Analysis of Hands on Activity and Student Engagement

in Middle School Eighth Grade Science Students

by

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Table of Contents

List of Tables

Abstract

The purpose of this study was to determine whether hands-on activity in a middle school science setting would increase engagement which would then increase the test scores of one group of students versus another group that was not taught using hands-on activities. The study was a pretest/posttest design, with a teacher's observation checklist to measure student time spent on task. A measurement tool was created by the researcher to record on-task engagement during each lesson. There was no difference in engagement of eighth grade Environmental Science students when hands-on activities were provided over textbook activities with the exception that the hands-on group had more meaningful discussion the topic with their peers. In the future, additional research could expand on the current study by including a larger sample sizes and a longer observational period.

CHAPTER I

INTRODUCTION

Engagement is a key factor in students' overall success in their educational journeys. Conner and Pope (2013) state that research has long linked academy engagement to positive social, psychological, and physical developmental outcomes. Dotterer and Lowe (2011) found a link between school engagement and adolescent outcomes such as dropouts, mental health, and substance abuse. They continue to find evidence that the relationship between student and teacher can increase the engagement for students in their classes. Vilardi (2013) believes that inquiry enhance and increases the learning processes. By increasing inquiry, you are increasing engagement.

Overview

Engaging students in their daily school activities is an ongoing task. At some point in every teacher's career, he or she will face unengaged students. Education becomes an ever-changing field when it relates to engaging the students in classroom activities. Years ago, teachers would lecture, and the students would quickly write down notes. Then textbooks were given out, and students read pages of text and answered questions on copy paper. Those methods are no longer engaging to the students according to Conner and Pope (2013). Instead, Conner and Pope suggest that interactive teaching, coupled with more relevant and rigorous curricula, might be an effective solution to the disengagement of middle school learners.

Students who are actively engaged in school will spend more time focusing on their studies which allow less time for them to get into trouble (Hirschfield & Gasper, 2011). On the other hand, students who have disassociated with being engaged in school are more likely to get

into trouble, have substance abuse problems, and drop out of school (Conner & Pope, 2013). As students progress through school, they are more likely to become less engaged in classroom learning because of outside influences.

This educator became interested in the topic of engagement after years of struggling to obtain the interest of her students in a middle school class. At times 50% or more of students would be disengaged in the classwork. These students would prefer to put their heads down, talk with other students, or just sit there and refuse to work. This school is a low-income school where the students may reside in a single-parent household or have parents who work overnight shifts and are unable to be involved in their child's schooling. Having involved parents is an important piece of schooling. Parent involvement helps teachers keep students engaged and involved in school activities and work. This school has established itself as an official AVID school and provides incentives for students who demonstrate respectful and responsible behaviors. Even with the support of the school and the community, engagement in classroom activities still remains a main factor in student success.

Statement of the Problem

Every teacher has preferred or learned methods of teaching although those methods of teaching might not be most beneficial for that year's learners. Each year teachers are presented with a new group of students and must endeavor to understand how those students are engaged and motivated to learn. From year to year, the education may need to be modified or even fully reinvented so that teachers' engagement and teaching strategies keep the students motivated to learn. Once students' attention is attracted, they will nourish positive feelings about science (Kahraman, 2014). Hands-on activities demand the students to participate (Vilardi, 2013). Students can't pretend to be completing a lab. They must work together to complete a given task

which results in the students being engaged in that given task. Once the inquiry of a lab begins, it can increase the learning process (Vilardi, 2013).

Hypothesis

This researcher hypothesized that the engagement of eighth grade students in an Environmental Science class would not increase when teaching using hand-on activities versus textbook and lecture activities.

Operational Definitions

Hands-on activities refer to the use of labs and/or manipulatives to reinforce or to teach a given topic. Textbook activities refer to the use of written text from a textbook or another printed source. Engaged is defined by the amount of time spent on task during class. This is measured by teacher observation.

CHAPTER II

REVIEW OF THE LITERATURE

This literature review explores the relationship between student engagement and academic achievement. Engagement is the foundation of many education courses because it is a necessary foundation to every lesson. Engagement is needed to have every student actively participating in every lesson and classroom activity. Students who are more engaged in school are more likely to be high achievers in high school (Park, Halloway, Arendtsz, Bempechat, & Li, 2012). Furthermore, low engagement is related to dropping out of school (Dotter & Lowe, 2011).

Engaging students is more than just planning and prepping amazing lessons. Student engagement can be broken down into three different categories: behavioral, emotional, and cognitive (Kahraman, 2014). Throughout this review of the literature, the three categories of engagement and how engagement can be increased in a science classroom will be explored. Teachers want all of their students engaged daily in the classroom. Disengagement in education is a serious social problem in the United States (Hirschfield & Gasper, 2011). Engagement may be the most pressing issue in education now.

In the United States, all children have access to free public education from kindergarten through 12th grade. However, not all students take full advantage of their free public education. Student engagement can be correlated to a student's school success (Hafen et al., 2012). One alarming finding is that, as students move through their schooling career, engagement drastically decreases (Hafen et al., 2012). Studies have shown that females are more engaged in school than males (Conner & Pope, 2013). Also, higher engagement is more prevalent in students of color

than in white students (Conner & Pope, 2013). Park et al. (2012) believe that the most pressing issue now in education is disengagement in classroom activities.

This educator became interested in the issue of student engagement after new district curriculum took the focus off testing students after every unit and converted the test into building projects to show what they learned. The researcher endures a yearly struggle to keep an entire class engaged in the day-to-day tasks of a 90-minute class. If students are not engaged in the curricula, then they cannot perform well on the test or projects. Finding ways to better engage students is thus a daily challenge.

Sections one, two, and three of this review will discuss the three forms of engagement that can be observed in students: behavioral, emotional and cognitive. Section one will take an in-depth look at how students' participation in school and school-based activity can affect their engagement in school. Section two will look at the emotional side of engagement and how feelings either positive or negative towards school affect their learning. Section three will take an in-depth look at how their investment in school affective their cognitive engagement. Section four will discuss how types of engagement in the classroom setting can affect the learning outcome. Section five will focus on fostering engagement in a science classroom.

Behavioral Engagement

Kahraman (2014) defines behavioral engagement as a student's participation in school and school-based activities. Klem and Connell (2004) also include time on task and intensity of concentration as components of their assessment of behavioral engagement. Behavioral engagement is the most visible for teachers to actively gauge in students. If a student isn't actively participating in class activities, school trips, and/or after school clubs, a teacher is able to

physically see that the student is not behaviorally engaged in school. Behavioral engagement is related to academic achievement (Kahraman, 2014). In order to be behaviorally engaged in school, a person needs to be present in school. Middle school students whose attendance rate is 79% or lower are at higher risk for having lower grades and being below grade level at reading (Klem & Connell, 2004). In addition, there are students who are not engaged enough due to external factors. Research shows that one-third of students are initially disengaged in class due to boredom (Conner & Pope, 2013).

Students who are engaged in school spend more time working on school work after school and participating in afterschool-sponsored activity than those students who are not highly engaged in school (Hirschfield & Gasper, 2011). Engaged students have been found to be protected from risky behaviors and unhealthy outcomes such as drug and alcohol abuse (Conner & Pope, 2013).

Emotional Engagement

Emotional engagement refers to a student's positive or negative feelings toward school (Kahraman, 2014). Students who have positive feeling towards school are going to be more likely to succeed, where students who have negative feelings toward school are going to be less likely. So far, studies have shown that emotional engagement doesn't always correlate to high achievement in school (Kahraman, 2014).

Teachers can play a major role in the emotional engagement in school for students. Caring support from teachers can lead to students being more academically engaged in their classrooms (Klem & Connell, 2004). It has been shown that middle school teachers who provide low support in their classrooms have more disengaged students (Klem & Connell, 2004). On the

other hand, teachers who provide more support make students feel more invested in that teacher's classroom. Using praise and a varsity of learning opportunities makes it easier for students to stay engaged and succeed in that subject (Tas, 2016).

Cognitive Engagement

Cognitive engagement refers to students' personal investment in their schooling (Kahraman, 2014). This type of engagement is a form of engagement that teachers and schools have very little influence on. Students form their own thoughts about why school is important and how well they will succeed. Teachers and schools can explain to students why school is important and why they should succeed at school but can't force students to be more cognitively engaged. Students who possess a greater amount of self-efficacy are expected to succeed more (Tas, 2016).

Engagement in a Classroom Setting

Engaging students early in their schooling career is critical. Students with early academic problems are likelier to be at risk for poor grades and dropping out later in their school career (Dotter & Lowe, 2011). Not only are lower engaged students more at risk for poor grades and dropping out, but they are also more likely to show lower interest in completing school-related tasks (Kahraman, 2014).

Within a group of students, there are several types of learners. One type is the goal-oriented learner. These learners have a large amount of cognitive engagement because they want to surpass the goals they have already set for themselves (Tas, 2016). Then there are performance-based learners. These learners want to show others their abilities. In order to keep these two specific types of learners engaged, a teacher needs to challenge the goal-oriented

learners and also to provide performance-based learners with an opportunity to show the class what they know. This can be a challenging task for teachers, but if teachers do address both types of learners well, they can keep both types of learners engaged.

Yearly, teachers attend conferences that inform of the need to hook learners. When preparing for observations, teachers are asked what they are doing to engage students. Engagement, though, doesn't just come from the first five minutes of a well-planned lesson. Engagement is ongoing throughout an entire lesson and the entire school day because students' emotions and behaviors change (Klem & Connell, 2004). Engagement is not something that can fully be done by just presenting students with the materials they need to learn. Research shows that the way teachers structure and support opportunity for involvement also helps to increase students' engagement and academics (Conner & Pope, 2013). Teachers need to provide a daily structure or routine in their classrooms that helps students to know the daily expectations and prepares them to be engaged. Also, providing students with a positive classroom climate can also help increase student engagement (Dotter & Lowe, 2011). Lastly, establishing positive relationships with students can also increase academic engagement (Dotter & Lowe, 2011).

Engagement within a Science Classroom

Within a science classroom there are numerous topics of study that are very abstract for the students to learn. Some of these topics are cell functions, water quality, molecular forces, and changes in forms of energy and gravity. All of these topics can be difficult for students to comprehend because they can't be seen concretely. Students who can't visibly see what they are learning about may be at risk for becoming disengaged in the classwork.

There are ways to keep students engaged in learning topics that are more abstract, however. Students can be engaged with problem-based learning, hands-on laboratory experiences, and cooperative, student-centered learning groups (Vilardi, 2013). Students who struggle with grasping abstract concepts and are unable to visualize some ideas can benefit from the use of physical manipulatives (Bruck, 2016).

Two different studies conducted by Vilardi that students' grades increased when they completed hands-on activities. In Teacher 1 and Teacher 2's treatment group, students who used inquiry-based learning scored higher than those in the control group (Vilardi, 2013). The inquiry-based lab activities increased subject matter in content knowledge and retention of materials for the students involved (Vilardi, 2013). Students enjoyed the inquiry-based activities, and they found the activities challenging in helping them learn the new material (Vilardi, 2013). In Teacher 1 and Teacher 2's (Villard, 2013) study, a hands-on activity was developed to assist learners in identifying and applying intermolecular motion (Bruck, 2016). Learners were encouraged to pose and ask questions and to make abstract concepts relatable to students through tangible, inquiry-based activities which allowed students to test better than the control group (Bruck, 2016).

Conclusions

Inquiry and hands-on learning demands that students be involved in the classwork, cooperate with other students, and use critical thinking (Vilardi, 2013). Students learn by their active participation in projects such as labs (Vilardi, 2013). Inquiry and hands-on activities are critical to keeping students in engaged and succeeding in school. In order to enhance and increase the learning process, inquiry is necessary (Vilardi, 2013).

CHAPTER III

METHODS

The purpose of this study was to determine whether hands-on activity in a middle science setting would impact engagement which will impact the test scores of one group students versus another group that was not taught using hands-on activities.

Design

This study was a pretest, posttest design, with a teacher's observation checklist to measure student time spent on task. Each group was taught six 90-minute lessons while a teacher completed an engagement checklist. Each group received three 90-minute lessons that included a combination of hands-on activities, readings, and direct teaching from the students. Then after the initial engagement data was collected, Group 1 was taught using hands-on activities, and Group 2 was taught using written and lecture activities. The data collected will be used to determine which group had more time on task.

Participants

The participants were from a Baltimore County suburban public middle school. The researcher taught four eighth-grade classes at this school. Two of the classes were gifted and talented, and the other two were standard classes. In Group 1, one gifted and talented class along with one standard class was taught using textbook/printed resources and lectures. The other two classes received hands-on activities. In Group 1, there were 46 students, 20 girls and 26 boys. In

Group 2, there were 56 students, 24 girls and 32 boys. Within these classes, the majority of the students are Caucasian.

Instruments

At the start of the study students were observed for three 90-minute mods by their teacher regarding classroom engagement. They were observed again during the three 90-minute mods while the study was being completed. Engagement observations were recorded on a checklist designed by the researcher. The items that were being observed for each student were:

- Participation in class discussions
- Completion of assignments
- Reminders to be on task
- Non-classwork conversations

Procedure

The 102 participating students from the four selected classes were observed for three 90-minute classes on engagement and given a pretest on their knowledge of motion. During the first three days of personal observation, the students were given a variety of hands-on and textbook/lecture activities to use to complete their classwork.

Once the study began, Group 1 was given mainly hand-on activities accompanied by a small number of readings during instruction. Conversely, Group 2 was given mainly textbook and lecture activities during instruction. After daily instruction, both groups were given the same informal assessment to complete without using their class notes. During the three-day study, the teacher circulated around the room to assist with the activities and record student engagement.

After the study was completed, the students were given the pretest again as a posttest. The scores were then compared to the original pretest scores to determine which group had the greatest overall improvement. The results of the data collected from the test and the teacher-collected data were used to determine whether using hands-on activity increases student engagement and learning.

CHAPTER IV

RESULTS

This study hypothesized that the engagement of eighth-grade students in an Environmental Science class would not increase when they were taught using hand-on activities versus textbook and lecture activities. Using hands-on activities to simulate a student's engagement in the required material seems to be a useful strategy to help students and to allow them to grasp more abstract concepts.

The null hypothesis stated that there would be no difference in engagement of eighth-grade Environmental Science students when hands-on activities were provided over text book activities.

The engagement of students was assessed using pre- and posttest data, which included teacher observation of student engagement using a teacher-generated engagement checklist. The pretest occurred as students received daily instruction which included a combination of hands-on and text learning with video clips intertwined in each activity. The posttest occurred after the students received differentiated engagement.

In order to test the difference in engagement methods, a series of independent t-tests were run. The series of independent t-tests were run to examine the data collected from the pre- and posttest data between the control and the experimental groups. The means and standard deviations for the engagements of both groups listed in Table 1 show that the pretest analysis demonstrated no significant difference between the control and the experimental group on how they completed the given tasks. In addition, their on-task engagement t-test results were [$t(102)=-1.371$, $p > .05$] . The data from the posttest also show no significant differences in engagement for hands-on teaching versus book work with the results of [$t(103)=.192=.192$,

p>.05}. Based on the data collected and the tests that were run, the control and the experiment group performed equivalently. The results supported the initial null hypothesis.

Table 1

Pre- and Posttest Measures for the Groups

Group	Pretest Engagement M(SD)	Posttest Engagement M(SD)
Experimental	87.04 (12.002)	89.09 (9.871)
Control	90.04 (10.261)	88.60 (14.668)

These results will be discussed in the following chapter.

CHAPTER V

DISCUSSION

The study in this paper hypothesized that there would be no difference in the engagement of eighth-grade Environmental Science students when hands-on engagement was provided versus textbook engagement. After the data was analyzed, the null hypothesis was retained. There was no significance difference in the pre- and posttest scores on the engagement checklist that was created by the teacher.

Implications of the Results

The results of the study supported the null hypothesis. However, although there was no significant difference in the pre- and posttest data on the difference of students engagement using book work versus hands-on during class, the classes who were engaged in hands-on engagement were off task more often than those students engaged in book work.

A review of the analyzed results suggests that the type of engagement does not play a role in students' engagement during class time. As the data showed, there was no significant difference in the engagement although the classes who participated in hands-on investigations were off task more often than the book work classes. This could be attributed to the fact that the hands-on engagement group had time during investigations to hold discussions and, when their discussion ended, they became distracted by other topics. Additionally, the teacher observer may not have identified these differences if not for the engagement checklist. The data collected implies that there is no difference in engagement of students using book work or hands-on activities.

Theoretical Consequences

As shown in the research that Villard (2013) conducted, lab-based inquiry can increase students' grades in their lab work. Research conducted by Bruck (2016) showed that "students who struggle to grasp abstract concepts benefit from their use of physical manipulatives and relatable objects to solve problems" (p. 23). The researcher observed many benefits to using hands-on engagements in the classroom as the previous research indicated that hands-on activities in a science classroom can increase engagement. The observed data collected did not support the previous research that stated that grades and student understanding would increase.

The observed noted that the students involved in the hands-on activities were more engaged in in-depth conversations related to the learning topic than those engaged in book work. Notwithstanding, this same grouping of classes that engaged in-depth conservation on the learning topic were also more likely to have be off task during class. Science teachers at this given school are encouraged to teach hands-on activities to allow students to solve problems and have in-depth on topic conversations/debates.

Bruck (2016) stated that students who struggle with grasping abstract concepts and are unable to visualize some ideas can benefit from the use of physical manipulatives. Also, Villard (2013) maintained that inquiry-based lab activities increased subject matter in content knowledge and retention of materials for the students involved. However, in the current study, students who received book work as engagement performed as well as those who received hands-on activities. Prior to this study, all students received a combination of book work and hands-on engagement. All groups knew the expectations of each type of engagement although they previously participated in more book work and paper/pencil engagement versus hands-on engagement. If this study were to be conducted for a longer time period and the students had even more

opportunities to engage in meaningful conversations/debates on the topic at hand, perhaps the academic a significant difference in engagement may have been observable.

Threats to the Validity

Throughout this study there were several threats to validity. This study consisted of a mix of gifted talented students and standard students. An internal threat to validity was that the selection groups were not tested for academic equivalence on the outcome measure prior to the study. Using either a group of gifted and talented students or a group of standard students and not a mixed ability grouping may have increased the validity. An internal validity threat to the study could have been that, as data were collected, the recorder may have used previous knowledge of each student's academic progress; this may have skewed the data. Having a nonbiased data collector could eliminate this threat. Another internal validity threat was maturation due to weather events and state testing. The researcher had a delay in the planned teaching schedule due to snow days and state required testing. This delay led to inconsistent days of teaching which could have affected the on-task engagement of the students. Student attendance was another negative threat to this study. Lastly, the length of the study could have caused a threat to the validity of the study. Data was were collected on the control and tested group for three days as observation and three days as the test was being conducted. Conducting the test for a longer period of time could have provided more data to analyze and compare.

Implications for Future Research

Future research into the engagement styles in a middle school science classroom should be conducted to provide the researcher and teachers with a better understanding of how students in this school might perform better. Researching using a larger group of standard students would

allow for a larger sample of students with similar educational levels and motivation. Research should also be collected for a longer period of time when minimal weather and state testing disruptions could be expected. This would allow for the students to become more accustomed to each engagement style and feel more comfortable participating and also allow the researcher to learn the students' engagement cues.

Conclusions

Analysis of the data collected during this study of book work and hands-on engagement in middle school science classes shows that there was no significant difference based on the difference between the pre and posttest. The null hypothesis was retained. In the future, research of a larger group of standard students and for longer duration may provide a more in-depth understanding in whether or not book versus hands-on engagement is more beneficial for students. Also, a study conducted with fewer interruptions could also make the results more valid.

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Appendix A

Teacher Engagement Chart

engagement				New learning								Review of class		Analysis
warm up completed	engagment visually engaged	verbally participated in engagement	Objec-tive									Verbally particpated	visually engaged	