The Classroom Environment: Effects on Learning, Motivation, and Behavior

Angela Pierotti

Follow this and additional works at: https://digitalcollections.dordt.edu/med_theses

Part of the Curriculum and Instruction Commons

Recommended Citation
https://digitalcollections.dordt.edu/med_theses/143

This Thesis is brought to you for free and open access by Digital Collections @ Dordt. It has been accepted for inclusion in Master of Education Program Theses by an authorized administrator of Digital Collections @ Dordt. For more information, please contact ingrid.mulder@dordt.edu.
The Classroom Environment: Effects on Learning, Motivation, and Behavior

Abstract
This research study examined the effects of flexible seating on student learning, motivation, and behavior. Two classes of fifth graders participated in the study, so that there was an experimental group and a control group. Each group consisted of 23 fifth graders. The experimental group had flexible seating in their classroom for a period of three weeks. The options included bean bag chairs, floor cushions, exercise balls, and patio chairs with cushions. The control group had desks and chairs for their seating. Both groups took pre- and post-tests to determine student knowledge in the areas of reading and math. The experimental group also took a survey at the end of the three-week period to communicate their levels of motivation, engagement, and comfort with the flexible seating. The experimental group improved both their reading and math scores. The control group improved their reading scores but decreased in their math scores. Paired t-tests did not show statistically significant evidence in differences among the two groups. The student survey answers showed that the majority of students felt that flexible seating allowed them to feel comfortable, motivated, and able to concentrate. The median absolute deviation (MAD) indicated that there was no evidence of a statistically significant difference between seating options.

Document Type
Thesis

Degree Name
Master of Education (MEd)

Department
Graduate Education

First Advisor
Patricia C. Kornelis

Keywords
Master of Education, thesis, classroom environment, flexible seating, learning, motivation in education, behavior

Subject Categories
Curriculum and Instruction | Education

Comments
Action Research Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Education

This thesis is available at Digital Collections @ Dordt: https://digitalcollections.dordt.edu/med_theses/143
The Classroom Environment:
Effects on Learning, Motivation, and Behavior

by

Angela Pierotti
B.A. Seattle Pacific University, 2013

Action Research Thesis
Submitted in Partial Fulfillment
of the Requirements for the
Degree of Master of Education

Department of Education
Dordt University
Sioux Center, Iowa
May 2020
The Classroom Environment:
Effects on Learning, Motivation, and Behavior

by
Angela Pierotti

Approved:

Patricia Kornelis, Ed.D.
Faculty Advisor
May 8, 2020
Date

Approved:

Steve Holtrop, Ph. D.
Director of Graduate Studies
May 8, 2020
Date
# Table of Contents

Title Page .................................................................................................................................................. i
Approval ..................................................................................................................................................... ii
Table of Contents ......................................................................................................................................... iii
List of Tables ................................................................................................................................................... iv
Abstract ....................................................................................................................................................... v
Introduction.................................................................................................................................................... 2
Review of Literature ....................................................................................................................................... 4
Methods......................................................................................................................................................... 10
Results............................................................................................................................................................ 13
Discussion....................................................................................................................................................... 23
References ....................................................................................................................................................... 29
Appendices

  - Appendix A .............................................................................................................................................. 32
  - Appendix B .............................................................................................................................................. 34
  - Appendix C .............................................................................................................................................. 38
## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experimental Group: Mean Scores for Pre- and Post-Tests</td>
<td>13</td>
</tr>
<tr>
<td>2. Experimental Group: Paired t-test Results</td>
<td>14</td>
</tr>
<tr>
<td>3. Control Group: Mean Scores for Pre- and Post-Tests</td>
<td>14</td>
</tr>
<tr>
<td>4. Control Group: Paired t-test Results</td>
<td>15</td>
</tr>
<tr>
<td>5. Student Test Results: Experimental Group</td>
<td>16</td>
</tr>
<tr>
<td>6. Student Test Results: Control Group</td>
<td>18</td>
</tr>
<tr>
<td>7. Student Survey Results</td>
<td>20</td>
</tr>
<tr>
<td>8. MAD Test: Student Motivation and Comfort</td>
<td>21</td>
</tr>
<tr>
<td>9. Student Survey Results About Concentration</td>
<td>22</td>
</tr>
<tr>
<td>10. MAD Test: Student Concentration</td>
<td>23</td>
</tr>
</tbody>
</table>
Abstract

This research study examined the effects of flexible seating on student learning, motivation, and behavior. Two classes of fifth graders participated in the study, so that there was an experimental group and a control group. Each group consisted of 23 fifth graders. The experimental group had flexible seating in their classroom for a period of three weeks. The options included bean bag chairs, floor cushions, exercise balls, and patio chairs with cushions. The control group had desks and chairs for their seating. Both groups took pre- and post-tests to determine student knowledge in the areas of reading and math. The experimental group also took a survey at the end of the three-week period to communicate their levels of motivation, engagement, and comfort with the flexible seating. The experimental group improved both their reading and math scores. The control group improved their reading scores but decreased in their math scores. Paired t-tests did not show statistically significant evidence in differences among the two groups. The student survey answers showed that the majority of students felt that flexible seating allowed them to feel comfortable, motivated, and able to concentrate. The median absolute deviation (MAD) indicated that there was no evidence of a statistically significant difference between seating options.
Students often spend seven hours of the day at school. Most of that time is typically spent in the classroom, which is why it is important for teachers to set up their classrooms in a way that promotes student learning, motivation, and positive behavior. According to Dillon, Gilpin, Juliani, and Klein (2016), “Classroom environment can affect a child’s academic progress over a year by as much as 25 percent” (p. 22). Such environmental factors may include the type of seating and the arrangement of it in the classroom. Flexible seating has been a popular strategy in recent years among teachers and administrators as a means of improving student outcomes while transitioning away from traditional classroom atmospheres. The arrangement of the physical classroom may also serve as an opportunity to implement student choice when it comes to flexible seating. Dillon et al (2016) emphasized: “As a teacher, you can have the best curriculum and you can be the best facilitator of knowledge, but if you don’t have an environment that’s conducive for learning, then nothing else truly matters” (p. 3). Lesson planning must go beyond the textbooks, manipulatives, and activities. Environmental factors must be considered in order for students to maximize the impact of their learning experiences.

Problem

For years, classroom layouts have looked relatively similar. Rooms filled with rows of uniform desks that face a chalkboard or whiteboard are a sight that students have grown accustomed to seeing. Despite the many enhancements made to curriculum and the delivery of instruction, the basic classroom layout has seen little change over the years.

Until recent years, most traditional classrooms have lacked regular opportunity for students to select their seating type and location. Currently, various seating arrangements have become increasingly popular throughout K-12 classrooms in the United States. Examples of seating include clusters, horseshoe, random assignment, and flexible seating options. Among
those flexible choices are bean bag chairs, cushions, exercise balls, stools, and tables. These possibilities provide a growing opportunity for students to explore and discover for themselves, taking more of the learning experience and environment into their own hands. Alternative seating methods are allowing students to work together in ways and at levels that perhaps have not been as accessible in previous decades.

Making the switch from traditional student desks to flexible seating options may bring both intended and unintended outcomes. The overall goal of flexible seating is to increase student learning, motivation, and engagement. When students feel comfortable and safe, they are able to perform at higher academic levels. Flexible seating allows for increased levels of movement, collaboration, and choice. From a Christian worldview, these elements aid in viewing the student as a unique image bearer. Each student is created by God with special gifts and abilities. Allowing students to choose how and where they learn in the classroom opens up additional possibilities for honoring their differences.

Despite relatively new data that suggests group and flexible seating arrangements are conducive to learning, behavioral, and motivational outcomes (Brooks, 2012; Burgeson, 2017; Travis 2017), many teachers are hesitant to adapt these strategies. There may often be a lack of funding to provide these alternate seating options. As the body of supporting research surrounding this topic grows, it may be expected that a continued increase in flexible seating is seen in classrooms nationwide. The purpose of this study is to describe the effects of the physical classroom environment on student learning, motivation, and behavior.

**Research Questions**

In this study, the research was focused on the following three questions:
• How does flexible seating positively or negatively impact student learning with math and reading assessments?
• How does flexible seating positively or negatively impact student motivation?
• How does flexible seating positively or negatively impact student behavior?

Definitions

Provided below are the definitions of terms that are relevant to the study. These definitions belong to the authors cited:

Assess is: “To thoroughly and methodically analyze student accomplishment against specific goals and criteria” (Wiggins & McTighe, 2005, p. 337).

Flexible seating is: “…a choice provided to students that allows them to work around the room comfortably and focused. It provides students the environment they need to be their best” (Flexible Seating, 2016, p. 1).

Outcomes can be thought of as: “In education, shorthand for ‘intended outcomes of instruction.’ An intended outcome is a desired result, a specific goal to which educators commit” (Wiggins & McTighe, 2005, p. 346).

Student motivation is: “…students’ desire to participate in the learning process” (Lumsden, 1994, p. 1).

Literature Review

Classroom design and environment can positively or negatively impact student learning. According to a 2012 study conducted at the University of Minnesota, “class discussions occurred in 48.0% more of the observational intervals in the ALC [Active Learning Classroom] than in the traditional classroom” (Brooks, 2012, p. 5). In the study, the ALC was set up with five round tables and nine chairs at each table for students to sit. The students were also given flexibility to
move around the room to use various technology or to form groups as needed (Brooks, 2012, p. 2). The ALC had an environment that offered more opportunities for interaction and movement, thereby providing a classroom more suitable for collaboration. This study suggests that the seating arrangement of a classroom does in fact have an effect on students.

Historically, classroom layouts have consisted of rows of desks facing the chalkboard or whiteboard. Teachers have typically taught their students from the front of the room with all students facing them in rows, according to teacher-centered instruction (Cuban, 1993, p. 7). The teacher was commonly viewed as having an authoritative role in the sense that they were “givers” of knowledge and students were the “sponges,” expected to absorb that knowledge from their teachers. In these types of classrooms, students have typically had a designated place to sit day after day.

Various seating arrangements have become increasingly popular throughout K-12 classrooms as student-centered instruction has expanded (Cuban, 1993). Examples include clusters, horseshoe, random assignment, and flexible seating options. These possibilities provide a growing opportunity for students to explore and discover for themselves, taking more of the learning experience into their own hands. Limpert (2017) studied flexible learning environments according to a mixed methods approach, which included interviews, observations, and surveys in elementary classrooms. In terms of student choice, she found that “After thorough analysis of this data it could be concluded that the relationship between flexible learning environments that included various seating options and allowed for student autonomy and student attitudes about reading relied upon being comfortable and having choice” (Limpert, 2017, p. 92). This study suggests that the element of choice may be connected to student attitudes and motivation in terms of learning.
Teachers must make decisions about how to physically arrange their classrooms in a way that promotes positive student learning outcomes. Gremmen, van den Berg, Segers, and Cillessen (2016), examined the factors that teachers take into consideration when forming seating arrangements in the classroom to enhance the learning experience. They highlighted that seating arrangements are useful for overall classroom management, both in terms of prevention and intervention. Their study of 50 teachers from fourth through sixth grade examined how teachers make decisions about their seating charts and noted that teachers consider factors such as student cooperation and the management of students. The study found that teachers “mainly preferred arrangements in small groups to promote student cooperation” (Gremmen et al, 2016, p. 1). This study illustrated that student cooperation is a priority among teachers, and that seating arrangements are one way to foster it.

Social factors play a role in classroom management, as well as the way a classroom is arranged. Patton, Snell, Knight, and Gerken (2001) researched the impact that classroom setup had on educational outcomes in the public classroom where social factors are relevant (p. 1). They surveyed 138 elementary teachers to discover the types of seating arrangements they commonly used. They found that 94% of those surveyed have used small groups, which was a much higher rate than the other part of their study, the observed classrooms. In the 294 observed classrooms, only 76% of teachers were using small group arrangements. According to the research findings, there is “a significant, contemporary shift in elementary seating design preferences away from row designs to the use of cluster arrangements” (p. 5). This discovery captures the current movement away from standard seating and an openness toward other options.
Impacts of Flexible Seating on Student Learning

Wootton-Greener (2018), explored the advantages and disadvantages of flexible seating in elementary schools. She interviewed several teachers in Idaho to explore the reality of implementing this relatively new seating approach into the classroom. One second-grade teacher stated: “For children, having options of where to sit and who to sit next to allows them to have buy-in with their learning” (p. 2). Many teachers seek to increase the level of student buy-in or engagement, so the possibility of flexible seating in the classroom is one potential option.

Havig’s (2017) mixed methods study sought to determine the advantages and disadvantages of flexible seating in fifth-grade classrooms. Her study recognized that alternative seating methods provided a more comfortable and student-friendly environment. Furthermore, it was found that, “Seventy-nine percent of the students also believe flexible seating helped them focus while the teacher was teaching and while they were doing independent work” (p. 39). In turn, this study showed that student motivation may be increased through aspects of the environment, such as flexible seating options.

A classroom design with flexible seating can directly impact the learning and activities that occur in the classroom. Parnell (2016) explored the selection of furniture for elementary classrooms, and how to maximize the use of space. He stated: “Situating tables and chairs of varying styles and shapes invites different-size groups to enter, work, stay involved, move about, [and] collaborate on ideas and projects” (p. 2). By providing an assortment of seating options, a variety of collaborative learning experiences emerge as possibilities. Furthermore, Bullard (2016) claimed that an assortment of seating choices can improve test results. By having an assortment of different types of seating, it allows students with different preferences to all succeed academically.
Student success may be impacted by the environment in which students learn. According to Merritt (2018a), a positive classroom environment “facilitates students’ academic achievement and attends to their socialization needs” (p. 3). The elements of the classroom environment, including seating, contribute to creating a positive learning experience for students. In addition, a sense of cooperation and community also emerge from many classrooms with flexible seating plans (Merritt, 2018b). Students learn through their environments not just in terms of academics, but socially as well.

**Impacts of Flexible Seating on Student Motivation**

In terms of flexible seating, teachers will often have a system in place for students to take turns to choose their seats after a certain period of time. However, not all flexible seating involves the factor of student choice. Some teachers will have a seating chart while utilizing flexible seating options in the classroom. Travis (2017) sought to determine if there is a connection between student engagement and student choice when it comes to seating. She used observations and chi-square independence tests to determine connections. After conducting the research, Travis (2017) asserted: “It was determined there is a positive significant difference in the engagement level of students who have a choice in where they sit as compared to students who are assigned to seats” (p. 6). When considering these two different approaches, Travis’(2017) research confirmed that there was, “positive statistical difference in the engagement of students who had flexible seating and choice in where they sat, [and] students who had flexible seating and assigned spots” (p. 79).

Catalana and Runco (2016) explored the topic of motivation in children. When considering what motivates students, it is key to be aware that what motivates one student may not motivate another. As an explanation of motivation, they stated: “Motivation is driven by the
unique perceptions of individuals” (p. 4). This connects to flexible seating because one type of seating that motivates a student may not motivate the next student. Each student is driven by individual preferences. In terms of flexible seating, by having a variety of options, each student may be able to find a seat that suits his or her needs.

**Impacts of Flexible Seating on Student Behavior**

Some research studies show a connection between flexible seating and on-task student behavior. Havig’s (2017) study found that, “As a result of giving students ownership of flexible seating and opportunities to choose, students developed a greater sense of responsibility.” (p. 48). Providing alternative seating may lead to more on-task student behavior, as their sense of responsibility increases.

Bullard (2016) studied learning spaces that promote student learning in the primary grades and found that, “child on-task behavior and engagement is linked to learning and better achievement test results” (p. 3). The more students are engaged, the more they are likely to learn. Furthermore, Bullard (2016) found that, “both the learning and room design are linked to on-task behavior” (p. 3). Teachers can utilize the classroom seating to meet the academic and social needs of their students.

Additionally, Burgeson (2017) researched possible connections between student engagement and flexible seating in a third-grade classroom. Students completed surveys using the Likert scale to communicate their self-assessed level of engagement while using various flexible seating options. The study found that 61% of students felt a high level of engagement while using a wiggle seat, and seventy-eight percent felt a high level of engagement while sitting at tall tables (Burgeson, 2017). This study indicated that a majority of the class felt on-task while utilizing these seating options. In another study, Rosenfield, Lambert, and Black (1985) used a
time-sampling method to collect data from fifth and sixth grade classrooms. They intended to determine which of the three given seating arrangements allowed for more on-task behavior. The researchers’ hypothesis was confirmed that a circle arrangement was the best option (as opposed to rows or clusters) for on-task behavior.

Methodology

Participants

This research study included 46 fifth grade student participants from a private K through twelfth grade school in the Pacific Northwest. The student body of the school is 66% Caucasian, 15% African American, 11% Asian, 5% Hispanic, 1% American Indian, and 3% other. There were 23 students in the experimental group, 13 male students and 10 female students. In terms of ethnicity, the experimental group consisted of 15 Caucasian students, 4 Asian, 3 African American, and 1 Hispanic student. Four students in the experimental group have IEPs. There were 23 students in the control group, 11 males and 12 females. One student in the control group has an IEP.

Materials

In the experimental classroom, a variety of flexible seating was made available. Options included bean bag chairs, floor cushions, patio chairs, chair cushions, tables, and exercise balls. The control group used the standard desks and chairs that were originally in the classroom.

The researcher gave reading and math pre-tests (See Appendix B & C) to the experimental group at the beginning of the study. Another teacher gave the same reading and math pre-tests to the control group. Students did not see the answer key or see how they scored on the pre-tests. At the end of the three-week period, the same tests were given again as post-tests for both groups in the subjects of reading and math. The reading pre- and post-tests
consisted of ten questions related to two passages. The tests were from Houghton-Mifflin curriculum. There were five questions about sequence of events and five questions about story structure. The math pre- and post-tests consisted of ten computation problems from *Math in Focus* curriculum. The problems were about material that had been covered in the classroom prior to the study.

At the end of the study, a researcher-designed survey (See Appendix A) was given to the experimental group to collect additional data about student learning in terms of reading comprehension and computation. The surveys allowed students to share their opinions and feedback about which types of seating made them feel comfortable, motivated, and engaged.

**Design**

The design for this study was a quasi-experimental design. Random assignment was not used in the study, since the experimental and control groups were assigned according to preexisting classrooms. One class of 23 students was used as the experimental group, and the other class of 23 students was used as the control group. The independent variable in this research study was the variety of flexible seating options, and the dependent variables were student learning, motivation, and behavior. The research was conducted over a period of three weeks.

**Procedure**

Before the study began, the parents of the students in the experimental group were informed that flexible seating would be introduced in the classroom. To start the study, the students in the experimental group were given reading and math pre-tests. The reading assessments were produced by Houghton Mifflin, and the math assessments were produced by
Math in Focus. The purpose of giving the pre-tests was to create a baseline to be able to compare student learning from the beginning and end of the study.

Next, the classroom was rearranged by removing chairs and replacing them with alternative seating. Students removed their books and supplies from their desks and placed them in their lockers in the back of the room. Students would no longer be assigned to a specific desk and chair. A poster was hung on the classroom door with numbers one through twenty-three. Each student has an assigned number. On the first day of the study, numbers one through four got to be the first to choose their seating for the day. Then, numbers five through eight were allowed to choose, until all twenty-three students had chosen their seating for the day. The idea was that each day a different range of numbers would get to go first so that all students had a fair chance to select their top choice during the study.

For three weeks, students in the experimental group rotated their seating each day according to the rotation plan. The control group, on the other hand, remained at their original desks and chairs throughout the entire study. On the last day of the study, the experimental and control groups were given the reading and math post-tests. The tests were the same ones given at the beginning of the study as pre-tests, in which the reading tests were created by Houghton Mifflin, and the math tests were created by Math in Focus. The purpose of giving the post-tests was to determine if there was a positive or negative impact on student learning through the use of flexible seating.

Students in the experimental group also took student surveys at the end of the three-week research period (Appendix A). The surveys collected data about student motivation, comfort, and engagement with the use of flexible seating. Surveys were tallied according to the four different answer options. They were also analyzed for patterns in terms of flexible seating versus desks.
and chairs. Individual student results were also considered. Specifically, a student’s survey answers were compared with their reading and math assessments to determine any cause and effect.

Results

Research Question One

The first research question asked: How does flexible seating positively or negatively impact student learning with math and reading assessments?

Table 1

*Experimental Group: Mean Scores for Pre- and Post-Tests*

<table>
<thead>
<tr>
<th></th>
<th>Math Pre-Test</th>
<th>Math Post-Test</th>
<th>Reading Pre-Test</th>
<th>Reading Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.60</td>
<td>4.87</td>
<td>9.0</td>
<td>9.20</td>
</tr>
</tbody>
</table>

As reflected in Table 1, the experimental group averaged 4.60 out of 10 points on the math pre-test. The same group increased their average to 4.87 points out of 10 on the same post-test at the end of the three-week period. Students never saw the answers or knew how they scored, which reflects true growth in their knowledge of the concepts. Also shown in Table 1, the experimental group scored an average of 9 out of 10 points on the reading pre-test and averaged 9.20 out of 10 on the same post-test. Again, students were never provided with the answer key or shown how they scored. This suggests that the improvement in their scores may be attributed to the flexible seating options. The data reflects a five percent increase in math and a two percent increase in reading.
Table 2

*Experimental Group: Paired t-test Results*

<table>
<thead>
<tr>
<th></th>
<th>Math</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5297</td>
<td>0.2332</td>
</tr>
</tbody>
</table>

As shown in Table 2, a paired t-test was conducted to compare the math pre- and post-tests in the experimental group. The two-tailed P value equaled 0.5297. According to the results, this difference is not considered to be statistically significant. Likewise, a paired t-test was run to compare the reading pre- and post-tests in the experimental group. The two-tailed P value was 0.2332. This difference is not considered to be statistically significant.

Table 3

*Control Group: Mean Scores for Pre- and Post-Tests*

<table>
<thead>
<tr>
<th></th>
<th>Math Pre-Test</th>
<th>Math Post-Test</th>
<th>Reading Pre-Test</th>
<th>Reading Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.82</td>
<td>5.30</td>
<td>8.08</td>
<td>8.60</td>
</tr>
</tbody>
</table>

The control group’s average test results are outlined in Table 3. On the math pre-test, the control group averaged 5.82 out of 10 points, and went down to 5.30 out of 10 on the post-test. This reflects a decrease after the three-week period. In reading, the control group averaged 8.08 out of 10 on the pre-test and went up to 8.60 out of 10 on the post-test. This reflects an increase in scoring after the three-week period. A factor to consider is that they had more room to improve from the start. The experimental group tested higher in reading, so they had less room to grow and improve in. The data reflects a nine percent decrease in math and a six percent increase in reading. Again, these results are not statistically significant.
Table 4

*Control Group: Paired t-test Results*

<table>
<thead>
<tr>
<th></th>
<th>Math</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2478</td>
<td>0.0692</td>
</tr>
</tbody>
</table>

As reflected in Table 4, a paired t-test was also conducted to compare the math pre- and post-tests in the control group. In math, the two-tailed P value equaled 0.2478. According to the results, this difference is not considered to be statistically significant. Likewise, a paired t-test was run to compare the reading pre- and post-tests in the control group. The two-tailed P value was 0.0692. This difference is not quite statistically significant.
Table 5

**Student Test Results: Experimental Group**

<table>
<thead>
<tr>
<th>Student</th>
<th>Math Pre-Test /10</th>
<th>Math Post-Test /10</th>
<th>Reading Pre-Test /10</th>
<th>Reading Post-Test /10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 2</td>
<td>5</td>
<td>3</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 3</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Student 4</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 5</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Student 6</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Student 7</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 8</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Student 9</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Student 10</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 11</td>
<td>5</td>
<td>2</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Student 12</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Student 13</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Student 14</td>
<td>2</td>
<td>0</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Student 15</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Student 16</td>
<td>4</td>
<td>2</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Student 17</td>
<td>7</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 18</td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Student 19</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 20</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Student 21</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Student 22</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Student 23</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 5 outlines the pre- and post-test results of individual students in the experimental group. Fourteen of the twenty-three students in the experimental group either improved their math score or maintained the same score when comparing learning from the pre-test to the post-test. In reading, nineteen of the twenty-three students either improved their reading score or stayed consistent with their original score when comparing the pre-tests to the post-tests.

Student #12 improved in both the reading and math tests. The student went up from 7 to 9 points in reading, and from 3 to 5 points in math over the course of three weeks. In the survey, Student #12 indicated that they agree to have difficulty in sitting still, and that they disagreed
about feeling motivated to do their best when working at a desk and chair. Instead, they agreed to feel motivated to do their best at any of the given flexible seating options, which included bean bags, floor cushions, patio chairs with cushions, and exercise balls. This student’s comment and score suggests that the flexible seating provided a learning environment that was able to boost this student’s learning and motivation.

As another example, Student #21 went up from 8 to 9 points in reading, and from 3 to 6 points in math. However, this student indicated that they strongly disagreed that sitting still is hard for them. Unlike Student #12, Student #21 strongly agreed that they feel motivated to work at a desk and chair as well as agreeing or strongly agreeing that they feel motivated at all of the flexible seating options, too. This student’s comment and score suggests that some students may continue to show improvement no matter which type of seating they were using.

Student #17 strongly agreed that he felt comfortable when working at the bean bag chairs and exercise ball. These settings allowed him have a comfortable learning environment, which made it easier for him to learn. His math score improved by three points.

Other students, however, experienced negative academic outcomes from flexible seating. Some students did not really focus with the flexible seating, and actually got worse in their test scores which suggests that they would not learn better in their alternative environment which they enjoyed. They enjoyed the seating options not to learn, but to be comfortable. This could be for multiple reasons: learning habits, learning disabilities, how attentive they are in each of these environments, and how they process information in these different areas.

Student #13 is the only student from the experimental group whose scores dropped in both math and reading. Unfortunately, the student did not attempt most of the math test problems and left the majority of the problems blank. While taking the math post-test, the student was
distracted and looked around the room. She refused to solve the problems during the given time in class. Eventually, she asked if she could turn in the test as it was since she was not sure how to solve the problems. Student #13’s experience may suggest that the learning environment was not suitable for her, and she was unable to focus on the academics.

Table 6

**Student Test Results: Control Group**

<table>
<thead>
<tr>
<th>Student</th>
<th>Math Pre-Test /10</th>
<th>Math Post-Test /10</th>
<th>Reading Pre-Test /10</th>
<th>Reading Post-Test /10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 24</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Student 25</td>
<td>4</td>
<td>0</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Student 26</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Student 27</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 28</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Student 29</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 30</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Student 31</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Student 32</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Student 33</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Student 34</td>
<td>6</td>
<td>5</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 35</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 36</td>
<td>8</td>
<td>6</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Student 37</td>
<td>5</td>
<td>4</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Student 38</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Student 39</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Student 40</td>
<td>9</td>
<td>6</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Student 41</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Student 42</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Student 43</td>
<td>4</td>
<td>4</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student 44</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Student 45</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Student 46</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 6 provides the individual assessment data for the control group. Fourteen of the twenty-three students either improved their math scores or maintained the same score when
comparing tests. In reading, twenty of the twenty-three students in the control group improved or stayed consistent in their scores.

**Research Question Two**

The second research question asked: How does flexible seating positively or negatively impact student motivation? According to the student survey from Appendix A, students were asked fourteen questions about seating. The questions were mixed up so that similar questions did not appear next to each other on the survey. The questions were about motivation, comfort, and concentration for the seating types that were present in the classroom of the experimental group.
Table 7

**Student Survey Results**

### Comfort

<table>
<thead>
<tr>
<th>Type of Seating</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desk and Chair</td>
<td>0</td>
<td>7</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Bean Bag Chairs</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Desk and Exercise Ball</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Patio Chair and Cushion</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Floor Cushions</td>
<td>2</td>
<td>4</td>
<td>14</td>
<td>3</td>
</tr>
</tbody>
</table>

### Motivation

<table>
<thead>
<tr>
<th>Type of Seating</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desk and Chair</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Bean Bag Chairs</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Desk and Exercise Ball</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Patio Chair and Cushion</td>
<td>2</td>
<td>3</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Floor Cushions</td>
<td>1</td>
<td>7</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 7 provides results from the student surveys. When presented with the statement: “I feel motivated to do my best when I work at a desk and exercise ball,” nine students strongly agreed, seven agreed, five disagreed, and two strongly disagreed. This puts a total of sixteen students within the combined category of strongly agree and agree. This means that 69.5 percent of the class was in agreement that the desk and exercise ball made them feel motivated to do their classwork, which was one of the flexible seating options.
On the other hand, when given the statement: “I feel motivated to do my best when I work at a desk and chair,” twelve strongly agreed, seven agreed, four disagreed, and zero strongly disagreed. This brings a total of nineteen students within the combined category of strongly agree and agree for this statement. In both scenarios, the common factor was the desk and the difference, an exercise ball or a chair. Three more students felt motivated while working with a chair compared to an exercise ball, when looking at the data from this point of view.

There were three other seating types that the student survey referenced. The first was the patio chair with a table, in which a total of eighteen students either strongly agreed or agreed to feeling motivated when using them. The second was the bean bag chairs, in which eighteen students were also in the category of strongly agree or agree in terms of motivation. The third type was the floor cushions, and only fifteen students strongly agreed or agreed that they felt motivated when using them as a flexible seating option.

When considering each type of seating, the type that students in the experimental group felt most motivated with was the desk and chair. Although this was not one of the flexible seating options during the experiment, it served as a baseline to compare with the flexible seating that was in the classroom during the study. Out of all of the flexible seating options, there was a tie between the patio chair with a table and the bean bag chairs in terms of student self-assessment of motivation.

Table 8

**MAD Test: Student Motivation and Comfort**

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Comfort</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4699</td>
<td>0.4644</td>
</tr>
</tbody>
</table>
As shown in Table 8, the researcher conducted a mean absolute deviation test (MAD) to determine the average of the absolute value of the difference between the mean for student motivation. The data was randomized 10,000 times. The decimal value was 0.4699. Since it is greater than 0.05, the MAD statistic for student motivation does not provide evidence of a statistically significant difference between seating options.

In terms of studying the survey results related to student comfort, the researcher conducted another MAD test that was also shuffled 10,000 times. The decimal value was 0.4644. Since the value is greater than 0.05, the MAD statistic for student comfort does not provide evidence of a statistically significant difference between seating options.

**Research Question Three**

The third research question asked: How does flexible seating positively or negatively impact student behavior?

**Table 9**

*Student Survey Results About Concentration*

<table>
<thead>
<tr>
<th>Type of Seating</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desk and Chair</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Bean Bag Chairs</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Desk and Exercise Ball</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

The student survey results in Table 9 provide data about how students perceived their concentration while using various types of seating in the classroom. For example, students were given the statement: “I can concentrate on what my teacher is telling us when I work at a desk
and chair.” Eleven students strongly agreed, ten agreed, one disagreed, and one strongly disagreed with the statement. This puts a total of twenty-one students within the combined category of strongly agree and agree.

In addition, students were also presented with this statement: “I can concentrate on what my teacher is telling us when I work at a desk and exercise ball.” Nine students strongly agreed, eight agreed, two disagreed, and four strongly disagreed. In this situation, there was a combined total of seventeen students in the category of strongly agree and agree. This shows that four more students felt they could concentrate better while working at a desk and chair in comparison to a desk and exercise ball.

Table 10

**MAD Test: Student Concentration**

<table>
<thead>
<tr>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3101</td>
</tr>
</tbody>
</table>

As reflected in Table 10, in terms of survey results for concentration, the researcher conducted a mean absolute deviation test (MAD) to determine the average of the absolute value of the difference between the mean. The data was randomized 10,000 times. The decimal value was 0.3101. Since it is greater than 0.05, the MAD statistic for student concentration does not provide evidence of a statistically significant difference between seating options.

**Discussion**

**Overview of the Study**

The purpose of this study was to answer three questions: How does flexible seating positively or negatively impact student learning with math and reading assessments? How does
flexible seating positively or negatively impact student motivation? How does flexible seating positively or negatively impact student behavior? To answer these questions, fifth-grade students in the experimental group used a variety of flexible seating options for three weeks, while the fifth-grade students in the control group continued to use desks and chairs throughout the experiment. Pre- and post-tests were administered to both groups to measure student learning, and a student survey was given to each student in the experimental group at the end of the study.

**Summary of Findings**

This study suggests that if students are put in an environment they desire, they may retain more information and have better learning outcomes. The students in the experimental group of this study chose the flexible seating options that they felt comfortable with and what they felt was helping them learn. This aligns with similar research by Wootton-Greener (2018), which suggested that offering options for students creates buy-in for learning. Students chose places where they thought they were learning the most. However, the test results for all students did not reflect an increase in scores from the pre-test to the post-test.

This study found that there was a five percent increase in math test scores for the experimental group, while there was a nine percent decrease in math scores for the control group. This may be due to varying achievement levels between the classes in the subject area that were preexisting before the study. In reading, there was a two percent increase for the experimental group and a six percent increase for the control group. This could be due to reality that the control group had more room to improve in their scores when comparing the pre-tests and post-tests. These findings reflect a general increase in test scores; however, the results did not prove to be statistically significant.
In terms of the impact on student motivation, this study found that students in the experimental group felt most motivated when seated at a desk and chair. This was not one of the flexible seating options during the study, because it is what they have traditionally used outside of the study. Of the flexible seating options that were present during the three-week period, there was a tie between the patio chair with a table, and the bean bag chairs in terms of student self-assessment of motivation. These were the top two flexible seating choices among students in terms of self-assessment of motivation. This correlates to findings by Limpert (2017), who noted that student choice is related to attitudes and motivation for learning.

When asked about motivation while using a desk and exercise ball, 69.5 percent of the class agreed that it makes them feel motivated to do their classwork. On the other hand, when asked about motivation while using a desk and chair, 82.6 percent of the class stated that they felt motivated. This shows that according to the self-assessments, more students perceived that they felt motivated while using their traditional desks and chairs. This is comparable to available findings by Catalana and Runco (2016), which showed that what is motivating for one student may not be motivating for another student.

In terms of behavior, students completed survey questions that related to levels of concentration while using the various seating methods. Twenty-one out of twenty-three students stated that they could concentrate on what the teacher was saying while using a desk and chair. In contrast, seventeen out of twenty-three students self-assessed that they were able to concentrate when using a desk and exercise ball. This is similar to research by Travis (2017) and Parnell (2016) which suggested that not every seating type is ideal for each student. The element of choice allows students to have input about their learning environment. A factor to consider is that at the time the surveys were taken, the students had not used their traditional desks and
chairs for three weeks. They had to think back to at least three weeks prior in order to compare their levels of concentration and engagement to their more recent experiences with varied seating.

Limitations

There are elements of the study that have limitations, and those limitations could have impacted the results of the research. The first limitation is that the experimental group and the control group had only 23 students each. Given a larger sample size, the study may have generated different results. A larger and different group of students would mean different learning styles, abilities, and diversity could be involved in the study.

The second (and possibly most significant) limitation is that the research was conducted over a period of three weeks, which is arguably a short period of time for data collection. An extended period of time for observing and data collection would help ensure that reliable results are produced. Several weeks of additional data collection could help increase the reliability of the study.

A third limitation is that the study was conducted at a private school that is largely attended by students from middle and upper-class families. This may have had an effect on the data that was produced from the research, since it was not gathered from a very diverse population. A study that included more students from lower socioeconomic backgrounds would help provide reliable results.

A fourth limitation is that the experimental and control groups each had different teachers, meaning that there was the possibility for differences in instruction and routines. If the groups were led by the same teacher, that would eliminate variances in terms of those aspects. A fifth limitation is that the two classes are made up of different academic profiles. Although both
classes each contain 23 students, those students all have different abilities and talents. These
differences may produce varying results because both classes did not begin the study with the
exact same academic knowledge.

**Recommendations**

For future studies, the researcher recommends conducting the experiment for a longer
period of time, such as one semester. In terms of deciding how long to wait between
administering the pre- and post-tests, “it is recommended that retest intervals not exceed 6
months” (Horm & Atanasov, 2016, p. 2). This would help ensure reliable results.

In addition, the researcher would also let students choose their favorite type of seating to
have each day throughout the semester. This would decrease the variables and allow the
researcher to look for grade improvement both as a class, and as individuals. According to Travis
(2017): “… there is a positive significant difference in the engagement level of students who
have a choice in where they sit as compared to students who are assigned to seats” (p. 6). As a
result, differences may also be seen in the level of engagement among students with this
recommendation.

Furthermore, the researcher would provide pre- and post-tests that each consist of twenty
questions instead of ten. According to Horm and Atanasov (2016), “assessment length has been
shown to affect reliability—the longer the assessment, the more reliable the assessment” (p. 3).
The additional ten problems would provide opportunity for a wider range of results, and more
exact data to be produced.

Flexible seating can help to provide an optimal learning environment for students. Instead
of a “one size fits all” approach to classroom seating, students are able to experiment with
different options until they discover what works best for them. The added element of choice allows students extra opportunities to take ownership of their learning experiences.
References


Appendix A

Student Survey

I feel comfortable when I work at a desk and exercise ball.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel motivated to do my best when I work at a table with a patio chair and cushion.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel comfortable when I work at the bean bag chairs.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I can concentrate on what my teacher is telling us when I work at a desk and chair.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel comfortable when I work at a table with a patio chair and cushion.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel motivated to do my best when I work at a desk and exercise ball.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel comfortable when I work at the floor cushions.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
I feel motivated to do my best when I work at a desk and chair.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

Sitting still is hard for me.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I can concentrate on what my teacher is telling us when I work at the bean bag chairs.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel motivated to do my best when I work at the bean bag chairs.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel comfortable when I work at a desk and chair.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel motivated to do my best when I work at the floor cushions.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I can concentrate on what my teacher is telling us when I work at a desk and exercise ball.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
Appendix B

Reading Pre- and Post-Tests

Name

Sequence of Events
Read the passage. Then read each question and fill in the circle next to the best answer.

What a Blast!

On a spring morning in 1980, an earthquake shook the ground under Mount St. Helens in Washington. As a result, one side of the mountain slid away.

The earthquake created the largest landslide ever. It also awakened a volcano that had been quiet for over one hundred years. Just after the earthquake occurred, a blast of hot gas, steam, and rock spewed into the air. A huge cloud of ash rose fifteen miles into the sky. The ash was then picked up by the wind and scattered over 22,000 square miles.

Over 150 square miles of forest were flattened by the blast. A scorching fire following the blast burned the forest to the ground. When the fire died down, scientists went in to view the area. They saw that the beautiful mountain scene now looked like the surface of the moon.

A few months after the eruption, new plants began to appear in the blast zone. After several more years, the plants had spread across the area. Later, a few tiny trees sprang up from cracks in rocks. Following the trees, coyotes, foxes, and elk began to return to the mountain.

Today the volcano is a laboratory for scientists, who have made many discoveries. For example, they have learned how an ecosystem can renew itself and about the power of volcanoes.
1. What happened just before the landslide at Mount St. Helens?
   - A. Ashes were scattered over 22,000 square miles.
   - B. Coyotes, foxes, and elk came to the mountain.
   - C. The forest was burned by a scorching fire.
   - D. An earthquake happened under the mountain.

2. Which event happened first?
   - F. A blast flattened over 150 square miles of forest.
   - G. Scientists viewed the area destroyed by the volcano.
   - H. A fire burned 150 square miles of forest.
   - J. A few tiny trees sprang up from cracks in rocks.

3. When did the events in the fourth paragraph take place?
   - A. before the eruption
   - B. during the eruption
   - C. in the years following the eruption
   - D. one hundred years after the eruption

4. Which of these shows the order in which living things returned to the mountain?
   - F. animals, plants, trees
   - G. plants, trees, animals
   - H. trees, animals, plants
   - J. plants, animals, trees

5. Which signal word or words from the last paragraph show a time shift from the past to the present?
   - A. Today
   - B. discoveries
   - C. For example
   - D. renew
The Recital

Chad finished playing his favorite piece on the piano. Then he looked up at his piano teacher.

“How lovely, Chad! I can tell that you’ve been practicing,” exclaimed Mrs. Franklin. “Now, I have a surprise for you. In two weeks, we’re going to have a recital at the Parkdale Library. You’ll be able to play your song for your family. The other students and their families will attend, too.”

On the way home Chad kicked a stone from the path. He thought about how awful it would be to play in front of other people. “I just don’t think I can do it,” he decided.

That afternoon Chad asked his sister Cara to help him think of a way to get out of the recital. “It won’t be so bad,” she told him. Then she invited him to come with her to the library.

After they had been there awhile, Cara said, “Let’s go find the piano. As many times as I’ve been here, I’ve never seen it.” The librarian directed them to a room on the second floor.

The shiny, black piano was the most beautiful one Chad had ever seen. As he ran his hand lightly over the keys, Cara sat down in a chair.

“Go ahead, Chad. Just pretend that I’m not even here,” she urged.

Chad began playing. Within minutes he was carried away by the beautiful sound of the instrument. When he finished, Cara’s clapping startled him. Later, Chad and Cara stopped at the drugstore. Mr. Turner, who owned the store, greeted them. His daughter, Melissa, was one of Mrs. Franklin’s students.

“Chad, I can’t wait to hear you play at the recital,” said Mr. Turner. Chad looked at Cara. He thought about the piano and how much his mother and father would enjoy hearing him play it.

“Thanks,” replied Chad. “I think you’ll really like the piece I’ve chosen to play.”
1. Who is the main character in this story?
   - A. Mrs. Franklin
   - B. Mr. Turner
   - C. Cara
   - D. Chad

2. What problem does Chad have?
   - F. He doesn't want to go to the library with Cara.
   - G. He feels nervous about his piano recital.
   - H. He doesn't like his piano teacher.
   - J. He has not practiced his piano piece enough.

3. Who helps Chad solve his problem?
   - A. Cara
   - B. Mrs. Franklin
   - C. Chad's mother
   - D. Melissa

4. Where does Chad solve his problem?
   - F. at Chad's school
   - G. in the library
   - H. on the way home from his lesson
   - J. in Cara's bedroom

5. Which is the first important event?
   - A. Chad walks home.
   - B. Mrs. Franklin tells Chad about the recital.
   - C. Chad kicks a stone.
   - D. Cara invites Chad to the library.
Appendix C

Math Pre- and Post-Tests

Benchmark Assessment 1
for Chapters 1 to 4

Multiple Choice
(10 × 2 points = 20 points)

Fill in the circle next to the correct answer.

1. Find the product of 1,398 and 8.
   A) 1,390  B) 1,406  C) 174.3  D) 11,184

2. Find the sum of the value of 8 in 387,562 and the value of 7 in 7,328,562.
   A) 1,500  B) 7,800  C) 7,800,000  D) 7,080,000

3. Find the value of \(56 + [9 - (18/6)]\) × 2.
   A) 53  B) 59  C) 62  D) 124

4. A supermarket has 64 cartons of 40 peaches each. The peaches are packed into bags of 8 each. How many bags of peaches are there?
   A) 105  B) 140  C) 320  D) 336

5. A van cost $12,655. Mr. Smith paid a deposit of $6,655 and he will pay the rest in 12 equal payments. How much does he have to pay for each payment?
   A) $500  B) $2,000  C) $5,000  D) $6,000
6. Adam's father is 3 times as old as Adam. Two years ago, Adam was 15 years old. How old will his father be in 5 years?
   A 44 years  B 50 years  C 51 years  D 56 years

7. What is the value of $9 \div \frac{1}{3}$?
   A 27  B 8$\frac{2}{3}$  C 9$\frac{1}{3}$  D 3

8. Claire has $\frac{3}{2}$ gallons of water. She pours the water equally into 6 glasses. How much water is in each glass?
   A $\frac{1}{4}$ gal  B 1$\frac{1}{12}$ gal  C 7$\frac{1}{2}$ gal  D 9 gal

9. Write the product of $\frac{7}{20}$ and 3 as a decimal.
   A 0.86  B 0.95  C 1.05  D 2.1

10. Alice has $560 in the bank. She uses $\frac{1}{4}$ of it to buy a coat and $\frac{2}{3}$ of the remaining money to buy a present for her mother. How much money does Alice have left?
    A $70  B $140  C $208  D $420