Twenty-first Century and Self-regulatory Skills in a PBL Environment

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Introduction

Project-based learning (PBL) can be defined as using an authentic, real-life problem to invoke deep learning experiences for students (Barron & Darling-Hammond, 2008). It has been used heavily in the medical field to provide real-life experience to practicing medical students, and is increasingly popping up in K-12 learning environments. Studies have shown an increase in student performance and achievement in project-based learning environments. According to Barron and Darling-Hammond (2008), use of project-based learning techniques "...resulted in stronger performance regardless of race, gender, or prior achievement" (p. 3). In addition to the increase in performance, students are also learning valuable twenty-first century skills such as communication, reflection and collaboration when in PBL environments (Bell, 2010).

While there has been research linking classroom PBL environments to higher achievement, there is also research showing that students aren't learning the twenty-first skills necessary for the job force in schools. A research study conducted by Gallup (2013) on behalf of Microsoft Partners in Learning and the Pearson Foundation evaluated the use of twenty-first century skills found in the workplace. In this study, several respondents claimed that they did not cultivate the skills necessary for their job in school but rather developed these skills while on the job. This study revealed that only 14% of the respondents noted using technology for collaboration in school, a skill that is expected in the workplace. These twenty-first century skills, in addition to self-regulating skills such as taking ownership of one's learning, reflecting, and sustaining engagement throughout a project, are necessary not only for the workforce but for the success in PBL environments. Students who lack these self-regulating skills are shown to be less successful in PBL environments (English & Kitsantas, 2009).

Analyzing the skills that divide successful from unsuccessful students will help teachers in PBL environments better plan and scaffold their instruction in order to incorporate those skills. When analyzing teacher instructional strategies, studies show that teachers who use project-based learning to drive their instruction in addition to receiving extensive professional development on PBL instruction have a higher instance of teaching and assessing twenty-first century skills in the classroom (Ravitz, et al., 2012). In this same study, there was a decrease in teaching and assessing these skills in both teachers who used PBL instruction with no limited professional development and teachers who did not use the PBL instructional model (Ravitz, et al., 2012). Not only will the comparison of both self-regulatory and twenty-first century skills in PBL environments benefit students, its analysis will also benefit teachers who are using this model to further guide their instruction in efforts to better prepare students for the post-high school workforce.

Problem Statement

The problem to be investigated in this study is the discrepancy in proficient and non-proficient student achievement scores on elementary standardized tests, and their relationship to self-regulatory and twenty-first century skills in science, technology, engineering and math (STEM) environments where PBL has been purposefully integrated as a means to increase student proficiency scores. While a PBL environment has been equated with higher achievement scores on standardized tests (Barron & Darling-Hammond, 2008), there is a need to explore the deficiency of students who are not succeeding in this type of environment in addition to why students are succeeding in these types of learning environments. Success can be measured by a score of proficient or advanced on state achievement tests. In one PBL school, teachers noted a disconnect between student growth and achievement and the PBL instruction the students were receiving (CDE, 2014). While 80% of students at the school scored proficient or advanced on state mandated tests, other students did not achieve the same scores (CDE, 2014).

In order to succeed in PBL environments, students need strong self-regulatory skills and "…must take responsibility for their own learning process (English & Kitsantas, 2013, p. 146). As noted in the Gallup (2013) study, "Nearly six in ten (59%) respondents with a high school education or less strongly agree the skills used in their current jobs were developed outside of school" (p. 7). Collaboration and critical thinking are two twenty-first century skills measured in this study that workers were lacking but were needed to perform their job (Gallup, 2013).

Purpose of the Statement

The purpose of this quantitative method of inquiry and quasi-experimental design is to examine students' self-regulatory and twenty-first century skills with proficiency scores on Colorado state standardized tests for students in third through eighth grade PBL environments.

The tests used to measure proficiency scores in this study are the Partnership for Assessment of Readiness for College and Careers (PARCC), which assesses student proficiency in mathematics and language arts, and the Colorado Measures of Academic Success (CMAS), which assesses student proficiency in science and social studies. The skills of collaboration and critical thinking will be assessed using The Buck Institute for Education critical thinking and collaboration rubrics. Self-regulatory skills will be measured using the Motivational Strategies for Learning Questionnaire (MSLQ). The participants for this study are students at STEM (science, technology, engineering and mathematics) elementary and middle schools that use PBL instruction to drive student learning.

Self-regulatory and twenty-first century skills are necessary for students entering the workforce, as these skills are needed to thrive in today's world. Project-based learning has been found to be a successful strategy in developing these twenty-first century skills, and one many teachers are currently employing within their classrooms (Kek & Huijser, 2009). Rather than teaching these skills in isolation, integration into the domain-specific learning environment will aide in a deeper understanding of these skills (Ravitz, Hixson, English & Mergendoller, 2012). In order to succeed in a PBL learning environment, students must demonstrate strong self-regulation skills in order to monitor their own knowledge of what they know and what they need to know to solve the problem at hand.

Research Questions

Q1. Do self-regulatory skills influence student proficiency scores of third through eighth grade students on the PARCC and CMAS state assessments in PBL schools in Colorado?

Q2. Do twenty-first century skills influence student proficiency scores of third through eighth grade students on the PARCC and CMAS state assessments in PBL schools in Colorado?

Hypotheses

H1o. Self-regulatory skills do not influence student proficiency scores of third through eighth grade students on the PARCC and CMAS state assessments in PBL schools in Colorado.

H1a. Self-regulatory skills do influence student proficiency scores of third through eighth grade students on the PARCC and CMAS state assessments in PBL schools in Colorado.

H2o. Twenty-first century skills do not influence student proficiency scores of third through eighth grade students on the PARCC and CMAS state assessments in PBL schools in Colorado.

H2a. Twenty-first century skills do influence student proficiency scores of third through eighth grade students on the PARCC and CMAS state assessments in PBL schools in Colorado.

Population

The target population of this study is students in project-based learning (PBL) environments. These students are assessed yearly in their proficiency in reading, writing, mathematics, and every four years in science and social studies. In the Denver metro area, four different schools use project and problem-based learning as their main method of learning. Two schools, STEM Lab and STEM Launch, are K-8 schools; one school, STEM High and Academy, is grades 6-12; and one school, Colorado STEM Academy, serves grades 3-8. An additional characteristic these schools share is their focus on science, technology, engineering and math (STEM). Two of the schools serve at-risk populations with over 75% of the student body receiving free and reduced lunch.

Sample

In this study, the sample will be purposefully selected to include third through eighth grade students at a STEM school in the Denver metro area. This purposeful sample will be

chosen to include intact classes of third through eighth graders utilizing project-based learning as an integral component to instruction. The sample will include 42 third graders, 78 fourth graders, 46 fifth graders, 52 sixth graders, 42 seventh graders and 46 eighth graders. The total number of students used for this study will be 306 students.

Several studies have used purposeful convenience sampling to analyze achievement scores in PBL environments. Intact groups at elementary and middle schools have been used throughout the country to compare PBL environments with achievement scores on standardized tests (Thomas, 2000). In a review of research on inquiry and cooperative learning, Barron and Darling-Hammond (2008) also list a variety of comparative studies conducted in schools with classes already intact. In order to maintain a natural, PBL environment, intact groups receiving PBL instruction will best support this study.

Operational Definitions

Self-regulatory skills. Self-regulatory skills will be the first predictor variable for this study. They will be measured using the Motivational Strategies for Learning Questionnaire (MSLQ). This questionnaire, developed by Pintrich et al., (1991), was originally designed for college students to assess motivation and learning strategies. Since its development, it has been used in a variety of settings, including elementary schools (Milner, Templin & Czerniak, 2011). The data type for this variable will be ordinal.

Twenty-first century skills. Twenty-first century skills, specifically collaboration and critical thinking skills, are the second predictor variable in this study. According to the Partnership for 21st Century Skills (2011), twenty-first century skills can be broken down into the following categories: learning and innovation skills; information, media and technology skills; and life and career skills. For this study, the focus will be on three learning and innovation skills:

creativity and innovation, collaboration and critical thinking. These skills will be measured using the Buck Institute for Education (BIE) rubrics on creativity and innovation, collaboration and critical thinking. The data type for this variable will be ordinal.

Proficiency. Proficiency will be measured for students in third through eighth grade using two Colorado state assessments. The Partnership for Assessment of Readiness for College and Careers (PARCC) assesses student proficiency in mathematics and language arts, and The Colorado Measures of Academic Success (CMAS) assesses student proficiency in science and social studies. These measurements of proficiency are the outcome variables in this study. Proficient can be described as a score of proficient or advanced on each of these assessments, while a non-proficient score would be described as partially proficient or unsatisfactory. The data type will be interval.

Project-based learning. Project-based learning encompasses the term problem-based learning. PBL is the method central to instruction at the chosen STEM schools. The PBL method of instruction is an extraneous variable for this study.

Measurement Instrument/Tool

Four measurement instruments will be used in this study: The Partnership for Assessment of Readiness for College and Careers (PARCC), which is a state-mandated test that assesses student proficiency in mathematics and language arts; The Colorado Measures of Academic Success (CMAS), which is a state-mandated test that assesses student proficiency in science and social studies; and the Motivational Strategies for Learning Questionnaire (MSLQ), which uses the Likert Scale to inventory self-regulatory skills. The PARCC and CMAS assessments are valid and reliable tools used to assess student learning towards the Common Core and state standards (Partnership for Assessment of Readiness for College and Careers, 2015).

The MSLQ is an 81-item questionnaire in which students self-assess using a seven-point Likert scale system. The questionnaire is divided into two parts: Motivation and Learning Strategies. When scoring the questionnaire, it will be further divided into the following subsections: interest, expectancy for success, test anxiety, rehearsal, elaboration, organization, metacognition, time and study space, and self-effort. The MSLQ shows good reliability and validity as discussed by Pintrich, Smith, Garcia & McKeachie (1993).

Three rubrics from the Buck Institute for Education (BIE) will be used to assess twenty-first century skills: the creativity and innovation rubric, collaboration rubric and critical thinking rubric. These rubrics, created by the BIE, are aligned to the Common Core standards for Literacy and broken up by grade level band with a third through fifth grade rubric and a sixth through twelfth grade rubric. For this study, both grade level band rubrics will be used. The rubrics use a three-point system showing that the student is below the standard (a score of one), approaching the standard (a score of two) or at the standard (a score of three). Students will score themselves based on the characteristics listed in each of these levels. Teachers have been using the BIE's rubrics since their release in 2011 in conjunction with content rubrics to assess both the twenty-first century skills that align with Common Core Standards and specific content (Hallermann, Larner & Mergendoller, 2011). The rubrics have been used for both student and teacher reflection, and can be given at various checkpoints throughout a project or learning experience (Hallermann, Larner & Mergendoller, 2011).

Data Collection

1. Upon approval by The George Washington Internal Review Board and the Colorado STEM Academy (CSA), letters of consent to participate in the study will be sent out via

mail to families of all students at CSA. Consent forms will be returned by the end of February before the testing windows for state assessments begin.

2. All students at the school will be included in the study, unless the families choose to opt out (an option for this will be included in the consent form. Families will be asked to return the consent forms to the school with the students. Homeroom teachers will collect the signed consent forms and turn them in to the office, where I will collect them.
3. Prior to the state-required assessments, students participating in the study will take the MSLQ, an 81-item questionnaire. Students will complete the questionnaire according to the seven-point Likert scale of agreeableness.
4. Students will also complete the three BIE rubrics on creativity and innovation, collaboration and critical thinking. Here they will self-assess themselves in these three areas, and be assigned a score for each of the subcomponents within the rubrics.
5. The MSLQ will be scored according to the Motivational Strategies for Learning Questionnaire Manual (Pintrich, Smith, Garcia & McKeachie, 1991) by each of the nine subcategories as outlined in the measurement tool section of this study. Each of the subcategories include indicator questions, as listed in the MSLQ Manual (Pintrich, et al., 1991).
6. The PARCC assessment is a required test for all students in third through eighth grade. All students at CSA will take this assessment during the March testing window. Proctors for this assessment will be trained according to the state testing agency requirements.
7. The CMAS assessment is a required test for social studies in grades four and seven, and is required for fifth and eighth grades in science. Students in these grade levels will take

this test during the April assessment window. Proctors for this assessment will be trained according to the state testing agency requirements.

Data Analysis

1. The MSLQ scores will be calculated by scoring each individual subcategory separately. Each student assessed will receive a score in each of the nine subcategories, which will be listed and coded in an Excel spreadsheet. Student names will not be listed in the spreadsheet; rather, randomly generated student identification numbers (IDs) will be used.
2. A scatter plot graph will be used to display the overall scores of each subcategory by grade level from the MSLQ. This graph can be used to see instances of several students with similar scores, as well as to see where there were outliers.
3. The BIE rubric scores will also be numerically coded within the spreadsheet with the scores for each standard within the three rubrics.
4. A scatter plot graph will be used to display the scores of each standard of the BIE rubrics by grade level. This graph can be used to see instances of several students with similar scores, as well as to see where there were outliers.
5. Data from the PARCC and CMAS assessments will be released to the principal of the school, which in turn will be released to me for analysis.
6. An Excel spreadsheet will be used to list student achievement scores by subject, grade level and proficiency rating on both the PARCC and CMAS assessments. Student names will not be used on this file, but rather the same randomly generated student identification numbers as with the MSLQ will be used.

7. This data will also be displayed using a scatter plot graph to see the distribution of achievement scores by grade level and subject area.
8. SPSS data analytic software will be used to analyze the correlation (if any) between self-regulatory and critical thinking skills and student achievement.
9. The final report of this quantitative data will consist of several scatter plot graphs with accompanying narrative.
    a. The first set of scatter plots will show the correlation between student proficiency scores (divided by subject and grade level) and MSLQ scores. The MSLQ scores will be divided by motivation and learning strategies, the two main categories of questions within the questionnaire. It will then be further broken down to show the correlation between each of the nine subcategories and proficiency scores on the PARCC and CMAS assessments.
    b. The second set of scatter plots will show the correlation between student proficiency scores (divided by subject and grade level) and twenty-first century skills collaboration, critical thinking and creativity and innovation (as assessed using the BIE rubrics).

Data Storage

1. Data from the MSLQ, BIE rubrics, PARCC and CMAS will be stored in a password protected folder within on one computer with a backup stored on Google Drive. Data will be accessible only to me. Identifying names of students and the organization will not be used in the final report. Randomly generated student identification numbers will be used to track specific student data, however not numeric codes will be used in the final report

of findings. Data will be destroyed once the study has ended after a seven year waiting period.

Summary

The use of project-based learning (PBL), which originally was used with medical students to create realistic learning experiences, is slowly gaining popularity in traditional learning environments, specifically K-12 learning environments. While project-based learning has been linked to high achievement in classroom environments, there is a need for more specific research to determine factors influencing high achievement. This proposed quantitative method of inquiry and quasi-experimental design will look at student proficiency scores in conjunction with self-regulatory and twenty-first century skills, focusing on students learning in PBL environments.

This study will use both the Partnership for Assessment of Readiness for College and Careers (PARCC) and the Colorado Measures of Academic Success (CMAS) tests to assess student proficiency. The Buck Institute for Education critical thinking and collaboration rubrics will be used to assess twenty-first century skills while the Motivational Strategies for Learning Questionnaire (MSLQ) will be used to assess self-regulatory skills. All students in one Colorado school which utilizes PBL and STEM as focal points of instruction will be included in this study, unless they choose to opt out.

The data from PARCC, CMAS, the BIE rubrics and the MSLQ will be used to determine the relationship (if there is one) between student proficiency, self-regulatory, and twenty-first century skills. Analysis and reports of the findings from this study may be used by educators who use PBL methods of instruction within their learning environments.

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