PROJECT BASED LEARNING VS. LECTURE BASED LEARNING

By

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Submitted to

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Submitted in Fulfillment for the Requirements for

61-683 Research Paper
Spring 2012

April 29, 2013
Abstract

The purpose of this study was to analyze the difference in achievement of students taught using project-based learning and those taught using lecture-based learning. The research includes findings that answer the questions, “Does project-based learning help students learn better?” and “Is there a difference in learning based on gender?” The research was conducted using a common assessment of students taught by two different teaching strategies, by two different teachers, in a Midwest high school. The findings were analyzed through Microsoft Excel. Findings are somewhat inconclusive, but indicate that project-based learning does not help students learn better. However findings show that females perform better with project-based learning than males and males perform better using lecture-based learning than females. Further investigation in project-based learning is warranted. Additionally, the district may want to consider the make-up of classes before implementing project-based over lecture-based.
Introduction

Background, Issues and Concerns

The school is in the suburban Midwest with a demographic that according to the DESE website has had an 8.8% increase in free and reduced lunch students over the last five years, and has had a 1.9% decrease in graduation rate. There has also been an 8.4% decrease in students entering post-secondary education. The demographics of the students are changing, as are the needs of the students in the classroom. Science teachers in the district along with other score subject area teachers are struggling to keep students engaged and are noticing an increasing number of D’s and F’s in the classroom. Students and faculty participated in a Daggett survey this year, and many of the students do not feel that most what they are learning has any impact on their daily lives. The district has adopted the Rigor/Relevance framework in hopes of increasing student engagement and achievement. The upper level of this framework includes student lead work and learning. This project will compare the achievement on a common assessment and the active engagement of students in two types of classes. On the classes will be lecture based and the other will be project based.

Practice under Investigation

The practice under investigation is whether project-based learning or lecture-based learning is most beneficial for students, both in gender learning and overall learning.
School Policy to be Informed by Study

The school cooperating in the research is beginning to understand and implement the R/R Framework. The R/R framework focuses on teachers moving and maintaining their students to the quadrant where students are highly challenged and engaged. This study will help science teachers in general understanding the need and benefits for using more project based learning.

Conceptual Underpinning

The International Center for Leadership in Education has done much research on the correlation of higher rigor and high relevance for students. Their research has shown for students to obtain and retain knowledge the learning has to be both rigorous and applicable to their lives or lives of someone they know. Project-based learning is traditionally rigorous (4-6 level on the Bloom’s taxonomy, but can fall below 4), also project based-learning is more real world oriented than lecture-based learning. In science inquiry-based learning has been praised, and in research is often compared equally to project-based learning. Project based learning will increase student performance on a compared to traditional lecture-based learning.

Statement of the Problem

In lecture-based science classes, students have low test scores.
Purpose of the Study

The purpose of this study is to look at data in two areas to compare the effectiveness of project-based learning and traditional lecture in science. This study will look at the results of common assessments and active engagement in the science classroom. There is an argument that while project-based learning in the science classroom may lead to more active engagement in the classrooms, it does not lead to higher test common assessments score as traditional lecture. The information gained will help inform science teachers on how to teach to all students in the science classroom.

Research Question(s)

RQ 1: Is there a difference in common assessment scores of students taught using project-based learning in science classes as opposed to traditional lecture?

RQ 2: Is there a difference in gender average scores of students taught using project-based learning in science classes as opposed to traditional lecture?

Null Hypothesis(es)

H₀ 1: There is no difference in common assessment scores of students taught using project-based learning in science classes as opposed to traditional lecture.
H₀ 2: There is no difference in gender average scores of students taught using project-based learning in science classes as opposed to traditional lecture.

**Anticipated Benefits of the Study**

The results of this study will help to inform science teachers of the best practice for teaching science. This study will also help to clear up misconceptions that educators have on the effectiveness of project-based learning versus traditional lecture. Teachers can use the information gained to focus professional development on developing these best practices. Better instructional practices will lead to better student engagement and higher common assessment scores. Better test scores will be beneficial for educator in the performance-based field of education.

**Definition of Terms**

ASP: A statistical package used to calculate statistical data.

CWC: Class Within a Class; sometimes used to describe the placement of students with mild to moderate disabilities in a regular education classroom.

DESE: Missouri Department of Secondary and Elementary Education

R/R Framework: the rigor/relevance framework
Summary

OP is a Midwestern suburban school that is part of a district with a changing demographic. The district is noticing the lack of motivation and achievement of students, so is adopting the R/R Framework based on information collected through a Daggett survey. This research investigates the achievement on common assessments of students taught by lecture-based teaching versus project-based teaching. This research also looks at the gender differences in score of both groups of students.
Review of Literature

Many studies have been conducted over teaching and learning strategies and gender performance differences. Two looked the differences in gender scores on standardized tests such as the ACT and SAT, one looked at project-based learning compared to inquiry-based learning, and the final study looked at the effectiveness of inquiry based learning in the science classroom.

According to the International Center for Leadership in Education (ICLE), students gain more knowledge through rigorous and meaningful experiences in the classroom. Students gain the most knowledge in Quadrant D, which is highly rigorous on Bloom’s taxonomy scale and highly relevant. “Students have the competence to think in complex ways and also apply knowledge and skills they have acquired. Even when confronted with perplexing unknowns, students are able to use extensive knowledge and skill to create solutions and take action that further develops their skills and knowledge,” (Rigor/Relevance Framework™, 2013 p. 3). Project-based learning is often included in Quadrant D.

In a study conducted through Wake Forest University, research is done over project-based learning in a social studies classroom. Project-based learning uses a constructivist approach to help students build knowledge. In the research paper the author predicts, “The self-direction for learning that constructivism allows can make it a more useful learning tool for students,” (Collier, 2012 p.3). Using this approach helps students build their own knowledge through the guidance of their instructor. The study concluded that project-based learning was
able increase engagement of students, but not necessarily achievement of students.

In one study of Texas students’ college readiness, the gender differences on the SAT and the ACT scores in 2005 and 2006 were reviewed. This study showed that more girls took the ACT than males, and girls had a higher composite score. However boys had a higher SAT score average than females. Males scored better on the math section, while girls did better with the verbal section on the SAT (Combs, Slate, Bustamante, Onwuegbuzie & Edmonson, 2010).

Another study conducted by ACT, tries to refute the statement that the ACT is bias against females. This study showed that the difference in composition scores was 0.1 between males and females taking the exam. ACT also looked at the differences in ACT scores and class scores of males and females in Colorado and Illinois. This study concluded that more males take the ACT. However, if more females would take the ACT, females would have a higher average (ACT Inc., 2005).

Another study was conducted with fifth grade science students. In this study two lessons were created; one lesson was project based, and the other was inquiry based. The study started with the students taking a pre-test, then exposed them to new material, and concluded with a post-test. The results showed that students who were taught project based and inquiry based both gained science knowledge. However there was no significant difference between the post-test scores in both groups (Panasan & Nuangchalerm, 2010).
In another study that followed ten science teachers over the span of 3 years. These teachers committed to professional development and implementation of scientific inquiry. The study then chose two of the teachers and looked at the data on students’ science knowledge gain. This study concludes that students gain more science knowledge using inquiry-based learning. Also students in this study reported liking doing inquiry-based labs over teacher led labs (Banerjee, 2010).

Based on the previous research, Project-based learning can keep students more engaged and tends to promote more learning. It also seems gender can make a difference on average with how a student learns. It seems as though males do better with more concrete information, and females do better with not as concrete information. Also, it appears as long a teacher is prepared in project-based learning, then students in general should learn better with project-based learning compared to traditional lecture.
Research Methods

Research Design

A common assessment over types of reactions was written for all sections of a general chemistry class. Teacher A has four sections of regular chemistry. There are a total of 51 females and 34 males in Teacher A’s combined classes. Teacher B has five sections of regular chemistry. There are a total of 53 females and 53 males in Teacher B’s combined classes. 50 students’ (25 female and 25 male) scores from each teacher were randomly selected using a random number generator to compare. Teacher A taught types of reactions using a two-day project followed by a lab. Teacher B taught types of reactions using two days of traditional lecture followed by the same lab. The tests will be scored the same and percentages will be compared for 50 random students for each teacher. The data was also broken down to compare the difference in gender scores in both areas.

Study Group Description

The students in both classes are sophomores taking an introductory class. Neither of the teachers has a CWC and special needs students are also distributed evenly throughout the chemistry classes. There is a wide range of ethnic and socioeconomic classes in both classes. Both teachers have a low-income students and middle income students. There are no upper class students in these classes. Both teachers have African American students, Hispanic students who are classified as English Language Learners, Asian, Middle
Eastern Students, and about 70% of the students are Caucasian. Both teachers are Caucasian in their middle ages.

Data Collection and Instrumentation

A common test was given to all students and scored by each teacher using a common rubric, with no room for bias. Each teacher entered her scores into an excel sheet and 50 random students (25 females and 25 males) will be selected using a randomizer. The data will analyzed in Microsoft Excel.

Statistical Analysis Methods

A Statistical Package (ASP) software was used to complete the t-test for gender score differences in this study. Additionally, Microsoft Excel was used to compile some totals used in the research.
Findings

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Teacher A</th>
<th>Teacher B</th>
</tr>
</thead>
<tbody>
<tr>
<td>points earned</td>
<td>20.19607843</td>
<td>16.86792453</td>
</tr>
<tr>
<td>(34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>female average</td>
<td>20.1</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>20.1</td>
</tr>
<tr>
<td>male average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall average</td>
<td>18.6</td>
<td>18.5</td>
</tr>
<tr>
<td>overall average</td>
<td>18.59803922</td>
<td>18.50803634</td>
</tr>
</tbody>
</table>

Table 1 compares the average scores of the students. Teacher A had a female average of 20.2, a male average of 17, and an overall average score of 18.6 out of 34. Teacher B had a female average of 16.9, a male average of 20.1, and an overall average score of 18.5 out of 34.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>All Students</th>
<th>Teacher A</th>
<th>Teacher B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>points earned</td>
<td>% correct</td>
<td>points earned</td>
</tr>
<tr>
<td></td>
<td>(34)</td>
<td></td>
<td>(34)</td>
</tr>
<tr>
<td>mean</td>
<td>18.01</td>
<td>52.97%</td>
<td>20</td>
</tr>
<tr>
<td>median</td>
<td>17.5</td>
<td>51.47%</td>
<td>20.5</td>
</tr>
<tr>
<td>min</td>
<td>1</td>
<td>2.94%</td>
<td>3</td>
</tr>
<tr>
<td>max</td>
<td>34</td>
<td>100.00%</td>
<td>34</td>
</tr>
<tr>
<td>mode</td>
<td>11</td>
<td>32.35%</td>
<td>15</td>
</tr>
<tr>
<td>standard deviation</td>
<td>10.27603215</td>
<td>30.22%</td>
<td>9.566096596</td>
</tr>
</tbody>
</table>

Looking at Table 2, Teacher A had an average score of 18.01 out of 34 points or 52.97%, and the standard deviation was 10.28. Teacher B had an average score of 20 out of 34 points or 58.82%, and the standard deviation was 9.57. Teacher B students scored an average of 1.99 points higher. The median score for A was 17.5, and the median for B was 20.5. The minimum score for
teacher A was 1 and the maximum score was 34. The minimum score for Teacher B was 3 and the maximum was 34. The mode for Teacher A was 11, and Teacher B was 15. When looking at the results in Table 2 Teacher B had higher average scores.

Table 3

<table>
<thead>
<tr>
<th>Teacher A</th>
<th>female scores</th>
<th>male scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>points earned</td>
<td>% correct</td>
</tr>
<tr>
<td>mean</td>
<td>20.6</td>
<td>60.59%</td>
</tr>
<tr>
<td>median</td>
<td>22</td>
<td>64.71%</td>
</tr>
<tr>
<td>min</td>
<td>2</td>
<td>5.88%</td>
</tr>
<tr>
<td>max</td>
<td>33.5</td>
<td>98.53%</td>
</tr>
<tr>
<td>mode</td>
<td>7</td>
<td>20.59%</td>
</tr>
<tr>
<td>standard deviation</td>
<td>10.27436129</td>
<td>30.22%</td>
</tr>
</tbody>
</table>

Tables 3 and 4, compare the female and male scores for both of the teachers. In Table 3, Teacher A females had a 20.6 out of 34 point average or a 60.59%, and the males had an average of 15.42 out of 34 points or a 45.65%. The females had a higher average score than the males by 5.18 points out of 34. The median for the females was 22, while it was 14.5 for the males. The max score for females was 33.5 and was 34 for the males. The minimum score for the females was 2, and the minimum score for the males was 1. The mode is 7 for the females and 11 for the males. The standard deviation for the females is 10.27 and 9.81 for the males.
In Table 4, Teacher B females had a 19.24 out of 34 point average or a 56.59%, and the males had an average of 20.76 out of 34 points or a 61.06%. The males had a higher average score than the females by 1.52 points out of 34. The median for the females was 23, while it was 20 for the males. The max score for females was 33 and was 34 for the males. The minimum score for the females was 3, and the minimum score for the males was 4. The mode is 15 for both the males and females. The standard deviation for the females is 10.79 and 8.32 for the males.

When comparing the averages between Teacher A females and Teacher B females, Teacher A females have a higher average score. Teacher A females had a 20.6 average and Teacher B females had a 19.24 average. Teacher A females scored 1.36 points higher than Teacher B females.

When comparing the average of Teacher A males against Teacher B males, Teacher B males have a higher average score. Teacher A males have an average score of 15.42 points, and Teacher B males have an average score of 20.76 points. Teacher B males have an average score 5.34 points higher than Teacher A males.
Table 5

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>Mean D</th>
<th>t-test</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (N=25)</td>
<td>20.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (N=25)</td>
<td>15.4</td>
<td>5.18</td>
<td>1.824</td>
<td>48</td>
<td>0.0743</td>
</tr>
</tbody>
</table>

Note: Significant when p<=0.25

Table 5 is a t-test comparison of the male and female score for Teacher A. 50 students were randomly selected to observe the differences between female and male test scores of a project-based learning lesson. The scores were broken into groups based upon the student’s gender. There were 25 female and 25 female student score in this sample. The mean of the female scores is 20.6 out of 34 points, and the mean of the male scores is 15.4 out of 34 points. The mean difference is 5.18 points. The t-test result is 1.824 and the df is 48. The null hypothesis is that there is no difference between the male and female scores. Since the p-value is 0.0743, and the Alpha was set at 0.25, the null hypothesis is rejected. Therefore, there is a significant difference in gender test scores for project-based learning. The females with a mean score of 20.6 scored significantly higher by 5.18 points than the males. Females score better than males on a test after project-based learning.
Table 6

t-test Analysis Results for Gender and Test Scores for Teacher B

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>Mean D</th>
<th>t-test</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (N=25)</td>
<td>19.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (N=25)</td>
<td>20.8</td>
<td>-1.52</td>
<td>-0.558</td>
<td>48</td>
<td>0.580</td>
</tr>
</tbody>
</table>

Note: Significant when p<=0.25

Table 6 is a t-test comparison of the male and female score for Teacher B. 50 students were randomly selected to observe the differences between female and male test scores of a lecture-based learning lesson. The scores were broken into groups based upon the student’s gender. There were 25 female and 25 female student score in this sample. The mean of the female scores is 19.2 out of 34 points, and the mean of the male scores is 20.8 out of 34 points. The mean difference is -1.52 points. The t-test result is -0.558 and the df is 48. The null hypothesis is that there is no difference between the male and female scores. Since the p-value is 0.580, and the Alpha was set at 0.25, the null hypothesis is accepted. Therefore, there is no significant difference in gender test scores for lecture-based learning.
Conclusions and Recommendations

When comparing the average scores of project-based learners (Teacher A) against lecture-based (Teacher B), the lecture based learners had a higher average score of 1.99. This would suggest that students learn better using lecture based teaching. However, this contradicts many of the studies done previously. This also contradicts the average before the 5 random students were selected. Before the randomization Teacher A had a higher average score than Teacher B.

The interesting part of the study becomes visible when looking at the gender breakdown of the scores. The females did better with the project-based learning than the males by an average of 1.36 points, and the males did better than the females in lecture based learning by 5.34 points.

This is because males tend to do better with more concrete information, which is how information is presented in lecture base teaching. On the SAT the males do better on the math section. And the females do better with not as concrete of material, which is how project-based learning is. They females score higher on average on the verbal section of the SAT than males (Combs, Slate, Bustamante, Onwuegbuzie & Edmonson, 2010).

The t-test results showed there was a significant difference in the female vs. male score using project-based learning. It would appear from the t-tests that female students average higher scores than males when taught using project-
based learning. The t-test results did not show a significant difference in test scores of female vs. male students in traditional lecture. In classes with more female students, it would be beneficial to use more of a project-based learning approach.

It is recommended that this be explored further over a larger span of time than a unit. Based on the information gathered in this research paper, project based learning is valuable, but it may be better suited to classes that have a higher female population than male population. Nothing concrete can really be determined by the data collected in the research.
References


