking, but they are not practical for widespread use because of the cost of grading such tests (Yeh 2001, Koretz 2008). Designing standardized tests that measure critical thinking through multiple choice questions is possible, according to Yeh. "The goal of a test of critical thinking is to determine if children can use facts, rather than recall them," writes Yeh (2001, pg. 14). He simplifies critical thinking to a "workplace" definition through evaluation of arguments. Through this conceptualization, he writes multiple choice questions that provide students with two different opinions about content and asks them to determine which argument is more valid. These questions do not require content knowledge as much as thinking skills to evaluate arguments. Yeh acknowledges that more than one option may appear valid, but that one will always be the strongest. Yet if students are shown very similar problems during class, they will use memory and not critical thinking to answer the question.

This example of multiple choice questions that attempt to measure critical thinking simplifies what critical thinking requires and is not widely used. First, the definition for critical thinking, as outlined in this literature review, is more complex than argument. Also, out of the 80 released test items from the Louisiana End of Course Exam from 2009 to 2012 in Algebra and Geometry (students must pass one of these required exams to graduate), only two followed Yeh's suggestion of test questions. Also, only half of the constructed response questions, the only non-multiple choice questions on the exams, asked students to provide explanations for their answers. These explanations were also for lower-level questions, simply asking students to describe a process that was most likely explicitly taught. The Biology End of Course Exam (the only standardized test in high school science) has only three constructed response and 50 multiple choice questions. Science as Inquiry, a section of all high school science curricula that focuses on the scientific method and problem solving skills, is not a part of the constructed response questions. Further, none of the 20 released multiple choice test items (this is only the third year the Biology tests have been given) ask for critical thinking skills. The two constructed response questions released do ask students to provide evidence for a conclusion, but the conclusion is drawn from a low-level question. Thus, the End of Course Exams in Louisiana do not adequately assess student' critical thinking skills.

To measure the lower-level basic skills, NCLB asks teachers to align instruction with standards and assessment (Polikoff 2012). State standards and curriculum materials have existed for decades, but enforcing it started with NCLB. The assessments provide extrinsic motivation for teachers to reinforce the messages of the content (Polikoff 2012). NCLB limited teacher agency to choose the material covered in the classroom. With standardized testing teachers received a powerful incentive to cover the content required by the state. A study of K-12

teachers from 2003 to 2009 found increased alignment of state curriculum and classroom instruction in math and English, but decreased alignment in science courses (Polikoff 2012). Since standardized testing does not require students to pass the science section, science classroom content is less strictly monitored, thus less aligned to state standards.

Henry Dyer, VP of the Educational Testing Service and creators of the SAT, warns that accountability systems must define goals for schools and should not only concentrate on one goal. By focusing on basic knowledge and skills, schools encourage students and teachers to focus on just that aspect of becoming successful, ignoring the social development involved in education and the interdisciplinary nature of learning (Rothstein et al. 2008). E. L. Lindquist, who developed the Iowa Test of Basic Skills, the ACT, GRE and original National Merit Scholarship Qualifying test warned back in 1951 about using tests as a single indicator of student achievement (Koretz 2008) although that is precisely how tests are being used today.

Gains in scores are typically the result of teaching test skills, not broadening and deepening of knowledge of the world and truly understanding what students have learned (Ravitch 2008). Tests are generally very small samples of behavior that we use to make estimates of mastery of large domains of knowledge and skills (Koretz 2008). Tests can only assess the ability to recall and apply information learned over a particular period of time (Burgess 2010). The immediate objectives of education in the curriculum are what tests focus on.

When designing tests, administrators have to pick a sample of the subject area to include. For example, when testing a student's vocabulary, the test administrator picks a few words that represent different levels of vocabulary. The test cannot assess if the student knows all of the words, just a representative sample of the skill (Koretz 2008). The reliability and validity of

such tests can come into question when sampling is not done correctly. Reliable tests measure the same level of proficiency for students on a standard, no matter which test they are taking. Valid tests make the correct inferences from the question and correctly determine if a student is proficient or not. Koretz insists that the tendency of teachers to "teach to the test" limits both the validity and reliability of these tests. If students are taught the specific vocabulary chosen for the test, for example, then the test administrator cannot infer a highly proficient vocabulary and, if given a different kind of test, the student would not get the same score (Koretz 2008).

Most studies have found that standardized tests limit instructional practice. In a study of teachers across grade levels in Kansas, Massachusetts and Michigan, a majority of teachers at each grade level said that state testing causes them to teach in a manner that goes against their views of what constitutes good educational practice (Clarke et al. 2003). Some teachers claimed that standardized tests improved instruction in math and reading by challenging teachers to cover more material, but they recognized how that shift takes away enrichment activities that improve students overall development (Clarke et al. 2003). One fifth of the teachers interviewed believed standardized testing forces them to focus on breadth of topics, not depth. While instruction in math and English may have improved the amount of content covered, the expanded curriculum and time constraints of lessons force teachers to focus on test-taking strategies. Teachers in urban middle and high schools expressed a concern about removing lessons that relate more to being successful in society than succeeding on the tests, such as performance activities, learning financial math, and public speaking (Clarke et al. 2003).

In a study of 300 classrooms done by Horizon Research, only 15% of classes provided opportunities for thinking, reasoning and sense-making during math instruction. High-level cognitive demands of instructional tasks often decline during instruction because teachers and

students are uncomfortable with the ambiguity and struggle that are caused by high levels of thinking, reasoning and problem solving (Weiss & Pasley 2004). Teachers can keep thinking and reasoning at a high level by questioning, encouraging conceptual connections and holding students accountable for explanations and meaning. Teacher use of questions that elicit and support student thinking and allocation of class time to reflect and communicate ideas are associated with higher student success in terms of motivation to study math and deeper conceptual understanding of the material (Boston 2012).

A study by the Center on Educational Policy found that shifts in instruction are related to the proportion of minority students in schools. Out of the 349 school districts sampled during the 2006-2007 school year, 62% had increased instruction in reading and math, but in urban school districts, the number was much higher, totaling about 4 hours per week more instruction in math and English (Rothstein 2008). Standards and strict curriculum guides force teachers to rush through a number of lessons in order to follow the pace set by the state. This produces rote mathematical knowledge instead of rich mathematical understanding. Since NCLB, mathematical instruction has lost sense-making and turned into a jumble of formulas and equations (Spencer 2012).

There is also no stipulation in NCLB to measure science inquiry, instructing students on how to use the scientific method to propose, defend, evaluate and solve problems. A study of third grade classrooms by the National Institute of Child Health and Human Development found that teachers only spent 6% of class time focused on science, compared to 56% of class time spent on literacy and 29% spent on math (Marx and Harris 2006). Science inquiry includes deepening student knowledge, applying new information, and engaging in investigations (Marx and Harris 2006). Higher level schools that are not as tied to NCLB because they do not receive

Title 1 Funds (generally non-minority, suburban schools) are more capable of focusing on science inquiry skills. Researchers fear this difference between urban and suburban, minority and non-minority schools, will make science inquiry an "upper class" skill (Marx & Harris 2006).

Findings of the Bill and Melinda Gates Foundation study on teacher effectiveness show that teachers with high student achievement on state tests are more likely to promote deeper conceptual understanding as well. The study compared student scores on math standardized tests in elementary and middle schools with tasks completed on the Balanced Assessment in Mathematics (BAM), a task-based assessment that is considered to have higher cognitive demands and require higher-order reasoning than most state tests. Teachers with high levels of achievement on state tests are more likely to also show achievement on the higher-order test according to the report but with a moderate correlation (.31 in elementary school and .38 in middle school). According to the report, this indicates that teachers are not simply teaching to the test, but improving higher levels of thinking (Ensuring Fair and Reliable Measures 2013). This study is the only example providing positive support for standardized testing.

Changes in instruction have not just led to issues with student achievement, but have also affected dropout rates. *The Silent Epidemic*, a 2006 report funded by the Bill & Melinda Gates Foundation, surveyed 470 dropouts. Over half said they left because their classes were boring, did not relate to the real world and were not engaging. A majority said they would have worked harder to graduate if school was more challenging and helped them achieve their goals (College Ready 2009).

The focus on standardized test scores comes from a scientific management and business approach to education (Henderson, Ravitch, Garrison 2012). Scientific management stresses

increasing economic productivity in the workplace by quantifying every movement of workers and analyzing the most efficient way to organize workflow. According to Jim Garrison, business leaders and politicians are leading the debate about how to fix our country's schools, constantly talking about the economy, efficiency, competitiveness, human capital theory and standardization. Suggestions of incentive-based pay and connecting test scores to teacher salaries come from the private sector, but private sector incentive systems are not solely based on quantitative measures (Rothstein 2008). Business leaders stress that using only quantitative measures, such as test scores, is a limited approach. Management literature also recognizes the importance of choosing evaluation tools and warns against picking the one that is the most easily measured: "it is better to imperfectly measure relevant dimensions than to perfectly measure irrelevant ones"(Bommer et. al. 1995). Evaluating teachers and students through basic skills, the easiest goal of education to measure, and matching that evaluation to teacher pay misinterprets private sector principles administrators are trying to mirror (Rothstein 2008). "Schools serve as a site for the smelting and refining of human resources"(Garrison 2012). Scientific management approaches to education train efficient and productive students suitable only for low-level jobs.

An emphasis on standardized tests also indicates the social control and normative pressures of contemporary education. In *Discipline Punish,* Foucault outlines the power mechanisms of schools (1975). The standards of education, the tests and the rules of engagement in schools represent hegemonic education policy that some educators question. In *Foucault and Education*, an analysis of Foucault offers teachers an alternative from following the enforced norms of education (Jardine 2005). The authors question the labeling of students as "ADHD" just because they do not want to passively accept knowledge and behave the same way as other students. "Science of education," using scientific management strategies to quantify

knowledge into enforceable skills that can be monitored and measured, further depicts mechanisms of power. Teachers do have to constantly monitor students to assess how well they understand the lesson and are comprehending the knowledge, but this monitoring can lead to panopticism, partitioned time and space, documentation, prescribed activities and repeated exercises that create an objectified and trained individual (Jardine 2005). The teacher's panoptic gaze constantly watches students from above and forces them to passively accept information as an object, not an active part of the learning process.

Foucault leads us to question not only the use of testing in No Child Left Behind, but also the whole idea of grades, points, ranks and documentation. If these standards of education are the artificial creations of society to discipline, normalize and make economic use of students, should they be so strictly followed? Should every class, from every region, be expected to follow the same route to high school graduation? Why do we learn about dinosaurs in 4th grade? Why do we study the weather in middle school? In subjects like math and English, the separation is a little more natural, as Foucault indicates, but there is some sorting of subjects that seems rather arbitrary. Are the "disciplines" in college simply different ways to discipline and categorize people? Sorting students by their majors is a convenient way to classify individuals according to a perceived set of their strengths and weaknesses.

We can simply accept the hegemony of education policy and follow the standards, but Foucault asks us to analyze the institutionalized norms placed upon us and question their purposes (Jardine 2005). Currently the U.S. Department of Education is questioning the scientific management of the education system. Teachers, principals, students and administrators form pockets of resistance within the power discourse in the face of bureaucratic management of schools. States lowered standards, requiring students to only pass 35% of standardized test to be

considered as "passing." Some districts and schools were caught cheating on these tests, either by feeding the students answers, erasing and correcting answers or using test questions to prep the students (Becket 2013).

These tests remain the basis of educational discourse because they are a rational, scientific way to measure school success. But the rational science aspect of these tests is starting to turn. According to the U.S. Department of Education, the lowering of curriculum standards and minimizing student achievement to achievement on standardized tests has diminished the competency level of students that graduate from high school. An increase in college remediation rates indicates a disconnect between curriculum expectations and college readiness (Howell 2011). Four in ten students starting 4-year colleges and half of all students enrolled in community college are required to take remedial classes. Enrollment in remedial courses makes it difficult for students to graduate college on time, or at all. A 2004 U.S. Dept. of Education study found that only 17% of students enrolled in remedial reading graduate with a bachelor's degree, and 27% of those enrolled in remedial math, graduate with a bachelors compared to 58% of students not enrolled in such classes. Standardized tests are not producing the same level of knowledge in students. They are producing students that are less politically and economically useful to society. The discourse of "truth" in education is beginning to question how useful these examinations are to train students in the correct manner. Strict discipline, standards and evaluations produce students who cannot be successful in the 21st century economy. Critical thinking and creativity are skills needed to be productive citizens, but not the objectives standardized testing enforces.

Critical Thinking

Unlike basic levels of knowledge, critical thinking is hard to categorize, evaluate and teach. The goals of "higher order thinking skills" and "critical thinking for innovation" appear frequently in educational rhetoric, but the definition of these terms is complex in relation to classroom learning. Bloom's taxonomy is a ranking of levels of knowledge, separating lower level thinking (recall, comprehension and application) and higher order thinking (analysis, synthesis and evaluation). Although critical thinking is a higher order thinking ability, it entails deeper reasoning and problem solving skills than the skills Bloom's outlines as higher order thinking (Ennis 1987). In "Critical Thinking and Learning," Mark Mason outlines the biggest differences between definitions suggested by authorities on critical thinking. One main distinction is whether critical thinking is domain specific, or can be related across disciplines. While John McPeak insists that one must learn the basics of a discipline in order to critically think within it, Robert Ennis and Richard Paul stress the application of reflective thinking and correctly assessing statements within all disciplines (Mason 2009). Siegel believes that critical thinking can extend through disciplines, but one must understand the logic and principles of a discipline to rationally apply critical thinking to it (Mason 2009).

This study will use Paul's model of critical thinking (Elder 2012) because it applies across all courses and grade levels. Paul also emphasizes using critical thinking to help the learning process, and not needing to have basic knowledge of a discipline to effectively use thinking skills. To Paul, critical thinking is that mode of thinking in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing and reconstructing it. Students are thinking critically when they are consciously and deliberately thinking through some dimension of the logic of the discipline they are studying. Critical thinking generates

purposes, raises questions, uses information, utilizes concepts, makes inferences, makes assumptions, generates implications and embodies a point of view (Elder 2010). Critical and creative thinking is a skill that requires generating and choosing ideas around a core of knowledge and logic. There is a cyclical relationship between idea generation and reflective judgment. Through thinking through a topic, one can question, investigate and build knowledge, reflecting upon ideas and reasoning through problems. Self-regulation is essential to the process, and understanding one's own attitudes and dispositions also affect this process (Baum-Combs 2009).

In *Learning to Think Things Through*, Gerald Nosich presents steps to critical thinking using Paul's model of Elements of Reasoning and Standards of Critical Thinking that students can apply to any subject area. The steps to approach any critical thinking question are to reflect on the question asked, think through the question using the elements of reasoning – point of view, purpose, assumptions, concepts, implications, information and consequences – and hold them to the standards of critical thinking – clear, accurate, important/relevant, sufficient, precise, deep and broad. According to Nosich, one can apply these steps to any discipline by thinking through the fundamental and powerful concepts of the discipline. These are concepts that can be used to explain a huge body of problems or questions. For example, one can answer a question about what happens when we get a cut through the fundamental and powerful concept of the cell. By using the same critical thinking strategies, but applying the concepts and vocabulary of a discipline, one can gain the skills needed in any area (Elder 2010; Nosich 2001).

Paul's model for critical thinking brings into account many elements of the goals of education. For example, he stresses exercising fair-mindedness, empathy and intellectual humility (Elder 2010). Through learning to think critically, Paul and his team of researchers at

the Foundation for Critical Thinking believe you can change all aspects of your personal and professional life (Elder 2010). According to bell hooks, critical thinking builds self-esteem, teaching people to be self-actualizing and self-determining. "It helped me survive the racist, sexist, class elitism outside the home of my growing up and the dysfunction which sanctioned abuse, betrayal, and abandonment within the patriarchal home"(hooks 2010, pg. 183). This process of critical thinking is essential to develop productive citizens in education. It is imperative to progress (Burgess 2010). Garrison stresses "true democratic education seeks educational equality as a way to educate individuals capable of criticizing and recreating society – not simply recreating the status quo" (Garrison 2012). Criticizing and recreating society require critical thinking and creativity, while basic knowledge and skills simply recreate the status quo.

Creativity

According to Paul, one cannot separate the ability to think critically and the ability to think creatively: "Creativity is essential to all rational dialogical thinking" (Paul 1987, pg. 143). The application of critical thinking and creativity in the workplace is referred to as innovation (Badran 2007). Innovation is taking a new creative idea and being able to implement it within an organization through seizing opportunities, seeking possibilities and creating new ventures (Badran 2007; Amabile et al. 1996).

Although it is difficult for students to be highly innovative, but giving them the creativity and critical thinking skills needed to be innovative in the future is possible. Supplementing the framework of critical thinking outlined above with an environment that supports creativity can achieve this goal. Creativity is the ability to create something new as applied to any domain. It can be a thought or idea, a process, an object, a product, a work of art or performance or an

interpretation (Badran 2007; Amabile et al. 1996). In math or science, creativity refers to designing new rules, new solutions, new problems and new questions. Schools and society are blamed for squashing creativity, but according to Sawyer, they actually make it possible (2006). It is possible to support creativity in the classroom, but unfortunately more often than not creativity is pushed aside to focus on short-term goals of normative lessons and standardized testing.

Research on creativity focuses on the cognitive processes and personality features of creative people, and environmental and social aspects of the creative process. J.P. Guilford, an early creative thinking researcher, explained novel idea generation as one aspect of intellect: divergent thinking. One's ability to be creative is determined by the four aspects of divergent thinking: fluency, flexibility, originality and elaboration (Guilford 1988). To fully understand how and why the cognitive processes of creativity occur, many psychologists look at creative people and their personality traits. One such study found that creative people are autonomous, introverted, open, norm-doubting, self-confident, self accepting, driven, ambitious, dominant, hostile and impulsive (Feist 1998).

The idea of the creative person in such studies makes creativity seem as something that cannot be taught or supported by an organization. Creative people with specific cognitive processes and personalities can alone create novel ideas. But creativity is essentially tied to *society* and *environment*. Andrew Hargardon refers to creativity as a "Chimera," a model of two genetically different materials tied together (2006). Personal creativity is essentially connected to the existing social structure through recombining established ideas and gaining acceptance of a new idea (Hargadon 2006).

The accepted definition of creativity within social psychology and management literature is "the generation of a novel product that is *useful and relevant*" (Paulus & Dzindolet 2008; Amabile et al. 1996; Badran 2007; Sawyer 2006; Agars et al. 2008). Thus, the creative idea is intertwined with the domain in which it is generated and social acceptance of the idea. Baer and Kaufman's 2005 amusement park theory of creativity attempts to explain this complex relationship. The initial requirements for creativity are intelligence, motivation and a suitable environment. The level of each of these elements is different for each situation, but not sufficient enough alone. For example, in mathematics, a certain level of knowledge of math processes is essential to creatively solve any problem, but simply having this knowledge will not produce creativity. Motivation and environment are complex, multidimensional elements that creativity cannot survive without. According to this theory, creativity varies according to the domain but the specific tasks can require similar skills. Therefore, creativity requires certain intelligence, motivation and a suitable environment, depending on the domain and the task at hand, but certain skills can be applicable in any domain.

Motivation is an essential element to creativity that has been studied from many angles. The amusement park theory stresses that motivation is directed in specific domains of creativity in empathy and communication, math and science or hands on activities. Regardless of shared skills, a person may exhibit creativity in only the domain that engages the person (Baer & Kaufman 2005).

Teresa Amabile's studies on the social psychology of creativity also pinpoint motivation as an essential factor in determining a level of creativity. She divides creativity into creative thinking skills, expertise and motivation. Task motivation is the element Amabile focuses her research on because it is one that teachers and managers can easily adapt (Amabile 1998).

Instead of separating motivation by domain, Amabile separates motivation into intrinsic and extrinsic motivation. According to the Intrinsic Motivation Principle, "Intrinsic motivation is conducive to creativity; controlling extrinsic motivation is detrimental to creativity" (Amabile 1996). Intrinsic motivation is being internally motivated to complete a task for one's own interest or enjoyment. Extrinsic motivation is an outside goal imposed upon an individual, and it is what many managers and teachers focus on. Giving money or prizes for completing a task, or stressing the importance of the task for an external goal, such as graduating college, reduces participant creativity. If students and workers perform a task because their own desire and not for a desired end product, then they will be more creative, according to Amabile (1987).

Teacher Evaluation Systems

The three goals of education mentioned above: basic knowledge and skills, critical thinking and creativity are not measured with the same consequences in teacher evaluations. NCLB measures the effectiveness of teachers through standardized test scores. These test scores also determine the school ranking, student graduation and school funding. Critical Thinking and Creativity are measured through classroom observations, which only weigh on the evaluation of teachers, not the entire school environment.

In "Measuring What Matters," Aaron Pallas, an educational sociologist at Columbia, outlines the difficulties with measuring teacher effectiveness. Teacher evaluation systems identify the kind of learning society values, and NCLB doesn't measure critical thinking, problem solving, social skills, work ethic, citizenship, community responsibility and other goals of public education (Pallas 2012). It also expresses what society values as good teaching which can only be measured through classroom observations (Pallas 2012). In a study of teachers, parents and children from elementary schools in the Midwest, the respondents understood the

importance of evaluation systems for teachers but suggested portfolios of classroom tools and classroom visits to exhibit use of effective classroom strategies in the process of learning not test scores, the output of education (Ballard & Bates 2008).

The Bill and Melinda Gates Foundation is currently running studies to examine current teacher evaluation systems and design more effective ones. Their preliminary report from a study of 4th through 8th grade teachers in five representative districts finds that a teacher's value-added score, while volatile from year to year and class to class, is one of the strongest predictors of future student achievement on standardized tests. Value-added scores use students' previous achievement on test scores as a predictor to determine how much the students should grow in one year and evaluate teachers through their students' growth. The Foundation also found that student perceptions of teacher effectiveness, a measure used in higher education but rarely included in primary or secondary education, was consistent for teachers across different classes. The most important indicators according to the study, were student perception of teacher control of the classroom and the use of challenging lessons (Learning About Teaching 2010).

The current evaluation model in Louisiana, COMPASS (Clear, overall measure of performance to analyze and support success) uses both value-added measures from test scores and classroom observations to evaluate teachers. The 2012-2013 school year is the first time that this evaluation system will be fully implemented. Each teacher's annual evaluation will be based 50% on value-added measures of student growth and the other half on classroom observations and professional practice. In New Orleans, schools in the Recovery School District and Orleans Parish School Board will be a part of this new evaluation system. Charter schools, which educated 78% of New Orleans public school students in the 2011-2012 school year create their own evaluation models. Charter schools are autonomous and while they are required to

administer the same standardized tests they have freedom to evaluate teachers and design courses on their own.

Value-added measures take into account previous test scores, disability status, free and reduced meal eligibility, attendance, English language proficiency and discipline history to determine the expected score for the student on standardized tests. In high school, this system currently applies only to the End of Course Exams in Algebra 1 and Geometry. Biology and American History are not all currently used for the value-added measures of student achievement because this is the first school year and the first graduating class that will be evaluated by these tests.

The nearly two-thirds of Louisiana teachers whose performance is not measured through test scores will develop student learning goals at the beginning of the semester based on district-approved assessments. Teachers in subjects that have EOCs, but do not have data from previous years to use value-added scores, can determine student goals through their achievement on these tests. For subjects not tested at all, the state recommends that national assessments be used, or the district can determine the assessments. At this point in Louisiana, teacher salary is not linked to performance on these assessments, or the EOCs, as in some states.

The other half of teacher evaluation is constructed from Charlotte Danielson's Framework for Teaching. This rubric, which outlines different levels of effective teaching, was originally developed in 1996, but has been updated many times, including in 2011, as part of the Measures of Effective Teaching Project sponsored by the Bill & Melinda Gates Foundation (Danielson 2011). Louisiana adapted the rubric, focusing on a subset of original categories, including setting instructional outcomes, managing classroom procedures, using questions and discussion techniques, engaging students in learning and using assessment in instruction. More

than 15 states have chosen to use the Danielson model in their evaluation tools (Louisiana Department of Education 2012). Parts of the model are directly related to critical thinking teaching strategies, such as planning lessons with rigor and high expectations, using questioning strategies to promote higher order thinking skills, engaging students in problem solving and task-oriented assignments, and allowing time for student reflection. Other parts are related to creativity, including putting students in diverse work groups, allowing students to evaluate themselves, providing sufficient resources to complete tasks and engaging students to be motivated in learning. The last part of the evaluation focuses on assessment, ensuring that students understand evaluation criteria and the meaning of high quality work and regularly diagnosing evidence of learning (COMPASS 2011).

Although approximately half of the evaluation of teachers is linked to goals of education other than basic skills, this half is unrelated to school ratings, student graduation and school funding. Students must pass certain parts of the EOCs and finish course work in order to graduate. Schools are rated and ranked through their graduation rates and student achievement on standardized tests and the school ranking determines the Title 1 funds a school can receive and if its charter will be renewed. Teachers must weigh the importance of their classroom observations with the importance of their school ratings, student graduation, funding and charters. The school environment is saturated with standardized testing and teacher evaluations are linked to this environment.

This thesis proposes a study of how teachers navigate the apparent contradictions of their roles in schools. Teachers are expected to focus on basic skills for students to pass standardized tests and use techniques of critical thinking and creativity for instruction. The heavy weight that NCLB and teacher value-added evaluations place on standardized tests detracts from the

attention teachers can place on critical thinking and creativity. This study will evaluate the extent to which teachers in New Orleans high school math and science classrooms focus on critical thinking and creativity skills. It will explore the goals of education that teachers have and how they compare to the evaluation systems in classrooms, schools, districts and nationwide.

Research Design

This study focuses on the consequences of educational policy actions and real world applications of learning strategies and the process of learning. Through this pragmatic worldview, I hope to gain an understanding of the process of learning in classrooms and the reality of teaching critical thinking and creativity skills. The pragmatist is able to reveal practical answers to society's problems (Creswell 2003). Through studying the education system in this manner I hope to aid in solving the disconnect between the immediate, content-specific goals of education, basic skills measured through standardized testing, and ultimate, cross-disciplinary goals of education, critical thinking and creativity. I focus on the effect of standardized testing on the teaching and the consequences on the learning process throughout my research.

This project is a case study of the teaching process and classroom objectives of New Orleans math and science high school teachers. A case study approach is most suitable for pragmatic research because it gives the researcher flexibility to use a variety of data collection procedures. A case study is an in-depth investigation of a phenomenon bounded by time and activity (Creswell 2003, Ali 2011). This design is "suitable for dealing with critical problems of practice and extending the knowledge base of various aspects of education" (Ali 2011). The problem of teaching critical thinking and creativity skills is important in education and understanding the classroom learning process will extend the knowledge of how to teach these skills. Case study is an appropriate tool to understand the dynamics of interactive social, cultural, personal and academic phenomenon in a classroom (Hitchcock & Hughes 95). While the findings are based in a specific time and place, New Orleans math and science classrooms during the 2012-2013 school year, the strategies studied apply to other school systems and

classrooms juggling with standardized tests and attempting to incorporate a focus on critical thinking and creativity as well.

Data for this research project include classroom observations, teacher interviews and content analysis of instructional and assessment materials. The classroom observations are participant observations where my role as a researcher is known to the teacher. Local, state, district or school administrators and other teachers frequently observe classrooms, thus the students and teachers are used to having classroom visitors. I asked the teacher to pick the day and time of the first observation. I observed each teacher for three hours, which meant two 90 to 100-minute periods for seven teachers and three 50 to 60-minute periods for two teachers. Each observation was accomplished during the same class period and lasted the entire length of the period. "Classroom observations help in drawing pictures of learning activities, the challenges, dilemmas and difficulties the teacher faces, and the way the teacher responds to these challenges"(Hancock 1998, pg. 162). Observations focused on teacher and student interactions, the classroom environment and the teaching strategies used. The field notes consisted of narrative accounts of these classroom attributes and any inferences, questions or insights I had during the class. The teacher is the main focus of the observation, but the students are minimal actors whose responses to teacher actions are noted.

The teacher interviews are based on the observations and a semi-structured interview schedule. The interviews cover any questions I had about my observation, classroom goals, the skills needed to be successful, teaching strategies used, negative factors that affect instruction, school support, testing, NCLB and goals for the future of education. A draft of sample interview questions is attached (see Appendix A). Two interviews were completed outside of the school environment, during school break or the weekend, and seven were completed within the school

during planning periods or after school. The interviews range from 45 minutes to 1 hour 20 minutes. I transcribed the interviews and coded them using the analytic strategy outlined below.

The content analysis includes instructional materials and assessments for one unit of classroom instruction. These materials include handouts, homework, projects, labs, assignments, tests and quizzes. Teachers either offered electronic versions of materials on my protected memory drive or hard copy versions copied from a notebook. The amount of materials received varied by the teacher's teaching method. For example, teachers that use the textbook do not have many handouts to give.

Research procedures were approved by the Institutional Review Board (See Appendix B). To protect the privacy of participants, I assigned each teacher a number and letter to represent their interview, observations and school documents. Any personal information on the documents, including teacher and student names and the names of the schools, was blacked out immediately upon acceptance. Throughout the study, I refer to the school through the SPS score or type of enrollment (For example, "C-School" for non-academically selective school with a C SPS score and "academically selective" for the two A schools that require an admissions test). I received informed consent from each participating teacher which outlined their participation and rights in the study. The informed consent form is attached (see Appendix C).

Sampling Procedures

To understand the effects of NCLB and the process of teaching critical thinking and creativity skills, I sampled New Orleans public high school math and science teachers. The schools chosen offer a diverse representation of the structure of schools in New Orleans, including network charter schools and non-network charter schools. There are no traditional public schools represented in my sample. New Orleans has the highest percentage of students in

the United States enrolled in charter schools at 78%. Of the 26 high schools in New Orleans during the 2011-2012 school year, only 10 were directly run by the Recovery School District or the Orleans Parish School Board. Of these, 8 were in transitional years, either just opening or shutting down (Cowen Institute 2012). Table 1 contains information about the seven selected schools.

Table 1

Schools Sampled

School Code	Type of School	School Board	Number of Students	2012 SPS	Admission	% Free or Reduced Lunch	% Black Students
A1	Charter	OPSB	730	198	Academic	30	30
A2	Charter	OPSB	1,709	167	Academic	24	32
A3	Charter	OPSB	881	130	Open	87	97
B1	Charter	OPSB	370	116	Open	73	81
B2	Charter	RSD	334	112	Open	92	94
C1	Charter	RSD	603	98	Open	89	98
D1	Charter	BESE	296	82	Open	85	62

I recruited participants through purposive sampling, choosing teachers at schools through subject area, teaching experience and suggestions from professionals in the field. The nine teachers include four math, four science and one engineering teacher, to represent a merger of the two subject areas. Four of the teachers have tested subjects (Algebra 1 and Biology) and the other five have non tested subjects (Physics, Chemistry, Algebra 2, and Engineering). Four of the teachers are from schools with academic selective enrollment and five teachers are from open enrollment schools.

The respondents vary by gender, race, teaching experience, background education and subject taught (see Table 2). Three respondents are female, six are male. Two are black and the other seven are white. The number of years teaching ranges from 3 to more than 20.

Participants include four traditional teachers, who received a teaching degree from an education school, and five non-traditional teachers. Non-traditional teachers received certification through alternative certification programs. Two of these teachers were trained through Teach for America, two through University of New Orleans and one through Tulane. According to Teach for America, 1 in 3 current students in the Greater New Orleans region have been in at least one classroom led by a Teach for America corps member. Thus, including a few of the over 400 former and 375 current TFA corps members is essential to understanding New Orleans public school education. Three teachers at academically selective schools did post graduate work within the sciences and taught at the university level before deciding to teach high school. Elementary and Secondary teachers must be certified through the state in order to teach in public schools despite previous teaching experience in private schools or universities.

Table 2

Teacher Demographic Information

School	Subject	Grade Level	Years Teaching	Gender	Race	Type of Certification	Background Education
A1	Physics	9	18	F	W	Alternative	Biology
	Biology	10	>20	F	W	Traditional	Biology
A2	Algebra 2	10	5	M	W	Traditional	Education
	Engineering	9	10	M	W	Alternative	Engineering
A3	Algebra 1	9	4	M	B	Traditional	Education
B1	Chemistry	11	4	M	B	Alternative	Social Science
B2	Algebra 1	9	4	M	W	Alternative	Business
C1	Physics	12	3	M	W	Alternative	Social Science
D1	Algebra 1	9	>20	F	W	Traditional	Education

Role of Researcher

The motivation behind this research project stems from my own experience teaching math and science at a New Orleans public high school. Despite my desire to instill a love of learning, critical thinking and creativity within my students, I found myself spending more time

pounding terms and concepts into the minds of my students. The pressures of standardized testing (at that point the Graduate Exit Exam – GEE – which tested 10th grade students in math and 11th grade students in science) redirected the goals of my classroom. My educational philosophy is built upon the idea that all students have the ability to learn, despite any family, health, socioeconomic status, race or gender barriers that may stand in their way. Through my own training in Teach for America, I learned about the power a teacher can have within the classroom to motivate and educate students to high levels of achievement. My novice status as a teacher makes me far from an expert but my experience at least provides a glimpse into the lives of teachers. I am familiar with the state curriculums for high school math and science, especially Algebra 1, Physical Science, Biology and Chemistry, and with the state required exams. My last year teaching was the pilot year for the EOC and I am currently teaching EOC prep courses in Biology at a local high school. Keeping in mind the failures of my classroom, I can appreciate the successes and failures of other science and math classrooms and understand the difficulties that come with teaching these subject areas.

Analytic Strategy

The coding strategy for the observations, interviews and instructional materials is based on Dr. Paul's model for Critical Thinking and Teresa Amabile's KEYS rubric. Dr. Paul's model for critical thinking entails concrete parts of learning for teachers to focus on during instruction. The process of critical thinking includes addressing a problem by thinking it through using the elements of reasoning and using standards to evaluate your own thinking. The two parts of this model, elements of reasoning and standards for critical thinking, depict ways teachers can model, teach and evaluate critical thinking in their classrooms. The elements of reasoning provide a way for teachers to ask for elements of thinking within assignments and in the classroom. The standards of critical thinking are a tool for evaluating student's critical thinking abilities. An adaptation of the model with classroom examples is outlined below.

Table 3

Assessing Instruction for Critical Thinking

From Elder, Linda. 2010. "Richard W. Paul: A Biographical Sketch." *Foundation for Critical Thinking*. Available: http://www.criticalthinking.org/ABOUT/Fellow_Richard_Paul.cfm

Elements of Reasoning	**Description**	**Example**
Generate Purposes	Understanding why the problem is important.	Students understand why they are doing the assignment.
Raise Questions	Asking questions about the material to either clarify or extend.	Students ask questions during lesson that help them understand the information.
Use Information	Using background information provided by the problem and background knowledge and experiences.	Students use previous day's lesson and old notes to help complete assignment.
Use Concepts	Using known theories, rules or ideas to answer the question.	Students apply rules and concepts learned previously in new problem.

(table continued)

Make Inferences	Extending the known information to infer possible conclusions.	Students use observations and knowledge to infer possible answers to the question.
Make Assumptions	Using information and inferences to justify assumptions.	Students use prior knowledge to make assumptions about the question.
Generate Implications	Extending information and inferences to other areas.	Students predict outcomes using prior knowledge.
Embody a Point of View	Placing knowledge and questions within a field of study or point of view.	Students approach problems as "mathematicians" or "scientists" according to their point of view.
Standards of Critical Thinking		
Clear	Explicitly presenting information, keeping audience and discipline in mind.	Students explain thinking explicitly to audience in clear voices.
Accurate	Using information appropriately and answering questions correctly.	Students present their answers with correct units, numbers and information.
Important/Relevant	The thinking relates to the question and extends information.	Students ask questions and imply information relevant to the problem.
Sufficient	Thinking process is complete and answers the question.	Students complete entire problem, keeping all parts of the problem in mind.
Precise	Thinker presents only relevant material and similar thinking processes draw similar conclusions.	Students stay on task and draw conclusions similar to classmates.
Deep	Thinking goes deep into problem at hand.	Students analyze all aspects of small details of the problem.
Broad	Relating problem to diverse situations.	Students apply thinking to many situations and come up with solutions that apply broadly.

To supplement Paul's framework for critical thinking, Amabile's rubric outlines the environmental factors that influence creativity. Developed based on studies of the social psychology of creativity to assess workplaces for their ability to support creativity, the rubric

focuses on aspects of creativity that the workplace can control, namely creating an environment to support intrinsic motivation. The six categories that Amabile found influence intrinsic motivation are organizational encouragement, supervisory encouragement, work group supports, sufficient resources, challenging work and freedom. Below is an adaptation from the KEYS Rubric with descriptions of each item and an example of what the category means in the classroom:

Table 4

Assessing Classroom Environment for Creativity

Adapted from Amabile, Teresa M., Regina Conti, Heather Coon, Jeffrey Lazenby and Michael Herron. 1996. "Assessing the Work Environment for Creativity." *Academy of Management Journal* 39(5): 1154-1184.

Scale Name	**Description**	**Sample Item**
Organizational Encouragement	An organizational culture that encourages creativity through the fair, constructive judgment of ideas, reward and recognition for creative work, mechanisms for developing new ideas, an active flow of ideas, and a shared vision of what the organization is trying to do.	Teachers are encouraged to use innovative teaching strategies. School vision includes creativity.
Supervisory Encouragement	A supervisor who serves as a good work model, sets goals appropriately, supports the work group, values individual contributions, and shows confidence in the work group.	The teacher has confidence in students and models creative behavior.
Work Group Supports	A diversely skilled work group in which people communicate well, are open to new ideas, constructively challenge each other's work, trust and help each other, and feel committed to the work they are doing.	Students trust group members and constructively challenge each other.
Sufficient Resources	Access to appropriate resources, including funds, materials, facilities, and information.	Students have the resources they need for their work.
Challenging Work	A sense of having to work hard on challenging tasks and important projects.	Teacher challenge students with relevant assignments.
Freedom	Freedom in deciding what work to do or how to do it; a sense of control over one's work.	Students have choice in completing assignments.

These models drive the analysis of the interviews, observations and content analysis. All three forms of data were subjected to the same strategy to determine the extent critical thinking and creativity are focused on in some parts of learning rather than others. I read through each data source twice, once looking for instances of critical thinking and once for instances of creativity. During these coding episodes, I also looked for intervening issues that may take away from a teacher's ability to focus on critical thinking and creativity. For example, if a teacher has a focused goal for his or her students, but this goal is for achievement on the EOC, that would be an intervening issue. If a teacher does not offer student choice on projects, but asks all students to follow on the same path to answer a problem, that would be an intervening issue. Throughout the analysis, I use memoing and zigzag techniques to develop a comprehensive model of New Orleans math and science high school instruction (Creswell 2003). The use of all three kinds of data allow teachers multiple avenues to show and explain the focus of their classroom and any impediments they face to full achievement of increasing critical thinking and creativity skills in students.

Limitations

This case study analyzes the process of teaching critical thinking and creativity in high school math and science classrooms within the constraints of NCLB, but the research design has limitations in its implications. By only including nine teachers this study does not evaluate all of the teachers and schools within the New Orleans area. By selecting only one or two teachers from each school it is impossible to make generalizations about the schools themselves. The process of learning varies greatly from classroom to classroom, subject to subject and school to school. Through an in-depth analysis of the nine participants, I hope to understand how teachers

make decisions about their classroom and organize the learning process, but cannot make generalizations about how these processes occur in other classrooms.

Although this study attempts to understand the effects of NCLB on classroom instruction, the design does not provide any comparison. Only three of the teachers included in the study have taught before and after the implementation of NCLB. What the findings can suggest is how classroom interactions and the process of learning relate to a focus on basic knowledge and skills assessed by standardized testing versus the process of supporting critical thinking and creativity. The models of critical thinking and creativity provide a measurement tool of the learning process to evaluate if the teachers within the current climate of standardized testing do in fact support the ultimate, cross-disciplinary educational goals of critical thinking and creativity that prepare students to be successful in the future.

Results

The analysis delves into how each teacher approaches the three main goals of education: basic knowledge and skills, critical thinking and creativity. Instructional techniques, classroom environments and assessment tools of participating teachers depict a stronger focus on basic knowledge and skills for teachers at open enrollment schools and critical thinking and creativity for teachers at academically selective schools.

Basic Knowledge and Skills

The teachers in the study mentioned that basic knowledge and skills are important for students to have to be successful in the future. Specifically, teachers outlined "fundamental skills" such as reading comprehension, writing, numeracy, number sense, computational skills and the "floor of learning". Teachers at open enrollment schools struggle with students who do not have the basic skills a student should have before entering high school. For example, an Algebra 1 teacher at a D-rated school noted her students lacked number sense, including mastery of simple addition and subtraction and multiplication tables. Even at an A-rated school, the Algebra 1 teacher noted that only 26% of his students have an on-grade level reading score, with most students scoring between a 4^{th} to 6^{th} grade reading level in their 9^{th} grade year. Classroom observations confirm that some students at these schools struggle with basic concepts. During a Physics lab at a C-rated school, a senior student was unsure about how to calculate the average of her data. During a lesson on exponents in an A-rated school Algebra 1 class, a student yelled out "I don't understand fractions!" Although these students all passed the standardized tests to pass into high school, and these schools all report different levels of school performance scores, all teachers from open enrollment schools in my study shared a similar struggle with basic knowledge and skills. The immediate objectives of content-based knowledge exhibited on

standardized tests are only loosely tied to ultimate objectives in the process of learning that students need to continue learning after passing the standardized tests.

Teachers deal with the lack of basic skills in a number of ways. One B-rated school, understanding the low level of students that enter the school, schedules two hours of Algebra 1 every day to students, one hour in the morning, and one in the afternoon. A Physics teacher at a C-rated school slowed down the pace of his class, covering two months of curriculum recommended material in 6 months, to focus on the dimensional analysis skills his senior students lacked. When faced with students who do not know multiplication tables, an Algebra 1 teacher at a D-rated school decided to allow kids to use their calculators so they can understand concepts without number sense.

Academically selective schools avoid this obstacle to learning through requiring entering students to pass specific GPA and assessment requirements. The norm-referenced assessments the schools require compare New Orleans students with students nation-wide. The Iowa Test of Educational Development and Iowa Test of Basic Skills, accepted by both schools, assess deeper conceptual understanding of math concepts and problem solving. The tests also assess science reasoning, but that section is not required for admission. To be accepted into the academically selective schools students not only have to achieve higher scores on these assessments, but the assessments themselves test deeper understanding than the LEAP exam students take to enter open enrollment high schools. GPA and assessment requirements are a form of resistance against the mandates of NCLB. If students who already possess basic knowledge and skills to pass the End of Course Exams, teachers at the academically selective schools can focus on other goals of education.

Yet classroom assessments of open enrollment and academically selective schools reflect teachers' goals of basic knowledge and skills. The teachers in Algebra 1, a subject tested with an EOC, gave tests with mainly, if not all, multiple choice questions that asked low-level knowledge and application questions. Non-tested subject teachers (Physics, Engineering and Chemistry) still assessed a majority of low-level multiple choice or fill in the blank questions for at least half of the test questions, but also constructed response or performance-based questions. This trend suggests that even teachers in non-tested subjects view tests as a way to assess basic knowledge and skills. Although academically selective schools can resist NCLB through entrance exams, the teachers at these schools and open enrollment schools still view tests as a mechanism to assess mainly basic knowledge and skills.

Teachers in tested subjects had a range of ways to focus student attention on standardized tests. The Biology teacher in an academically selective A-rated school only mentioned testing once during my observations in regards to an online test prep program the students are supposed to use once a quarter. The Algebra 1 teachers in non-academically selective A, B and D-rated schools all shared classroom goals of achievement on the Algebra EOC. These teachers structured their assessments using the EOC, explicitly telling students that the classroom assessments predict how well they will perform on the EOC. These teachers also had their classroom goal of achievement on the EOC written somewhere in their classrooms. The B and D-rated school teaches mentioned the EOC during class while discussing test taking strategies and stressing the importance of lessons. "Everything that you see is possibly going to be on the EOC," the B-rated school teacher stressed when discussing an upcoming classroom test. These were also the only two teachers in the study who used scores on tests and classroom assignments to extrinsically motivate students. The B-rated school teacher had a "Levels of Nerdom" display

on the board, marking different test scores with levels of nerdiness, ranging from Milhouse to Steve Urkel. "Our average is a Carlton right now," he explains, instead of using percents. He uses clickers as Checks for Understanding at the end of class with his students to instantly see how well each student can answer a multiple choice question about the day's lesson. The D-rated school teacher has a system connected to calculators that measures how well each student does on the warm up. Each period competes to get the highest percentage and win 10 extra points on their next test. Academically selective schools have weeded out students who struggle with basic knowledge and skills. Open enrollment schools have not, and thus teachers have to focus more on standardized tests.

When asked about their opinions about standardized testing, teachers expressed conflicting opinions. All teachers admit that the standardized tests represent low levels of thinking. A Chemistry teacher at a B-rated school believes, "that test is by far only a test of like the very basics and kids should be demolishing it." An Algebra teacher from a B-rated school agrees that "the test is typically the floor of learning." Yet testing for many teachers is a necessary evil. "I agree it's necessary to test," explains an Algebra 1 teacher from an A-rated school, "It does too many bad things, but its intentions are good." An Algebra II teacher at an academically selective school admits to hating testing, even within his own classroom, but "I actually think that's a very healthy step because it gives them something to shoot for and it allows them to set concrete goals." By "them" the teacher was referring to students at non-academically selective schools. Teachers view testing in a positive light when comparing it to the past of no accountability, where students were pushed along without any standards, but these same teachers disagree with some aspects of how it is implemented including evaluating teachers, using it as a single source of information on a student and holding everyone to the same

standard. The purpose of education to enforce content-based, immediate objectives as evaluated through NCLB was mentioned by all teachers in the study in all levels of classroom instruction.

Critical Thinking

Although teachers mention basic knowledge and skills as an important goal of education, they only mention them in connection to building higher level of knowledge from that. "Having the fundamentals, the computational skills down pat is absolutely fundamental because you're only going to be able to access conceptual understanding and really deeply connect with math concepts if you get all of the math basics," explained one B-rated school Algebra 1 teacher. A Chemistry teacher at a B-rated school believes, "all students can and deserve to master really rigorous meaningful science content and prove that whether its science or something else, that you should never limit yourself to only being able to do this level of work." All teachers interviewed believe literacy, number sense, reading comprehension and other basic skills are necessary to build critical thinking skills.

This conceptualization relates to the debate within critical thinking that one must have knowledge about the field to critically think within it. According to McPeak and Siegel, one must understand the logic and principles of a field to apply critical thinking. But Paul emphasizes that teachers can use critical thinking to help the learning process. Not having basic skills is not enough to stop the critical thinking process, according to Paul. Critical thinking improves our knowledge through analyzing, assessing and reconstructing it. Critical thinking can be used as a tool to build basic knowledge and skills.

The elements of critical thinking that the teachers mentioned as goals of education are courage, perseverance, intestinal fortitude, reasoning, curiosity, problem solving and intellectual honesty. These goals are communicated less to students than the concrete goals of scores on

tests. When I asked how teachers communicate these goals to students, four said they probably should do it more, one only mentioned it in the course syllabus and two others simply said they do not communicate these goals to students. One Algebra teacher at an A-rated school recognized his own lack of critical thinking skills when he left high school: "I was the type of student, just give me a book, give some examples, like a robot. I didn't have to reason. It wasn't until I got to college because those skills are absolutely necessary…I didn't have those reasoning skills, you know. It was sad that day I realized that, I really cried." The teachers recognize the disconnect between how students are traditionally taught and trying to get them to think critically. Critical thinking skills are more difficult to assess and teach, and thus some teachers voiced frustration at the resistance of students to think.

During a Freshmen level Physics class at an academically-selective school, a student voiced the difficulty in learning to think: "My brain aches when I walk into this room," she said. When the lesson was finished, she made hand motions to show her brain exploding. "I never, never, never give them an answer," the teacher explains. "They have to give me the answer. It frustrated them initially. That's their job and so forcing them to think and rethink improves their thinking." The engineering teacher at an academically-selective school connects standards based education and testing to the students' lack of motivation to think. He views NCLB as the mechanism causing the disconnect between immediate, content-based objectives and cross-disciplinary ultimate objectives.

> "Thinking is what's missing, especially when you have all these standards based things and everybody is teaching so that they can pass and figuring out what the test is so they are ready to take it. My job here is to get them to stop and think about it. It's really frustrating, they don't like that piece of it. Just give me the steps, yeah that's the way you are supposed to teach, but that's not really helping you in life."

The chemistry teacher at a B-rated school tried to get students to read and comprehend a lab without spoon-feeding them the information. "I can't hold your hand, you have to use your brain," he said, frustrated that students wanted him to explicitly state the directions. "It would be easier," a student said. "Oh, if I just thought for you?" the teacher retorted. After the class, the teacher explained his frustration to me. Teachers that do not ask students to use these thinking skills in lower grades foster students that expect to be coddled through lessons. Students are trained to be the passive acceptors of knowledge. They are used to the Foucauldian control mechanisms of the school, and switching power roles can be confusing and frustrating.

When asked directly how to teach thinking skills, teachers muddled through a response. "I don't know what that would be," explains an Algebra 1 teacher at a B-rated school. "That's the million dollar question," says another Algebra 1 teacher from an A-rated school.

In some classrooms, teaching critical thinking is demanding students to "think", "use logic", "go through the thought process", "figure it out", "if your brain doesn't hurt, you're not thinking hard enough", and "someone impress me". Although teachers could not articulate specific strategies to teach critical thinking, many of their classrooms did break down the elements of Dr. Paul's model for critical thinking to assist students in building thinking skills.

Elements of Reasoning

The strategy used by most teachers was to model their own thinking process when approaching problems. One Algebra 1 teacher at a B-rated school explains this process: "I start to ask specific questions. So, I'm doing all the thinking for them and then they do it on

their own. So release of responsibility." The teacher asks questions to get students to think through problems critically. Teachers ask students "why" to understand the information they use and inferences they make. Instead of explicitly asking students to go through each step of critical thinking, teachers show students how they think through problems using these steps. For example, when introducing Physics students to acceleration, a teacher says, "When I think of acceleration, I think of accelerating my car, pushing the pedal down. When I do that my car speeds up. And we just learned what speed is last week, so I think acceleration will have something to do with distance, time and speeding up." This thought process activates prior knowledge and requires understanding one's own assumptions about a topic. By modeling for students what strong critical thinking looks and sounds like, teachers can support students to use similar processes when approaching new topics and problems. These teachers specifically model raising questions, using information, using concepts, making inferences and making assumptions.

The purpose of assignments and information is explicitly communicated to students through connection to real world applications. A biology teacher at an academically selective school, while teaching about Phyla, explains the evolutionary, economic and ecological importance of different organisms. For example, worms have an evolutionary advancement that builds towards our complex digestive system. Worms also can infect our pets, causing economic and ecological consequences. A lesson on phyla becomes a connection to our bodies and a "life lesson" about owning pets. An engineering teacher at an academically selective school connects every part of his lessons to the lives of engineers. We learn vocabulary so engineers can communicate with each other. We learn both international and U.S. units of measurement because you never know where your part is

going to be made. We only write in blue or black ink because engineering notebooks are legal documents. These deep connections to the real world are about more than simply trying to motivate students through connecting the lesson to their lives. They try to get students to understand why this information is important to learn. Connection lessons to the real world can motivate students, but also shows them how to draw implications about their knowledge to apply to new problems, as outlined by Paul.

One Algebra teacher at a B-rated school spoke about this difference: "I never want it to take away. It's never supposed to be like, all of this math is boring and here's a story that isn't boring. There is a danger in that." Attempting to connect every lesson to the student's real world is challenging because it takes a lot of planning, but also it give students something to be motivated about instead of building a love of learning and intrinsic motivation to learn. A Chemistry teacher at a B-rated school explains that it's unrealistic to make teachers connect everything to real life: "There has to be a culture change around school and learning towards learning things is cool," he explains. Extrinsic motivation, being motivated by outside factors, is short-term and not conducive to deep, critical thought.

In the classrooms I observed concepts are taught in two ways: through explicit steps given by teachers and through students developing the concepts on their own. Concepts include theories, definitions, laws and principles that students need so they can think critically through a problem, but these concepts can also be developed through critical thinking. Teachers in schools without academic selective admission were more likely than teachers in schools with academically selective admissions to explicitly give students steps to solving problems. The Algebra 1 classrooms started new concepts by giving students the

exact rule and having them write notes. In the A-rated School, the Algebra 1 teacher presented the law in words and in Algebra, and also showed students why it works, building from the previous day's lesson. The teacher asked students to "break it down," to do problems through the steps he had taught them. The Algebra teacher in the D-rated school showed students why the rules of factoring work and then gave students explicit steps on how to solve the problem. The Chemistry teacher in the B-rated school used an example of a recipe to introduce the topic of stoichiometry, but then gave students a step-by-step process on how to do the problems. The teachers want to ensure that the students understand why and how the processes work, but show them the steps and then ask them to follow them. Teacher-led lessons support students as passive acceptors of knowledge, and not active within the learning process. By giving explicit steps to processes, teachers limit the possibility of critical thinking in student-centered learning.

Teachers in the academically-selective schools would not give students the concepts, but instead guide them to coming up with them on their own. The classroom where this was most evident was the Algebra 2 classroom with Mr. Hedberg. He places problems on the board that form a pattern. For example, students understand how to do logarithms, but do not know the rules of how they are related. After doing ten log problems, the students have to find the pattern, write their own rule, a title for the rule and devise a sample problem. The students discuss, argue and question the math problems until they have taught themselves the lesson. This student-centered learning ends with the same result, students know rules and processes for solving problems, but instead of being told, the students come up with it themselves. Paul's model of critical thinking is fully reflected through this lesson. Students are not given any instructions other than trying to

find a pattern. They have to question, use previous information, interpret, draw conclusions and define concepts throughout the lesson with only minimal coaching from the teacher.

Modeling instruction is a method of teaching used by the Physics teacher at an academically-selective school that also supports student-centered learning. The teacher leads students through the definition of acceleration by using their previous knowledge about speed and velocity, and their real-world sense of the word. Then, the teacher has students create graphs of the relationship of acceleration and velocity and the students find the pattern. They create the equation. "We know this is a good equation because we saw it happen," the teacher explains. "Don't worry about memorizing it because we will use them so frequently you will know them." To delve deeper into the concept, the students design their own labs where they try to determine if acceleration changes with height of a ramp, length of a ramp or initial speed. They use these labs to come up with rules about acceleration. This example involves another aspect of Paul's model, where students are asking their own questions independent of the teacher and finding the answers using prior knowledge. They have to acknowledge their own assumptions through how they believe acceleration will be affected by the lab but be ready to question and change these assumptions if the lab proves differently.

Project Based Learning is another technique used by the engineering teacher at an academically selective school. Students are given a design brief naming a problem and criteria for solving that problem. These problems are related to real world issues and require that students work in groups to solve the problem. For example, one brief describes a company that wants to build algae farms that would yield the most with the

least start-up costs. Students must follow environmental and economic constraints to design the algae farms by hand and on the computer program. The brief is modeled after real-world engineering briefs and entails all the complications of a real world problem. If students get stuck they must ask questions and search out information on their own.

These teachers guide, coach and support their students towards critical thinking and learning, they do not allow their students to be passive acceptors of information. Teachers voice the frustrations that can accompany this process, from both themselves and students, because it is not the typical model of classroom instruction. But these teachers believe it is the best way to teach students critical thinking skills. The teachers also acknowledge that their classroom practices work because their students are academically selected. "We have some of the brightest kids in the city," one teacher admits. "There are a lot of skills and concepts, like the Algebra skills, that you need to be creative," says another. Three of the teachers at academically selective schools also have more training within their subject than teachers at open-enrollment schools. Having deeper content knowledge allows teachers to have students deeply connect with content as well. The teachers at open-enrollment schools do not have educational backgrounds in their subject areas.

There is a difference between foundational skills and critical thinking skills, and you need both to be successful. Two teachers at academically selective schools used homework as a way for students to practice basic skills and course time to build critical thinking. The biology teacher asks students to read and obtain basic information before class, and then she questions them to critically think through the information. The Algebra 2 has students complete review problems for homework the night before, and then builds on these in class. The basic information that students can get from "reading a book," as one Algebra

teacher put it, can be done at home so school is a place for critical thinking and building on student knowledge. The immediate, content-based objectives can be supported through the process of critical thinking, activating prior knowledge to build to higher levels of thinking.

Standards for Critical Thinking

Teachers apply standards for critical thinking through informal and formal evaluations of student thinking processes. Implicitly, teachers clarify student answers to questions during class, asking leading questions or simply repeating the information back in a clearer way. A biology teacher at an academically selective school tells students to "be specific" and give a "clear answer." A physics teacher at a C-rated school asks students to evaluate each other's thinking: "Does that make sense?" "Is that a good prediction using the information we have?" An Algebra teacher at a D-rated school uses a similar strategy, asking students "Can we do that?" after one student answers a question. The informal evaluation of critical thinking through teacher questions during class discussion and labs permeated all of the classrooms I observed.

The formal evaluation of critical thinking through assessments was much less pervasive. As discussed in the previous section, most classroom assessments featured multiple-choice questions that relied on basic knowledge and application of skills. An Algebra teacher in an A-rated school did ask students to predict outcomes in a few multiple choice questions, but these "predictions" were more about knowing how to read a graph than thinking through a problem. Most teachers used constructed response, or non-multiple choice questions to regurgitate processes or information learned in class. For example, An Area Volume and Density Quiz in the engineering class asked students to

calculate how many spray cans one would need to cover 200 cylinders. While this question may require critical thinking, it is a problem the students are familiar with and have done many times in this class. Tests in most classrooms did not evaluate critical thinking as much as give students an opportunity to show what they have learned, whether through critical thinking or direct instruction. The output of education measured through basic knowledge and skills is apparent in all of these classrooms. Even teachers who focus on the process of learning through critical thinking still assess student ability to retain the immediate, content-based objectives of education. Although the process of critical thinking is important to these teachers, they measure the output of student knowledge through basic knowledge and skills.

Three teachers include performance-based assessments on their tests. Performance-based assessments require students to apply knowledge and skills to a new problem instead of answering questions that assess the basic knowledge and skills. A physics teacher at a C-rated school asks students to figure out the relationship between the diameter and circumference of a circle. He gives explicit directions on how to complete the lab and hopes they see a pattern and draw conclusions. Yet, the teacher only grades whether or not they complete the lab, draw a correct graph and use the correct units, assessing only basic knowledge and skills. The Algebra 2 teacher at an academically selective school mirrors his instruction in his assessment, giving students basic problems they can understand, giving them a pattern, and asking them to come up with a rule, question and title. These performance based assessments require students to critically think through new problems that require multiple processes to solve.

Creativity

Although all teachers mentioned some aspect of critical thinking as one of the learning goals for their classrooms, only one teacher mentioned creativity as one of his goals. Specifically, the Algebra 2 teacher from an academically selective school says his classroom goal is "courage and creativity in the face of a new problem, which includes perseverance and skills to work in a group." Only two other teachers mentioned creativity in their classrooms, one in terms of a specific lesson and the other in terms of individual student creativity in projects. Despite literature that suggests creativity and innovation are important tools in the workplace and to predict future success, the focus on creativity within classrooms is limited.

An administrator of a B-rated school explains this disconnect: "I think part of that is *the brutal reality of bringing kids up to level*. Getting our kids to be truly innovative often feels far off. It's not where my head ends up going often enough. It's far more often to getting kids on and then above grade level." A Chemistry teacher at a B-rated school also says, "The hard part about students doing things that are super creative is that they just sort of have no idea where to start. They only understand the content at such a low level at times it's hard to push them to analogize and make creative things."

When explicitly asked about creativity in their classrooms, a few teachers viewed creativity as a personality trait that a student either has or does not have. During projects, the "more creative ones will flourish," explains a physics teacher at an academically selective school. "Some kids are a little bit more imaginative, more creative inherently," mentions an Algebra teacher at a B-rated school, who praises individual creativity in his classroom, but does not focus on bringing out creativity in his students. This mentality

perpetuates the idea of "creative people" and diminishes support for building environments for creativity. If teachers do not believe creativity is an important skill they can build and support in their classroom, they will focus on other goals of education.

Without a focus on creativity, some teachers still create classroom environments that can support creative thinking skills and build intrinsic motivation. Elements of Amabile's KEYS rubric that were observed in classrooms and when speaking with teachers help depict how teachers support or stifle creativity in their classrooms. Organizational support, supervisory encouragement, work group supports, challenging work and freedom appeared differently in academically-selective and open-enrollment classrooms.

Organizational encouragement for creativity is not prevalent in schools in my study. Although a few teachers mentioned having a positive school culture and shared values within the organization, the culture and values are not related to creativity. Teachers praised school cultures surrounding discipline, student responsibility, student mastery and supportive coworkers. None of the mission statements at schools mention creativity, and only one mentions innovation. Having a shared vision of creativity throughout an organization is important to motivate teachers and supervisors to support creativity, according to Amabile.

Access to resources and teacher evaluations are the two main areas of organizational support mentioned either positively or negatively by teachers. Teachers at the D and C-rated schools are the only two who complained about not having enough money for classroom materials. The D-rated school Algebra teacher has high tech calculators in her classroom because of a previous job she held with the calculator manufacturer, but she wishes the school could provide them for all of the math classrooms.

The C-rated school physics teacher had to borrow technology to measure the velocity of objects for a lab. The desire to have these technologies in the classroom is to aid students in understanding the material, but also to help students at a lower level. Students at the academically selective school's Algebra 2 class are not allowed to use calculators at all in class. Students in the academically selective Physics classroom had to measure the velocity by hand. Although technology is a classroom asset, if it is used as a crutch instead of as a tool, it actually decreases creativity.

Teachers at the academically selective schools that have technology and resources use the technology to help students be more creative. Students in Physics shot videotapes of carts going down ramps and then used the technology to help them graph the situation. Students in engineering use a computer program to design parts that they create on their own: "Use the tool to your best advantage," explains the teacher. Students hand draw the designs before going to the computer. Technology does not guarantee creativity and innovation in classrooms, but when used appropriately technology can support creative learning.

A lack of organizational support or freedom from strict classroom evaluations, was viewed both positively and negatively. The Algebra 2 teacher at an academically selective school discusses the positive elements of freedom:

> "In the second year I was teaching GEE kids who were in calc, I felt a little bit of pressure, but other than that small period, I've had an incredible amount of freedom…It would be easy for people to say, you're doing this weird thing where you're not instructing them. So I think it would be hard to grow up on my own in that sense if someone was constantly telling me what my classroom should be like."

This teacher relates his freedom to being in a non-tested subject. He is able to push creativity and use different teaching techniques because of this freedom in teaching a non-

tested subject. The school does not impose restrictions on his classroom so he is able to make his own decisions about what to focus on and how to instruct. A Biology teacher at an academically selective school spoke of the lack of freedom in her classroom due to accountability systems: "When I started teaching, I taught. That's what I did, I taught…because there were not all these extraneous demands, but as the years go on it's getting worse. To me that is really distracting from the ability of a teacher to be able to do what they should be doing." Her classroom environment includes elements of creativity and critical thinking, and she wishes she had more time to focus on the process of her instruction than extraneous paperwork and accountability systems.

The Physics teacher in a C-rated school has freedom in his classroom, but as a third year teacher, wishes he had less. He wants feedback and advice on how to better discipline and manage his students. An Algebra teacher at a B-school doesn't have freedom in his classroom and has very structured evaluations and management techniques to use in his classroom but he views this as a positive thing, making him a better teacher. A less-structured school environment gives teachers the opportunity to be creative and support classrooms built on creativity. A structured school environment is related to discipline and control strategies and strict adherence to standards and state requirements, which is not conducive to creativity.

Supervisory encouragement in the classroom means the teacher sets goals, models creative thinking and has confidence in students. The only goals explicitly told to students are goals of achievement on standardized tests as extrinsic motivation for students. One teacher mentions his goal of courage and creativity in his syllabus, but any goals teachers have for creative and critical thinking are only implicitly included in classroom instruction.

When I asked teachers about how they communicate these goals to students the majority of them admit that it is something they could be doing better. The Chemistry teacher at a B-rated school doesn't believe in giving students extrinsic goals:

> "I'm a really big believer in intrinsic motivation and just wanting to know something in and of itself is meaningful. And if I make my classroom about proving someone wrong or chanting or a test, then it totally robs students from the thought that one day they should just want to know things."

Setting extrinsic goals for students, including competitions, grades and test scores, takes away part of the intrinsic motivation to learn and possibly be creative. Yet, without communicating goals of creativity students are not aware that creativity is important and something they should strive for to be successful in the future. By not valuing creativity as a goal of education, teachers do not express to students the importance of creativity for success in the future.

Teachers in the academically selective schools were more likely to have confidence in their students' ability to complete assignments and be creative. "You guys are too smart, way too smart," says a physics teacher. "We have some really great kids," says the Algebra 2 teacher. If teachers have confidence in their students they can trust them to work together and think critically on their own. Without this confidence teachers are more likely to directly instruct students because they do not trust them to take control of their learning. A chemistry teacher at a B-rated school speaks about his frustrations with students: "If students don't have a concern about it, they won't remember it at all…It's frightful to think that students live in a world where numbers are scary and don't make sense to them." His lack of confidence in student ability to think appears in the classroom when he doesn't trust students' ability to figure out problems on their own. Although teachers in open enrollment classrooms begin lessons through questioning techniques and

trying to get students think, they are more likely to get frustrated with students' lack of understanding and settle for step-by-step instructions. The teachers use questioning to get students to understand the why and how of the processes, but give them step-by-step instructions to actually perform them.

An important aspect of teacher support is setting up the groups that students work in and the physical arrangement of the classroom. The four teachers in tested subjects – Algebra teachers at A, B and D-rated schools and a Biology teacher at an academically selective school – arrange students in rows of seats, lecture style, organized by student choice, academic ability or alphabetically. The other five teachers (and the Biology teacher during labs) arrange students in groups of four or five for class and/or labs. Being able to work in groups is essential for success in future employment and provides support for creativity through trust and communication of ideas. The groups that I witnessed were mainly student-selected and change for each project. A chemistry teacher at a B-rated school arranges students heterogeneously for lecture, but homogeneously for labs. "That way I can potentially expect the highest two groups to get through the entire lab and have harder questions and the lower students I expect to get them through the meat of the lab." The biology and physics teachers from an academically selective school mentioned that they let students pick groups, but that it is normally better to group less skilled students with higher skilled students. Due to behavior issues, mismatch of personalities and student complaints, these teachers allow students to pick groups, but they also acknowledge that all students are at a high enough level at their school. Allowing students to pick groups can help with communication and trust within the group but can also stifle creativity. Diversely

skilled groups, especially when working on labs and projects, give students access to new ideas and constructive criticism.

Trust and communication are aspects of the group that teachers can support. For example, the Algebra 2 teacher who asks students to write reflections about who they would like to work with at the end of each unit begins the year with strategies of how to work well in groups: "There's a little bit of tough love, like I often back away from questions they ask me…and say you need to figure that out as a group." Students in his class asked group members to explain information and trusted each other to answer questions before asking the teacher for help. This student-centered learning within groups supports active learning and creative and critical thinking. In classrooms at open enrollment schools, students constantly asked the teacher to explain problems or confirm answers. Teacher-led instruction leads students to question their ability to create knowledge and view themselves as passive acceptors of knowledge. The teacher must confirm that a student is right for other students will ask that person for help. Students do not trust themselves or other students to lead their own learning in these classrooms.

All of the teachers I observed included challenging work within their lessons but in academically selective schools the teachers were more likely to push their students to do higher level work. For example, in the A, B, and D-rated Algebra 1 classrooms, teachers presented challenge problems on worksheets or the promethean boards either labeled as such or not, but skipped over them during the actual lesson. Teachers in academically selective schools picked specific groups or students who are further along in the lesson to pursue these challenge problems. This technique is known as differentiation, giving higher level students opportunities to grow and lower level students more support. Even teachers

at open enrollment schools who report critical thinking as a goal and desire to challenge students push these goals to the side during instruction. Pulling low or average students to understand the lesson is more important in open enrollment schools than teaching them challenging, higher level problems. Algebra 1 teachers are required to get their students to pass the EOC but these tests are at such a low level that challenging students is not necessary. The brutal reality of bringing lower level students up to level takes away from achievement in higher levels of learning.

Freedom of movement, freedom in choice of assignment and freedom of how to complete assignments in the classroom is among the most important elements to support student creativity and it appears the least in classrooms. A biology teacher who has been teaching for more than 20 years speaks of the tendency of teachers to stifle student freedom in class:

> "There's some teachers that get upset or self-conscious if they don't know an answer so they are afraid to go off script. On the other hand, I have no problem saying well I don't know, let's find out. Because that's where all knowledge starts, asking questions."

During her class she lets students choose what topics to go over more deeply. For example when discussing round worms she let students pick, by majority rule, which type of worm she will discuss more extensively. This requires a wide range of knowledge on the teacher's part and a willingness to risk not knowing the answer to student questions. This teacher also believes that the most important aspect of teacher education is gaining content knowledge, "so you are comfortable in your classroom with your kids no matter what question they throw at you." Three of the teachers at academically selective schools had content knowledge through graduate degrees and postgraduate work within their fields.

None of the teachers at open enrollment schools had training within their fields. Without the content knowledge, it is difficult for teachers to offer student choice.

Freedom of movement in the classroom includes the idea of play, being active in the classroom and learning for fun. John Dewey (1959, pg. 112) stressed the importance of being active in learning:

> "I believe that the active side precedes the passive in the development of the child's nature. In education, the child is thrown into a passive, receptive or absorbing attitude, the conditions are such that he is not permitted to follow the law of his nature, the result is friction and waste."

Teachers spoke in positive and negative ways of "playing" in their classrooms. Teachers open enrollment schools spoke of play in terms of behavior: "the students just want to play" and "when I taught before standardized testing kids just played around so much." These teachers also were more likely to stress discipline and timing in their classrooms. Keeping students on task and not wasting instructional time is related to completing the curriculum and preparing for standardized tests, which are timed. An Algebra teacher at a B-rated school constantly reminds students how much time they have to complete tasks. This school also enforces strict disciplinary policies, including walking in straight lines, staying seated for the entire class period and controlling how students respond to questions. This teacher admits that creativity is not a focus of his.

A focus on standards and curriculum is a mechanism of Foucauldian power. This school, and other schools that have strict focus on increasing test scores, organize students by how well they do on tests, and classify them accordingly. Although the teacher at this B-rated school uses "Levels of Nerdom" to classify students and give them extrinsic motivation to increase their knowledge and skills, whether a student is labeled as Milhouse, below 50% or needs improvement has similar normative goals. The strict discipline at this high school is meant to

increase instructional time, thus increasing test scores and building students up multiple grade levels in one year but it is not conducive to creativity.

Teachers at academically selective schools speak of playing positively and use techniques to help students remain active during class. A physics teacher's favorite lesson includes using a "toy" to understand Newton's laws. The class goes outside and in the hallway with this "toy" and kicks it and answer questions to understand what is happening. "So we got Newton's Laws out of you know playing," she explains. The engineering teacher tells students to "go back to working on your computer or playing on your computer," equating the work of designing a part on the computer program with play and fun.

These teachers also gave students more choices in how to complete assignments. As mentioned earlier, teachers at academically-selective schools are less likely to give students step-by-step instructions on how to complete tasks. They recognize and support multiple ways of completing an assignment. The engineering teacher glances over computer screens and says, "that's an interesting way to make that part." The physics teacher allows students to decide what they are going to test in their acceleration lab: how high is the ramp? How much does the cart weigh? What's the initial speed? The Algebra 2 teacher asks students to design their own problems and come up with their own rules. He reinforces during the lesson that there are multiple ways to come up with the answer and praises students when he recognizes a creative solution.

Teachers in open enrollment schools give exact instructions and tell students the process they want them to use to solve the problem. Teachers dissuade students when they do it differently. "Don't do it your way," an Algebra teacher at a D-rated school says to a student. When a student asks if a problem can be done in a different way in the chemistry classroom the

teacher says, “This is the only way you will get the right answer,” which gives the student exact instructions and shows a lack of confidence in the student’s skills. This tactic of teacher-led instruction also relates to content knowledge. If they teacher is only aware of one way of solving the problem, they will not recognize when the student attempts to use a different process. Also, controlling student movement in the classroom, how they learn and how they perform tasks is related to discipline, an aspect of education teachers at open enrollment schools praised.

The Brutal Reality

Teachers believe students need to have certain skills before they can move on to higher levels of learning. Teachers at academically-selective schools have students in their classrooms that already possess a certain level of knowledge, motivation and drive that these teachers build off of. Even in tested subjects these teachers do not worry about basic knowledge and skills but concern themselves with teaching students how to think critically and be creative when coming across tasks. They have confidence in their students to access these skills and push them along through coaching and support. The students drive their own learning in these classrooms with teachers answering questions or asking questions that move the students along. These schools are able to resist the clutches of NCLB through requiring an entrance exam. By weeding out any students who may struggle with the basic knowledge and skills tested on the EOC, academically selective schools can focus on critical thinking and creativity.

The teachers in non-academically selective schools have students with a lower level of knowledge but these are also students who have only been expected to learn at this lower level through the years. “Knowing the things that our kids don’t know, but have the ability to know, is pretty great,” says an Algebra 1 teacher at a B-rated school. The students have the ability to be creative and think critically, but they are required to learn certain “basic” knowledge and skills

through NCLB before the school system allows them to practice critical thinking and creativity. The critical thinking teaching strategies teachers use in academically selective schools could be applied to students with lower levels of knowledge to help them grow, but curriculum, time and testing restraints keep teachers focused more on ensuring students have basic skills. A lack of confidence in students' skills and fear of receiving a low SPS score support schools and classrooms that focus on basic knowledge and skills. Since these students are required to show these skills on a test the focus is giving them the basic knowledge and not giving them the skills that could help them learn the basic knowledge themselves. Every skill builds on another, and whether students are at an 8^{th} grade, 5^{th} grade or 11^{th} grade math or reading level, there is a way to focus on giving them thinking skills to help them get to the next level. It may take students longer to get the "basic knowledge and skills" that the curriculum deems necessary for a student to learn but they will be left with critical thinking and creativity skills that will help them throughout their entire life.

Discussion

The educational environment is saturated with standardized testing measuring the output of education. The process of learning critical thinking and creativity is only evaluated through teacher observations and is not linked to school funding, student graduation, school ratings and school charters. Immediate, content-based goals of education are the output of education according to NCLB and most of the teachers I interviewed. Assessments in almost all classrooms focused on basic knowledge and skills measured through multiple choice and lower level constructed response questions. Formal evaluations of schools are linked to achievement on standardized tests, just as formal evaluations of students are linked to assessments of basic knowledge and skills. Even teachers with goals of critical thinking for their students mainly assess basic knowledge and skills on tests. The output of education as basic knowledge and skills extends through all of the classrooms I visited, even in non-tested subjects. Student achievement in most of these classrooms is measured through tests. NCLB defines student achievement through standardized tests and these teachers' classroom assessments mirror that definition.

But none of the teachers I interviewed believe that basic knowledge and skills is the one way to define student achievement. They all mentioned goals of critical thinking or creativity as important aspects of education and hopes for their students. Through classroom instruction and interviews, the teachers depict the critical thinking skills they would like to instill in their students. Understanding the why and how of assignments and connections to the real world were prevalent in classrooms. But the extent to which teachers focus on building critical thinking skills in students and providing an environment for creativity differed by classroom and teacher.

Participating teachers at open enrollment schools with students who struggle with basic knowledge and skills only informally focus on critical thinking through questioning and modeling their own thinking process. These classrooms feature teacher-led instruction, giving students step-by-step instructions and exact definitions for processes and terms. Students in these classrooms face discipline and behave as passive acceptors of knowledge, instead of actively being a part of the learning process. Without knowing the educational background of students it is difficult to imply why basic knowledge and skills are lacking, but the learning processes in open enrollment school classrooms limits student ability to be critical and creative thinkers.

Academically selective schools weed out students who may struggle with basic knowledge and skills. The entrance exam acts as a mechanism of resistance against NCLB, allowing teachers to focus on supporting critical thinking and creativity and not rest on basic knowledge and skills. The teachers at academically selective schools were more likely to support student-centered learning and give students freedom in their classrooms. By selecting students with high achievement on tests, these schools can avoid pressures of NCLB. The goal of basic knowledge and skills is already achieved, thus teachers can focus on the process of learning.

The fear voiced by researchers that scientific inquiry, math reasoning and critical thinking skills are reserved for white, middle-class students may be a reality. The academically selective schools only have between 24-30% of students who receive free or reduced lunch, a measure of the poverty level of students. Open enrollment schools have 73-89% of students who receive free or reduced lunch. Also, academically selective schools have a majority of white students, with only 30-32% of students who are black. Open enrollment schools have between

62 and 97% black students. Popular discourse about the achievement gap between white and black students only focuses on achievement on standardized tests, not critical thinking and creativity. The racial differences in whether teachers support critical thinking and creativity is an area that needs to be researched further.

This study focused on nine classrooms within New Orleans public schools during the 2012-2013 school year. The analysis investigated the extent to which these teachers focused on critical thinking and creativity strategies as outlined through Paul's model for critical thinking and Amabile's social psychology of creativity. The differences between student populations, and whether students had to pass a test to be accepted into the school is only one way to view these data. The types of teachers these schools attract provides another explanation for differences in teaching style in selective and open enrollment schools. Three of the four teachers at academically selective schools have deep content knowledge within their area and the five teachers at open enrollment schools do not. The types of motivation and background that students bring to the classroom, regardless of level of basic knowledge and skills, is another important explanatory factor. The research design focused only on student-teacher interactions within one classroom, thus outside factors and influences were not investigated. More research needs to be done to understand the organizational influence and student population factors that affect the extent to which a teacher focuses on critical thinking and creativity.

Limitations of time and space are characteristic of case studies, but the findings provide insight for other teachers, schools and school systems. By deeply investigating each of the nine teachers included in the study through multiple avenues of data, this study clarifies classroom practice and gives others a glimpse into what standardized testing means to the process of

education, not simply the outcome. It also offers a model through Dr. Paul's critical thinking and Amabile's creativity to study other classrooms and teachers and evaluate their practices.

When politicians and education researchers recognized faults within the U.S. education system, the answer was to add structure and create a quantitatively evaluated, highly accountable system of testing and school performance scores. Through a single score, politicians and researchers are able to determine if a student deserves to graduate, a school deserves funding, a teacher deserves a job and a charter school deserves to stay open. This highly rational mechanism to evaluate schools, students and teachers only focuses on the output of education and ignores the process of education. New Orleans has been praised for raising student test scores since transforming the school system after Hurricane Katrina, but the critical thinking and creativity within these schools has not been evaluated.

Although there are many factors that can influence the classroom experience of students, the teacher is one of the biggest influences on student achievement. Teachers can choose the instructional methods and goals of their classrooms, within the constraints of NCLB, student populations and organizational pressures. Measurement of learning immediate objectives of basic knowledge and skills is the main evaluation of student achievement. Some teachers then focus on completing all the material in the curriculum within the limited time frame of a school year, which limits critical thinking and creativity.

While teaching biology at the high school level, I faced the same decisions these teachers must make. Should I make sure students understand every topic in the curriculum that is going to be on the GEE? Or should I take time to support student thinking and scientific reasoning and drop some curriculum material? My decisions were based on my educational philosophy of giving students skills to be successful in the future. I did not teach certain parts of the biology

curriculum that I knew would be tested on the GEE because I wanted my students to experience a deeper understanding of science. We dissected pigs, performed a measurement Olympics, collected samples of plants, visited a psychology lab at Tulane University and planted marsh grass to help rebuild the bayou. Many of my students did not have the basic knowledge and skills needed to pass the GEE, and in fact many of them failed, but I did not want to take away the active learning of students. I believe they should have the opportunity to lead their own learning, even if it takes up time that could be spent learning curriculum materials.

NCLB enforces curriculum standards and learning a certain amount of material over a certain amount of time. But the process of learning can be long, confusing and different for many students. Standardized testing and required state curricula give politicians a way to classify, evaluate and control schools, but they enforce focusing on the output of education as basic knowledge and skills. Teachers can choose the instructional strategies they use but only within the constraints of NCLB. As long as jobs, school rating, school funding, student graduation and school charters are tied to standardized test results, imparting basic knowledge and skills will be the main goal of education. By relaxing these standards and giving teachers more choice in what to focus on in their classrooms, schools can become places that better support critical thinking and creativity. Accountability systems should be defined not by the output of education in basic knowledge and skills, but by the process of teaching critical thinking and creativity. If evaluation systems value these two ultimate objectives of education, teachers and students will be able to focus on building critical thinking and creativity in their classrooms.

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APPENDIX A

Sample Interview Schedule

Section 1: Goals for Student Success

Talk to me about your goals for your class.

Discuss how you decided on these goals for your classroom(s).

Section 2: Skills for the 21st Century

Tell me about the skills you think students need to be successful.

Tell me what skills you think are needed are the global economy?

Section 3: Teaching Strategies

Describe one of your favorite lessons.

Talk to me about the teaching strategies you use the most in your classroom.

Section 4: Creativity and Innovation

How do you think teachers can support critical thinking and creativity in the classroom?

Describe a time when a student/students was/were innovative in your classroom?

How important do you think critical thinking and creativity are in the classroom?

Section 5: Negative Issues for the classroom

Tell me about issues that challenge your ability to be successful in the classroom.

Section 6: Organizational Support

Tell me how your school supports your classroom.

Is there anything you would like to change about this support?

Section 7: Testing and NCLB

Talk to me about your experience with testing at your school.

Section 8: The Future

Describe your hopes for the future of the teaching profession.

APPENDIX B

Title of Study: Classroom Interactions in Public New Orleans High Schools

This research project will investigate the process of learning in New Orleans Public School classrooms. In an era of No Child Left Behind and emphasis on standardized testing, how do teachers support the process of learning in the classroom? Specifically, the research intends to observe student and teacher interactions in science and math public high school classrooms, to interview teachers about the goals of education and strategies they use to support the learning process and to analyze instructional and assessment materials used in the classroom.

Your participation in this study will consist of three classroom observations, one interview and donation of instructional and assessment material for a full classroom unit. There is minimal risk involved in this study. The main thing I will ask of you is your time, which I know is valuable to teachers. This time is only for the one on one interview. For the classroom observations, I will simply sit in the back of your classroom. If you would like me to assist during the class as well, I would be happy to. I will even offer my time for help grading or planning any future lessons.

My goal for this research is to offer teachers a voice in the debates on standardized testing, teacher evaluations and student achievement. Teachers in New Orleans schools have overcome a number of obstacles in order to educate our students, and I want to share your story. Your name, the name of the school you teach in, the names of any students included and any other personal facts that indicate your identity will be kept confidential in this study. All teachers will be assigned a number, and their school will be discussed through its SPS score and organizational structure (for example, a B public charter school authorized through the RSD).

Involvement in this study is voluntary. There will be no penalty or loss of benefits is you refuse to participate in the study. You may choose to discontinue participation at any time. If you have any questions concerning the research study, please contact me at jcarrol2@uno.edu.

Sincerely,

Jamie Carroll
University of New Orleans
Department of Sociology, Milneburg 174

By signing below you are giving consent to participate in the above study.

_____
SignatureDate

_____
Printed Name

Please contact Dr. Ann O'Hanlon (504-280-3990) at the University of New Orleans for answers to questions about this research, your rights as a human subject, and your concerns regarding a research-related injury.

APPENDIX C

University Committee for the Protection of Human Subjects in Research
University of New Orleans

Campus Correspondence

Principal Investigator:	Vern Baxter
Co-Investigator:	Jamie M. Carroll
Date:	November 26, 2012
Protocol Title:	"Creativity and Critical Thinking in Secondary New Orleans High Schools"
IRB#:	09Oct12

The IRB has deemed that the research and procedures are compliant with the University of New Orleans and federal guidelines. The above referenced human subjects protocol has been reviewed and approved using expecited procedures (under 45 CFR 46.116(a) category (7).

Approval is only valid for one year from the approval date. Any changes to the procedures or protocols must be reviewed and approved by the IRB prior to implementation. Use the IRB number listed on this letter in all future correspondence regarding this proposal.

If an adverse, unforeseen event occurs (e.g., physical, social, or emotional harm), you are required to inform the IRB as soon as possible after the event.

Best wishes on your project!

Sincerely,

Robert D. Laird, Ph.D., Chair
UNO Committee for the Protection of Human Subjects in Research

Vita

Jamie M. Carroll grew up in Washington, D.C. After studying sociology and journalism at New York University, she moved to New Orleans for Teach for America. Teaching Physical Science, Biology, Chemistry and Algebra 1 at Joseph S. Clark High School in the Recovery School District in New Orleans after Katrina showed her all the difficulties teachers face. She decided to leave the classroom and enter the Masters program at University of New Orleans in Sociology to study the social processes involved in classroom environments. She will join the graduate program in Sociology at University of Texas at Austin in the fall to train for her PhD.