SUPPORTING MATH EMPORIUM STUDENTS’ LEARNING THROUGH SHORT INSTRUCTIONAL OPPORTUNITIES

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A Thesis

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This study focuses on the concept of including traditional math classroom experiences in a math emporium College Algebra II course. The aim of the study was to gain an insight into the opinions of students about which emporium structure they prefer as well as which they believe they can be more successful in. Also, this study analyzed emporium students’ academic success in both scenarios. To accomplish these goals, two sections of College Algebra II in the math emporium were offered the option to attend traditional classroom experiences (called short instructional lessons) led by the instructor during the fall semester of 2016. The participants were enrolled in one of the two classes taught by the researcher and used MyLabsPlus as the instructional software package. The treatment group consisted of the students who self-selected to attend the short instructional lessons, thus the control group was the students whom did not attend.

Mathematics achievement was measured by a comprehensive final exam. Achievement data was collected prior to any short instructional lessons and at the end of the study. Students’ attitudes towards the math emporium, mathematics, and the short instructional lessons were measured throughout the semester using surveys in Qualtrics. Analysis of Variance (ANOVA) was used to determine whether there were significant differences in academic achievement in the control and treatment groups. A $\chi^2$ was performed to decide if there was a significant change in the students’ beliefs on the helpfulness of the short instructional lessons throughout the course of the study. A correlation was used to determine whether there was a significant relationship between student achievement in College Algebra II and the number of short instructional lessons attended. A coding scheme was used to track the common themes from the students’ free responses in the Qualtrics surveys.

Results of the ANOVA tests indicated a significant difference in academic achievement between the control and treatment groups. Students who attended 4 or more of the short instructional lessons earned a significantly higher final grade than those students who did not attend. Results of the correlation showed a weak, positive relationship between student academic achievement
and the number of short instructional lesson attended. Through the coding scheme four common themes emerged from students’ responses in regards to the short instructional lessons, the math emporium, and mathematics in general. The most cited of these common themes being that the addition of the short instructional lessons was beneficial and added value and enjoyment to the math emporium environment.
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CHAPTER 1 INTRODUCTION

Remedial courses can be found at virtually any college campus across the country. A breakdown of data on college students in 2004 showed that “29 percent of all students at public four-year institutions have enrolled in a remedial class” (Diploma to Nowhere, 2008). Students who place into developmental courses are more likely to delay graduation and are less likely to graduate at all. In fact, 71 percent of students who are required to take remedial coursework do not go on to graduate with a bachelor’s degree (Diploma to Nowhere, 2008). Mathematics in particular, consistently has a high remedial enrollment rate. As students enter college as freshmen, 22% of them are placed in developmental mathematics courses (Thiel, Peterman, & Brown, 2008, p.49). According to Thiel, Peterman, & Brown (2008), less than half of the students who initially major in science, technology, engineering, or mathematics (STEM) go on to graduate and receive a degree in their desired STEM field (2008). In the early 2000’s educators and administrative personal recognized the need for a redesign in remedial math courses and saw technology as the “silver bullet” to do so (Twigg, 2011, p.26). Out of the efforts to redesign and improve developmental math courses came the birth of the math emporium.

A math emporium is a self-paced math course that is completed with the aid of an instructional software package, which includes computational exercises, videos, practice exercises, and online quizzes (Twigg, 2011, p. 27). Students work on math problems and ask for help from instructors, graduate teaching assistants, or undergraduate assistants when needed. Virginia Tech pioneered the first math emporium and studies have shown positive effects in terms of attendance, pass rates, performance on end-of-course exams, and future enrollment in mathematics courses since the opening of the emporium (Twigg, 2011, p.27). At Virginia Tech, the math emporium houses anywhere from 1,000 to 2,000 students per semester; traditional weekly classes are not offered, attendance at a specific class time is not required, and students flip a cup to signal that they need assistance. In general, math emporiums follow the Virginia Tech model with three major places of variation: attendance, weekly traditional meetings, and size of facility (Twigg, 2011,
The idea of having weekly traditional classroom meetings is not one that all schools adopt. As previously stated Virginia Tech does not offer traditional classroom meetings, they solely offer open lab time. Other schools, such as the University of Idaho, have weekly focus meeting where a group leader explains the current course material, announces any upcoming deadlines, as well as helps students develop better math study strategies (The Polya, 2016).

There are limited studies examining which emporium structure is more effective in increasing student mastery and positively affecting student opinions on the course, the instructor, and mathematics. This study focuses on the differences between a fully computer based instruction emporium and an emporium offering traditional classroom experiences. The U.S. Department of Education reported that there are advantages for blended learning and that “it was the combination of additional learning time and materials as well as additional opportunities for collaboration that produced the observed learning advantages” (U.S. D. of E., 2010). A math emporium that offers traditional classroom experiences is a type of blended learning and this study may be able to further support the claim that blended learning gives students an advantage. The researcher investigated if there is a relationship amongst an emporium offering traditional classroom experiences, academic achievement, and attitude towards math and the new additions into the emporium setting.

1.1 Statement of the Problem

For the past decade math emporiums have been become a common choice when redesigning developmental math courses at both two and four year college institutions. Thanks to the highly student-centered environment, coupled with the reduction of costs, more and more universities are making the shift to the math emporium over traditional lecture courses. There is an ample amount of research literature on the impacts of the initial course redesign. Thus far, the results on the redesign have been positive (Twigg, 2003, p.28, 2011, p. 27, 2013, p. 1; Demiroz, 2016; Bowen, 2007; Thiel, Peterman, & Brown, 2008), but there are aspects of the math emporium that require further investigation. There is a deficiency of research on emporiums beyond the initial redesign. With many options on how to structure an emporium, not enough research has been conducted over which approach is the most effective.
Furthermore, exploring how the emporium setting disrupts the traditional student-professor rapport is an avenue that is under represented. Student-professor rapport reflects more than a caring, likeable teacher. Wilson and Ryan (2013) found that when rapport is tied to student academic success it seems to move beyond liking the teacher to what the teacher does to make the class more engaging for the students. In a math emporium, the relationship between students and the professor changes. The professor is no longer the main source of new class material. Rather, the professor is now a resource that the students can choose to utilize. With research studies revealing emporium students are left with a feeling of isolation (Martin 2005; Cordes, 2014), more studies need to be completed to determine if the loss in student-professor rapport is responsible for the feeling of isolation.

Additionally, there is a need to study the relationship between the math emporium setting and the attitudes of students on math and learning. The results in past studies have been inconsistent. Bishop (2010) explored the effects of the math emporium on student attitudes towards math. She discovered that the students whom where enrolled in the traditional algebra courses had significantly higher attitudes towards math after the class quizzes than their peers whom were enrolled in the algebra emporium sections. On the contrary, Nguyen, Hsieh, and Allen (2006) conducted research on the integration of instructional-based software and found considerably different results. After data analysis, the researchers concluded that the web-based mathematics assessment and practice enabled students to recognize their mistakes. The instantaneous feedback allowed the students to gain a sense of control over their own learning, thus feeling less anxious in the classroom. The problem examined in this current research is whether there is a connection among the structure of an emporium, academic achievement, and attitude towards mathematics and the emporium.

1.2 Purpose of the Study

The purpose of this study was to determine the effect of traditional classroom experiences in a math emporium setting. Specifically, looking at the impact on student academic achievement and attitudes towards mathematics and on the overall emporium environment. The study involved one
independent variable, the inclusion of traditional classroom experiences called short instructional lessons. The study included three dependent variables. One dependent variable in the study was student attendance at the short instructional lessons. This was measured by recording which students attended the optional short instructional lessons and which students chose to continue to work on their own with the online instructional software. All students in the Algebra 2 sections were given the opportunity to attend and participate in the short instructional lessons, which were held during class time. Thus those students who chose not to attend the short instructional lessons were the control group and the students who chose to attend and participate in the short instructional lesson became the research group.

The second dependent variable was student achievement and was measured by the differences in the unit test scores of the Algebra II students who attended the short instructional lessons and those students who did not attend. The control and research group took the same unit test using the same computer software.

The last dependent variable was student attitudes on mathematics and the emporium environment. This variable was measured through the series of four surveys given throughout the fall semester of 2016. The goal of this research is to determine whether offering traditional classroom experiences in an emporium setting improves student achievement and attitudes toward mathematics or the emporium in general.

1.3 Research Questions

The purpose of this study is to gain an insight into the opinions of emporium students at a public university in the Midwest as to which emporium structure they prefer, as well as which they believe they can be more successful in. In addition, this study analyzes the emporium students’ academic success when they become involved in traditional classroom experiences, called short instructional opportunities, versus those who continue to use the fully computer-based emporium system. The research questions for this study are:

1. What is the nature of students’ perspectives on incorporating short instructional lessons into their emporium experiences?
2. How does attendance at the short instructional lessons change over the course of the study?

3. What differences, if any, in student achievement were there between and among students who participated in short instructional lessons and their peers whom did not participate?

Delimitations

1. Participants in this study were limited to those students who enrolled in one of two mathematics courses taught by the researcher, specifically two College Algebra 2 sections at a public university in the Midwest.

2. The study was limited to the fall semester of 2016.

3. Computer-based instruction was limited to using the online instructional software package MyLabsPlus.
CHAPTER 2 LITERATURE REVIEW

This research study is designed to determine the effect of short term learning outcomes in an emporium model on student beliefs and achievement in mathematics. Relevant areas of research literature will be provided in order to create a context for this particular study. First, the research literature on the transition to the math emporium will be examined to provide clarification on what a math emporium is and how it is used. Second, some literature on student beliefs towards success in the mathematics classroom will be investigated. Lastly, literature on student-teacher rapport will be explored. The exploration of this literature highlights some areas where there is not enough research and how this particular study fills this existing gap in the research literature.

2.1 Transition to Math Emporium Setting

College students are not always prepared for the rigor and difficulty of college level courses. Mathematics is a subject where many students are required to take remedial or developmental courses before reaching their major requirement. One of America’s most persistent learning problems is the dismal record of students’ performance in these developmental and lower level mathematics courses (Twigg, 2011, p.26). This problem sparked the National Center for Academic Transformation to initiate a redesign in high enrollment, developmental mathematics courses. Out of this redesign the math emporium was created. The goal was to create an active learning environment within a large lecture setting supplemented by a variety of web-based class activities (Twigg, 2003, p. 30). The course redesign was not about putting courses online; rather, rethinking the way in which the instruction is delivered (Twigg, 2011, p.26). In a math emporium, students engage with instructional software to complete the online, self-paced, mastery modules. These courses are not online courses, but they are web-assisted. This means that students have an assigned classroom time and that most coursework is completed on computers. When students encounter a difficult problem they can immediately signal for assistance from one of the emporium faculty members. The faculty consists of full time instructors, GTA’s, and upper level undergraduate assistants. In
recent years much research has been conducted to examine the impact that the math emporium setting has on students’ achievements and attitudes.

Many scholars have found positive attributes in math emporiums, and highly recommend the course redesign. Demiroz (2016) stated that

Computer-Assisted Instruction research yields promising learning outcomes in college algebra. In a comparison study, the effects of Computer-Assisted Instruction on student performance in college algebra classrooms concluded that students enrolled in Computer-Assisted Instruction sections preformed better than students enrolled in traditional sections in terms of understanding functions, exhibiting positive attitude changes, and showing reduced math anxiety (p. 25).

Carol Twigg, president and CEO of the National Center for Academic Transformation, published impressive statistical results after conducting her massive emporium redesign in the early 2000s. Within her study, before the implementation of the math emporium at Virginia Tech an average of 80.5 percent of students completed the course by achieving grades of D or better. In the two fall semesters immediately preceding the emporium redesign to an average of 87.25 percent completed the course by achieving grades of D or better (Twigg, 2011, p. 28). These success rates were not a singular occurrence. At the University of Alabama Student the success rates of a C or better increased from 40.6 percent in the fall 1999 traditional course to 78.8 percent in fall 2003 after the emporium redesign (Twigg, 2011, p. 29). Similarly, at the University of Idaho student success rates of a C or better in Intermediate Algebra increased from 59 percent in the traditional format to 75 percent in the redesigned format and in Pre-calculus from 68 to 75 percent (Twigg, 2011, p. 29). Bowen conducted a study to assess whether a significant difference existed in students’ perceptions prior to and after the implementation of mastery learning curriculum in an undergraduate, web-assisted, mathematics course. One result of this study yielded that the number of students who received an A or B at the end of the course increased from 35 percent to 55 percent after the inclusion of the web-assisted software (Bowen, 2007). Additionally results demonstrated
that fewer students dropped the emporium style course when compared to the traditional lectures (Bowen, 2007). Finally at the conclusion of Dermiroz’s research, students enrolled in the college algebra web-based emporium sections at Fairfield University had a higher mean scored then students enrolled in the traditional courses (Demiroz, 2016). All five of these examples point to the emporium experience enhancing student achievement, but not all studies have a similar positive conclusion.

Cordes examined the experiences and perceptions of developmental math students in an emporium setting. During participant interviews, common themes of dissatisfied student opinions towards the math emporium emerged. One common theme was the feeling of isolation. Participants reported feeling isolated from their peers as classmates progressed through the material and they did not (Cordes, 2014). Another common theme coming from the participant interviews was the desire for a different instructional method. A majority of participants mentioned a longing to have a traditional classroom experience or discussed frustrations with the current structure of the class. In fact, her study suggested that the math emporium environment negatively impacts students’ attitudes towards math and towards technology supported math (Cordes, 2014). Bowen reported student perception of timely feedback on classwork was worse in the emporium course than the traditional setting. She theorized that the decrease in perceived feedback was due to the students’ association of a human interaction with the word “feedback” (Bowen, 2007). The computerized, immediate, and appropriate responses given by the software were helping student mastery, but without a human element the students did not feel as though they were receiving suitable advice. A study conducted at Virginia Tech, the birthplace of the math emporium, focused on students’ opinion of the math emporium environment. The results reflected students’ dissatisfaction with the math emporium and raised a concern regarding its lack of effectiveness (Davies, Falcone, McElhinney, & Vasquez, n. d.). When surveying students the researchers found, only 24 percent of students believed the math emporium was effective. Additionally, the results suggested that the majority of students would rather take math courses with an actual professor rather than teach themselves the material. One of the questions posed by the researchers was “In general,
do you believe being taught by a professor is better than learning math by yourself, why?” Two examples of student responses were, “[Yes] they [the teachers] have gone through the learning process themselves, and can help you avoid some of the pitfalls” and “Yes, reading math on a screen is much less engaging” (Davies et. al., n. d.). Although student achievement rates seem to increase with the implementation of a math emporium, there may be a disconnection between student success and attitudes about the math emporium that requires further research.

In order for success to happen in an emporium setting, research has shown there are common key features that must be present. These key features include: a sophisticated course software, clearly established expectations for progression, requiring attendance, and one-on-one personalized and immediate assistance (Twigg, 2013, p. 6; Cordes, 2014; Twigg, 2011). When these features were in place students have reported feeling comfortable asking questions (Cordes, 2014) and having the ability to progress quickly or slowly through material (Twigg, 2013, p. 7). Overall, the key emporium features helped provide students’ with a sense of satisfaction in a technology-rich mathematics class (Demiroz, 2016).

This research study focuses on the inclusion of traditional classroom experiences, called short instructional lessons, in an emporium setting. Specifically, this study examines the relationship, if any, between the inclusion in the short instructional lessons and improvement in academic achievement and student attitudes towards math and the math emporium setting. It is important that the history and current literature on the math emporium is understood because then the necessity of the study becomes clearer. Although there exists studies examining math emporium environment, the results have been mixed thus more research must be done to clarify the math emporium’s effects on students.

2.2 Student Attitudes on Mathematics

In today’s society there is a commonly held bitterness towards mathematics. As students mature, they often demonstrate a sense of loathing directed at mathematics and they accept the idea that mathematics is irrelevant or unimportant in the world. Often students enter college with a predisposed negative attitude about mathematics courses. Thus, around one percent of students en-
tering college today choose mathematics as their undergraduate major (Tapia & Marsh, 2002). The term attitude in context of this study will correlate to students’ emotions and feeling towards the subject of mathematics. Student attitude towards mathematics plays a crucial role in the teaching as well as learning process of mathematics (Farooq & Shaw, 2008; Schoenfeld, 1989, p. 349; Bishop, 2010). Achievement levels in mathematics courses are considerably influenced by personal beliefs about one’s own mathematical ability, the value of the mathematics, and the enjoyment of the mathematics (Tapia & Marsh, 2002). Research dating back to the 1970’s has consistently provided support for this claim and has shown a positive correlation between confidence in one’s mathematical abilities and achievement in the classroom (Schoenfeld, 1989, p. 342).

Accompanying the growth of online instructional tools in mathematics education, researchers have started studying the attitudes of students towards mathematics in online and blended settings. The results have been mixed as to whether the addition of technology has positively or negatively affected students’ attitude towards mathematics.

Nguyen et. al. (2006) conducted a study over the effects of web-based assessment and practice on students’ mathematics learning attitudes and had positive results. During the interviewing process, the researchers heard common themes about the web-based assessments providing instantaneous feedback, more examples and instruction, as well as allowing second and third attempts on concepts. In the study it was shown that a majority of participants either agreed or strongly agreed that they enjoyed doing work on the computer and they preferred to have more lessons on the computer. Love (2004) reported similar findings in his study over the computer based instruction software ALEKS. The conclusion of his analysis showed an improved competence in mathematics and increases in attitudes toward mathematics from the students that received computer based instruction when compared to their traditional counterparts.

Conversely, Bishop (2010) conducted a study to determine whether computer-based instruction had an effect on student mathematics achievement and students’ attitudes toward mathematics in developmental and introductory math courses that resulted in a negative effect. Her descriptive analysis suggested students’ attitudes towards mathematics worsened when enrolled in a course
with computer-based instruction and remained constant or increased when enrolled in a traditional math course. Comparable results were found in Martin’s (2005) study on the effects of different delivery types of computer-based instruction in mathematics on college prep students. One finding of the study was that the overall attitude towards mathematics was lower in those students who worked individually with the computer-based instruction system. Martin attributed these lower attitudes of the individuals to the possibility that these students could have felt isolated from their peers and lack of teacher support.

Although research is split on the impact of technology on student attitudes regarding mathematics, it is clear that students attitudes towards mathematics is correlated with academic performance (Schoenfeld, 1989, p. 347; Farooq & Shaw, 2008, p. 75), self-confidence in mathematical abilities (Bishop, 2010), and student enjoyment of mathematics (Tipis & Marsh, 2002).

One important factor that is examined in this study is if the inclusion of traditional classroom experiences, called short instructional lessons, impact students’ attitudes towards math. The literature review indicates that it is unclear if the inclusion of technology into the mathematics classroom impacts the attitudes towards mathematics. This background knowledge is important to have, because the study reveals that student opinions of mathematics and the math emporium are more positive than indicated by some researchers. These results could add to the literature that technology, when used correctly, improves student attitudes towards mathematics.

2.3 Student-Professor Rapport

Rapport in the classroom can be thought of as a harmonious relationship in which the instructor and the students have a clear understanding for each other’s learning styles and communicate effectively. At the collegiate level student-professor rapport has been shown to have an impact on student learning outcomes (Fraymeir & Housen, 2000; Wilson, Ryan & Pugh, 2010, p. 246; Swenson, 2010), student enjoyment or attitude of the material (Wilson & Ryan, 2013), and student engagement in academically beneficial behaviors (Wilson, Ryan & Pugh, 2010, p. 250). Building this meaningful and impactful rapport with students encases more than simply being a likeable teacher. Swenson argues that rapport involves knowing who students are outside the classroom as
well as understanding their learning styles, then using the new relationship to teach at a more personalized level. Many new faculty workshops include sexual harassment training, but lack training on how to grow relationships with students in the classroom. Although these professors are experts in their fields, they are not traditionally encouraged to think about the classroom relationships that should be present. A study by Wright, D’Albe and Jones (2016) reported that there is a significant preference from students for instructors to have certain personality traits over pedagogical ones. Students in Wright et. al.’s study preferred instructors whom they felt were trustworthy, and honest to instructors whom were skilled in teaching techniques or masters of the material. There is a growing amount of evidence supporting the claim that effective teaching is as much about the technical merit of the instructor as it is about the relationships and communication in the classroom (Swenson, 2010; Fraymeir & Housen, 2000).

When communication amid students and their peers or with the professor moves from task orientated to interpersonal, a mutual respect and sense of trust is created in the classroom. The created trust allows students to ask the “stupid questions” or ask for clarification on new concepts (Fraymeir & Housen, 2000). It is in this environment that professors can challenge their students to achieve at high levels of learning. These high levels of learning can include mathematical analysis, synthesis, and evaluation all of which require interaction between class members. Fraymeir and Housen (2000) found that students can preform low-level academic tasks without outside influence, but high-level cognitive tasks require students to have open communication with their instructor, suggesting once again that rapport impacts learning levels.

Professor-student rapport is essential in both traditional classrooms as well as online and blended classrooms (Swenson, 2010; Wright et. al., 2016). Rapport in online learning environments is defined as a close interactive relationship that is built upon trust, shared control, and engaging in activities that are aimed at advancing the skills and abilities of the entire group (Wright et. al, 2016). Building rapport with students is more natural when in the context of a traditional classroom, but with the reduction of face-to-face time between professors and students in an online environment building the same relationship can become increasingly difficult. When a professor
initiates the personal interactions, whether by chat rooms or discussion boards, students are more likely to engage in class activities online (Swenson, 2010). As education continues to advance its instructional technology, it falls to the professors to maintain and boost the interpersonal connections that technology based learning can unintentionally strip away (Wright et al, 2016).

This research study focuses on the effects of the inclusion of short instructional lessons in a math emporium. At the Midwest University where the study was conducted, the initial emporium structure was that interactions between students and professor were student initiated. Some researchers have witnessed that students in this type of emporium environment can feel a sense of isolation from their professor and peers (Martin, 2005; Cordes, 2014). In the literature review the benefits of creating a strong student-professor rapport in the classroom was clear. This study will begin to show that by bringing a traditional classroom experience into the math emporium, a student-professor rapport once again flourish.

2.4 Conclusions From Literature Review

From the review of this literature, it is apparent that aspects the math emporium setting require more investigation. Student-professor rapport can become lost in the transition into the math emporium setting thus effecting student attitudes and achievement in mathematics. This investigation of the existing literature has revealed important gaps such as:

1. Most research literature on math emporiums focuses on the initial redesign.

2. The majority of mathematics education research on technology focuses on fully online courses or traditional lecture courses, but not hybrid courses.

This research study attempts to fill these gaps because the focus is on the inclusion of traditional math classroom experiences in a math emporium course thus creating a hybrid course highly integrated with technology. The aim of the study is to gain insights into the opinions of students about which emporium structure they prefer, as well as, which they believe they can be more successful in. The investigation can aid in furthering the research on math emporiums past their initial redesign. Finding the most effective instructional environment for mathematics at the collegiate level is extremely important, especially for those students in need of remediation before they can
continue on to the college-level math courses. Farooq and Shaw (2008) stress that the way math is presented in the classroom and then perceived by students, even when teachers believe they are presenting it in an authentic way, can still leave many students feeling alienated from math. The feeling of alienation could result from the type of instruction students encounter. Studying which instructional environment can benefit the biggest population of students is a large undertaking and one that requires more research. This project is necessary because it strives to add to the body of research on the redesign of undergraduate remedial mathematics courses and its effect on the attitudes and academic achievement of students. The results of this study may help future researchers and educators as they design a math emporium to fit their specific needs.
CHAPTER 3 METHODOLOGY

At a Division I university in the Midwest, the math emporium houses four math courses that are categorized as developmental. These four courses are Elementary Algebra, Intermediate Algebra, College Algebra I, and College Algebra II. There are two circumstances in which students are placed in the math emporium courses. First, a student can be placed in a math emporium course if he or she has earned a score of 21 or less on the math portion of the ACT. The second circumstance in which a student is placed in a math emporium course is through the math placement test given by the university. If a student displays that he or she is in need of remediation before enrolling in their major’s required math course, they will be placed in the emporium courses.

The math emporium utilizes an instructional software package called MyLabsPlus that has a cyclic nature of pre-test, homework, post-test, and exam. Students begin each unit by taking a pre-test. The purpose of the pre-test is to determine what content the students currently comprehend, and which topics they need to master. The results of the pre-test generate a list of homework problems that, when completed, open a post-test. This post-test mimics the end of unit exam; it has the same number and type of questions. Then by the specified deadline students take the end of unit exam. This cycle continues until the students have completed all seven of the unit exams. Throughout the cycle the emporium students do not have the opportunity to participate in traditional classroom activities such as alternate explanations of course content by an instructor or class discussions. In addition, interactions between students and the emporium staff are usually student initiated. Unless a student asks for assistance by raising their hand, the student is typically left to work at their own pace.

3.1 Participants

A total of 58 students from two different 1220 courses were invited to participate in the study during the 2016 fall semester. These two 1220 courses are distinguished as 1012 and 1013. The students enrolled in 1012 and 1013 had varying levels of academic status and a variety of past
emporium experiences, as shown in Tables 3.1, 3.2, and 3.3.

Table 3.1: Student’s Academic Standing

<table>
<thead>
<tr>
<th>Course Number</th>
<th>1012</th>
<th>1013</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>21</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td>Sophomore</td>
<td>2</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Junior</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Senior</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>High School</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>29</td>
<td>58</td>
</tr>
</tbody>
</table>

Note there were 4 students still in high school that had the opportunity to participate in the study. These four students were able to enroll in the 1220 course as part of the college credit program offered by the university to local high schools. Students in the program receive both high school and college credit for each course in which they are enrolled. For means of analysis, these four students will be considered to be at freshman academic standing with no prior emporium experience.

Table 3.2: Student’s Academic Standing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Non-Freshman Students</td>
<td>22</td>
</tr>
<tr>
<td>Students Previously Enrolled in Emporium Courses</td>
<td>20</td>
</tr>
<tr>
<td>Students New to the Emporium</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3.3: Number of Completed Emporium Classes (n=20)

<table>
<thead>
<tr>
<th>Number of Past Emporium Classes Taken</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Students</td>
<td>4</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

3.2 Procedure

During class time, early in the semester, the researcher verbally explained the project including the purpose of the surveys and how the short instructional lessons would work. The researcher emphasized the voluntary aspect of the entire project. The first survey was sent to the students in both 1220 courses in an email. If the students chose to complete the survey they were able to
do so at this time. In this email was a link to a survey asking students about their opinions on having traditional classroom experiences, called short instructional lesson, in the math emporium (see Appendix A). Within one week of the initial survey, the researcher announced the goal of the first short instructional lesson as well as the date that the short instructional lesson will be held. All short instructional lessons were held during class time on the same day of the week throughout the study. Both 1220 courses both met two days a week for 75 minutes each, and with end of unit exams held on days when short instructional lessons were never offered. This provided consistent schedules for students. There were two types of short instructional lessons held during class time. In either type of short instructional lesson attendance was completely voluntary, students were welcome to join or leave the lesson at any time. An undergraduate classroom aid kept a written record of those students whom attended each of the short instructional lessons.

The first type of short instructional lesson was an overview of the important new concepts in the unit. To prepare for the overview short instructional lessons the researcher completed the pre-test, with the intent of identifying the main mathematical ideas and challenge questions of the unit. The list of new or challenging mathematical topics became the learning goals for the overview short instructional lessons. From these learning goals the researcher constructed the lesson plan, keeping in mind that the short instructional lessons must not exceed a thirty-minute threshold in a seventy-five minute class. This time constraint was followed to give students the opportunity to complete their pre-test, homework, or post-test during precious class time. Using the teaching strategies of scaffolding, quick checks, class discussions, and multiple representations when possible to enhance the short instructional lesson. Figure 3.1 shows an example from a lesson plan from an overview lesson where the researcher started with a mathematical task that the students were comfortable with and built upon this knowledge to introduce a topic that can be challenging. Figure 3.2 displays an example from an overview lesson plan. In this particular overview lesson, the researcher gavestudents different mathematical representations to use when determining whether or not something is a function.

The second type of short instructional lesson was a challenge problem lesson. The purpose
of the challenge problem lessons was to provide students with additional opportunities to work on difficult problems from the unit. MyLabsPlus allows instructors access to the item analysis of all homework, tests, and exams, hence the researcher was able to find which questions were most commonly missed on the pre-test and post-test. Three to four most commonly missed questions were used as the basis of the challenge problem lessons. In addition to compiling the list of three to four questions, the students had the opportunity to request a specific problem be added to the list through email. During the challenge problem lessons, the researcher worked through the designated problems asking for student contribution and participation at each step of the problem.

Near the half way mark in the semester a second survey was sent in an email to students (see
Appendix B). In this survey, students were asked similar types of questions as the first survey, but now the students had exposure to the short instructional lessons giving them a new perspective. During the week before final exams students received an email containing a third survey (see Appendix C). This third survey asked the student specific questions based upon their attendance at the short instructional lessons throughout the semester. Participation in any of the surveys was completely optional as well as anonymous. Furthermore, there were no incentives for participating in any of the surveys, thus a point was made to thank the class after each survey was collected for taking the time out of their day to complete the surveys.

Once all three surveys were collected and the researcher analyzed the qualitative responses. One aim of this analysis was to determine if any additional questions should be posed. The researcher then created a list of seven questions to better illustrate the research questions. These questions were sent to the students in an email containing the link to the survey (Appendix D). This final survey was composed of both multiple choice and open-ended questions about the student’s attitudes towards mathematics, the math emporium, and the addition of the short instructional lessons. Participation in this survey was again completely optional as well as anonymous. [ 
CHAPTER 4 RESULTS

The purpose of this research study was to determine if including short instructional lessons in the math emporium impacted students’ academic success as well as their opinions on the math emporium. Research question 1 states; what is the nature of students’ perspectives of the benefits of incorporating short instructional opportunities into their emporium experiences? By exploring student’s opinion on the math emporium, student-professor rapport, and what method of learning the students prefer this question can be better understood.

4.1 Research Question One

Data analysis for research question one started by examining the qualitative findings from the online surveys. Questions 4, 5, 7 from survey 4 (see Appendix D) provided valuable qualitative data for research question one. Additionally, question 3 in survey 2 (see Appendix B), and question 6 in survey 3 (see Appendix C) contributed qualitative data to the investigation of this research question. The questions listed above asked students about their opinions on mathematics, the math emporium, and the addition of the short instructional lessons. Additionally the above questions asked students how they would make the math emporium or short instructional lessons more beneficial. The following themes emerged during analysis of the student responses:

Theme 1: Interaction between students and the instructor or students and their peers is important and makes for a more successful academic classroom

Theme 2: A math emporium with no traditional classroom experiences, where interactions are student initiated and students work independently is effective for some students

Theme 3: The addition of the short instructional lessons was beneficial and added value and enjoyment to the math emporium environment

Theme 4: Math is scary, difficult, and monotonous, which is why a math emporium is not comfortable for some students

Table 4.1 gives the frequency counts for the previously mentioned themes. There were 82
student responses to these specific questions. Some of the student responses touched more than one theme making a total frequency 97. The surveys were online and anonymous, so pseudonyms are not used. A sequential delimitation was used for respondents (e.g., Student A, B, C). If a student was quoted for more than one response the letter was repeated. Limited discussion will be provided in this section, the in-depth discussion of these of how these themes help formulate an answer for the first research question will be part of the discussion section.

Table 4.1: Research question one: Themes from qualitative data in the student responses

<table>
<thead>
<tr>
<th>Theme</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme 1</td>
<td>18</td>
</tr>
<tr>
<td>Theme 2</td>
<td>10</td>
</tr>
<tr>
<td>Theme 3</td>
<td>47</td>
</tr>
<tr>
<td>Theme 4</td>
<td>22</td>
</tr>
</tbody>
</table>

The most commonly cited theme was Theme 3 which stated, the addition of the short instructional lessons was beneficial and added value and enjoyment to the math emporium environment. Students wrote about the inclusion of the short instructional lessons overall aided in their learning process and that the short instructional lessons should be continued. Student A said:

I think that the [short instructional] lessons are extremely beneficial for practice and notes before taking the pre-test. All the information is well presented and all questions that are asked by students are clearly answered.

Student A believes that the short instructional lessons are advantageous to their success on the pre-test. Student A also pointed out that they believe having the material presented in a clear and concise manner by the instructor improves the chance of earning a high score on the pre-test. Additionally, Student A values the interactions between the instructor and the students.

Student B wrote, “I really appreciate the step-by-step process in exchange from the online data work. It puts it into perspective and I would suggest doing it in all classes.” Student B expresses similar values to Student A. They both value the rapport between students and the instructor when learning new class material. In fact, Student B enjoys the shift from the online unit work to the
A slightly different opinion came from Student C:

I like these [the short instructional lessons] a lot, it is a very hard transition coming from a high school with 15 kids in a math class to 100 people coming to a room and doing [an] online course. When the mini lessons are given it makes me feel more comfortable and gives me a strong start on the subject.

In addition to expressing how the short instructional lessons help her start the unit successfully by earning a high pre-test score, Student C discusses how the short instructional lessons make her feel more comfortable in the math emporium. Continuing the theme of needing the additional assistance when transitioning from high school, Student D wrote:

Short [instructional] lessons are very helpful. Most of the topics in class were things that I’ve done in high school. I took senior math my junior year in high school and the short [instructional] lessons really helped to kick the dust off. Honestly if it wasn’t for the short [instructional] lessons I would have [had] a lot harder of a time passing the course. I used the notes I took with the short [instructional] lessons to my advantage and was able to earn off of them (the homework problems) more than the lessons online taught by a computer.

Like the other example responses Student D believes it is important and preferable to hear the course material from their instructor as opposed to using the online modules. Student D discusses her belief that the short instructional lesson aided in her overall academic success.

Theme 4 (math is scary, difficult, and monotonous, which is why a math emporium is not comfortable for some students) was the second most common theme that appeared in the qualitative data from the surveys. When students were asked to type a word or phrase that best described how they felt about mathematics in general, many students gave responses such as anxiety inducing, frustrating, and difficult. Student E wrote, “One way to describe a math emporium is annoying and
bothersome”. Student F later responded to a different question saying, “One word to describe the math emporium is aggravating”. Similarly, Student G wrote:

I think the best way to learn math is by lectures and with an actual teacher. The videos we watched never went over everything that was on the homework and the homework was always more harder (difficult). I didn’t learn anything from them.

To these students math was challenging and the math emporium was not their desired learning environment. As a result, they did not enjoy their time in the math emporium regardless of the inclusion of the short instructional lessons. This data helps bring to light that not all students thrive in the math emporium setting, and this student dissatisfaction leaves researchers with a new goal, how to better the newly formed math emporium. When Theme 4 was explored, due to the anonymity of the surveys, the researcher was not able to identify if a student who had a negative attitude towards mathematics or the math emporium attended any of the short instructional lessons. What the researcher could do was connect one student’s responses within one survey. Table 4.2 shows a visual of the student’s free responses within one survey.

Table 4.2: Students’ Responses Within One Survey Regarding Opinions on Math and Experiences in the Emporium

<table>
<thead>
<tr>
<th>Student</th>
<th>Opinion on Math</th>
<th>Description of a Math Emporium</th>
<th>Experience in 1220</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student W</td>
<td>Tough</td>
<td>Different</td>
<td>Pleasant</td>
</tr>
<tr>
<td>Student X</td>
<td>Difficult</td>
<td>Useless</td>
<td>Bad</td>
</tr>
<tr>
<td>Student Y</td>
<td>Boring</td>
<td>Awful</td>
<td>Okay I Guess</td>
</tr>
<tr>
<td>Student Z</td>
<td>Anxiety Inducing</td>
<td>Aggravating</td>
<td>Best Math Experience</td>
</tr>
</tbody>
</table>

When tracking students who reported having negative attitudes towards the math emporium or mathematics 45% reported having a negative experience in their 1220 class with the addition of the short instructional lessons. On the other hand, 55% of the students who had negative attitudes towards the math emporium or mathematics reported having a positive experience in their 1220 class with the addition of the short instructional lessons. This positive experience will be further examined in the discussion section.
Eighteen student responses included comments that were connected to Theme 1 (interaction between students and the instructor or students and their peers is important and makes for a more successful academic classroom) making it the third most cited. Several students wrote about how learning in a social setting was helpful, and that they appreciated the interactions between themselves and the instructor. Student H wrote, “you [the instructor] want to connect with everyone so they can pass with class with flying colors”. This student felt that the key to success was the connection between a student and the instructor. Student I’s response said, “Math is a subject that is either easy to grasp or very difficult. So, letting people ask questions as needed can make sure everyone is succeeding to the best of their abilities”. Much like Student H’s response Student I saw a connection between interacting with the instructor and succeeding in the math emporium. Student I pointed out that although the math emporium allow students to succeed on their own, it was through the aid of the instructor that students reach their fullest academic potential. This student response aligned well with Vygotsky’s zone of proximal development, which was the difference between what a learner could do without help and what he or she could do with help. (Vygotsky, 1978). A slightly different perspective came from Student J:

I was able to talk to the instructor on any questions I had and it helped. Other than that I don’t like talking to people I don’t know well because it makes me feel nervous, however, it [our relationship] makes me feel better about asking questions in this laid-back environment.

The rapport that Student J and the instructor had allowed Student J to ask questions that aided in her academic success even though Student J was a self-proclaimed introvert. The environment that the instructor created allowed all students to feel as thought they can ask questions with out pressure of being correct.

Lastly, Theme 2 (a math emporium with no traditional classroom experiences, where interactions are student initiated and students work independently is effective for some students) was cited the least in student responses. Theme 2 was evident in Student K’s response; “I am a very independent person when it comes to math and only ask for help when I cannot figure out something on my
own”. Student K appreciated the structure of the math emporium because Student K preferred to ask for help as needed instead of being bothered by a lecture or group activities. Another response that cited Theme 2 was Student L. Student L wrote, “the [short instructional] lessons aren’t helpful for the students who worked ahead and have already done that content”. This opinion was not singular. The idea that the short instructional lessons were not helpful to those students who were ahead of the minimum pacing occurred in at least 5 separate student responses. To these students whom were ahead of the course pacing, the current emporium model at the Midwest University worked well. These students were able to succeed at an accelerated pace and thus the short instructional lessons were not useful to them. A different type of student response that cited Theme 2 was from Student M it reads:

There wasn’t any real interaction with other students [in the math emporium], and I learn a lot of the material on by myself without anyone around. The undergraduate assistants were helpful some times, but often they didn’t have great methods of explaining something, so it was easier to just figure it out myself.

This student was able to use the computer module to resolve issues when he or she reached a challenging problem. He or she did not ask for help from other students or the instructor. In fact, Student M found the computer system to be more reliable and easier to understand than the undergraduate assistants in the room. Student M worked more efficiently when he or she was independent rather than when working with others.

Additional, questions 1, 2, and 3 from the fourth survey (see Appendix D) contributed to the resolution of research question one, but these questions were not considered qualitative data. Question 1 asked students to choose the best description of the type of relationship or level of rapport he or she had with their 1220 instructor. The results were summarized below (Figure 4.1).
Figure 4.1: Student reported relationship or rapport level with instructor (from survey 4)

When asked to pick the description that best defined the relationship between the student and the professor twenty-two students responded. Eighteen (81.82%) students claimed to have an interpersonal relationship with the instructor. The term interpersonal relationship referred to the instructor honestly wanting the student to succeed in MATH 1220 as well as other aspects of the student’s life outside of math. Three (13.64%) students responded that they had a professional classroom rapport with the instructor (e.g. the student felt as though the instructor was willing to help and explain concepts while in class). None of the students selected the passing acquaintance rapport or poor rapport descriptions when defining the relationship they had with the instructor. Lastly, one (4.55%) student picked the option of “other” to describe the rapport or relationship that the student had with the professor.

Question 2 asked the students what factor or factors allowed their confidence in their own mathematical abilities and their comfort level in the math emporium to grow as the semester progressed. Figure 4.2 summarizes the result of this question.
Students were able to select all of the factors that they thought contributed in the growth of their confidence in their own mathematical abilities and their comfort level in the math emporium. Since some students reported multiple factors there are a total of 57 factors selected from 21 students. Twenty (90.91%) of the students selected that the instructor’s attitude and willingness to help both inside and outside of the classroom contributed to the growth of their confidence and comfort level in the math emporium. Fourteen (63.65%) students chose their own hard work as the factor that grew their confidence and comfort in the emporium. These students believed that the more time and effort that they put into the course the greater that their confidence grew. Nine (40.91%) students said that the passing of time helped grow their confidence in their mathematical. The more experience that the students had in the math emporium the more comfortable they became with structure of the course and the details of MyLabsPlus. Of the students who answered this question, seven (31.82%) stated that the MyLabsPlus software was highly educational, and competing the videos, explanations, and homework gave them confidence to succeed in the mathematics course. Six (27.27%) of the students who responded selected the undergraduate assistants’ aid as a factor that allowed their confidence in their own mathematical abilities and their comfort level in the math
emporium to grow as the semester progressed. Lastly one (4.55%) student selected the “other” option, meaning their factor of success was not listed.

Lastly, Question 3 asked the students to rank their ideal math-learning environment for developmental courses such as 90X, 95X, 1210, and 1220. The graph below shows the distributions of the students’ preferences of learning environment (Figure 4.3).

![Figure 4.3: Distributions of student learning environment preferences (from survey 4)](image)

For the students’ ideal learning environment the first place ranks were as follows: first a traditional lecture course (28.27%), tied at second 100% online and math emporium (23.81%), third an activity-based classroom (19.05%), and last was the flipped classroom (4.67%). The rankings for students’ second choice for their ideal learning environment were: a flipped was (33.33%), a math emporium (23.81%), an activity-based classroom (19.05%), a traditional classroom (14.29%), and a 100% online course (9.52%). When selecting their third preference for an ideal learning environment, students produced these rankings: first a flipped classroom (38.10%), tied for second were an activity-based classroom and math emporium (19.05%), third was a 100% online classroom (14.29%), and lastly a traditional lecture course (9.52%). For the students’ ideal learning environment the fourth place ranks were as follows: a traditional lecture course (28.57%), tied at second were the math emporium and an activity-based classroom (23.81%), a 100% online course (14.29%), and a flipped classroom (9.52%). Lastly the learning environments that students chose as least desirable were ranked as follows: first a course that was 100% online (38.10%), tied at
second was a traditional lecture course and an activity-based classroom (19.05%), third a flipped classroom (14.29%), finally a math emporium (9.52%).

Notice that the students’ responses were split on their desire to take a math course in a 100% online environment. 23.81% chose the online environment to be their first choice of ideal learning environment while 39.10% of students selected the online environment as their least liked learning environment. Another interesting result from this question to point out was that the math emporium was highly ranked as an ideal learning environment. The math emporium was chosen as students first pick 23.81% of the time, second pick 23.81% of the time and third pick 19.05% of the time. Even with poor reviews in other questions the students still chose the math emporium as one of their idea learning environments.

The last type of data that helps answer research questions one was the Likert data from surveys 1 (Appendix A), 2 (Appendix B), and 3 (Appendix C). The students were asked questions involving the likelihood of attending or continuing to attend a short instructional lesson, how beneficial the short instructional lesson was. Table 4.3 shows the changes of student responses for helpfulness the short instructional lessons throughout the semester.

Table 4.3: Student opinion on the helpfulness of the short instructional lessons

<table>
<thead>
<tr>
<th></th>
<th>Very Helpful</th>
<th>Not Helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning of the Semester Survey</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>Mid Semester Survey</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>End of Semester Survey</td>
<td>19</td>
<td>8</td>
</tr>
</tbody>
</table>

A $\chi^2$ test was performed to determine if the student opinion of the helpfulness of the short instructional lessons on the mid semester survey had the same distribution as the initial survey indicated. The relation between these variables was significant, $(1, N = 26), p < 0.039$. Thus there was a difference between the initial student opinions of the helpfulness of the short instructional lessons and the opinions of the students at the middle of the semester. Another $\chi^2$ test was performed to determine if the student opinion of the helpfulness of the short instructional lessons on the end of semester survey had the same distribution as the mid semester survey results. The
relation between these variables was not significant, \((1, N = 27), p < 0.307\). Meaning the students’ opinions did not change from the middle of the semester to the end of the semester regarding the benefits of the attending the short instructional lessons.

4.2 Research Question Two

Research question two states: How does attendance at the short instructional opportunities change over the course of the study? To find an answer for this research question, attendance at the short instructional lessons was recorded. The attendance at the short instructional lessons over the course of the semester is showed in the graph below (Figure 4.4).

The highest attendance at a short instructional lesson was 24 students (41.38%). The lowest number of student to attend a short instructional lesson was 14 (24.14%). The average number of students at any given short instructional lesson was 21 (36.21%). The median number of students was 22.5 students (38.79%). The standard deviation of the attendance was 3.38 students. Notice that the attendance at each of the short instructional lessons fluttered, but no dramatic increase or
decrease occurred as the semester progressed. This constant group of students whom attended the short instructional lessons will be further discussed in the next section.

Likewise, in survey 3, students were asked “what is the likelihood that they would attend a short instructional lesson if their instructor offered them again in the following semester”. Figure 4.5 shows a summary of the results. Eighteen (81.82%) students reported that they are very likely to attend short instructional lessons if they are taught by their next semester. Meaning that these students found the experience beneficial to their learning and would participate often next semester. Four (18.18%) students reported that were somewhat likely to attend short instructional lessons if they were to be offered next semester by their instructor. These found the short instructional lessons to be helpful, but would only attend a short instructional lesson next semester if they felt they needed help on a topic. The final two categories (probably not and definitely not going to attend a short instructional lesson if offered next semester) did not receive any votes from students.

![Figure 4.5: Student likelihood of continuing to attend the short instructional lessons next semester](image)

Another avenue that the researcher pursued during data analysis of research question two was determining the presence of a correlation between the number of short instructional lesson attended and the student’s overall class attendance. A correlation coefficient was computed to assess the
relationship between the number of short instructional lessons that students attended and their overall attendance in the course. There was a positive correlation between the two variables, \( r = 0.536, n = 58 \). A scatterplot summarizes the results (Figure 4.6). Overall, there was a moderate, positive correlation between the number of short instructional lessons attended and percent of classes the student attended. Increasing the number of short instructional lessons attended was moderately correlated with the student attending more classes during the study.

![Figure 4.6: Correlation between the number of short instructional lessons and the percent of classes attended by the student](image)

### 4.3 Research Question Three

The third research questions states: what differences, if any, in student achievement were there between and among students who participated in short instructional opportunities and their peers whom did not participate? As previously discussed the attendance at the short instructional lessons was recoded. Based upon attendance, the students were split into two groups. The first group consisted of the students who attended at least four of the eight short instructional lessons. The second group was comprised of the remaining students. After each unit exam the students’ scores
were recoded and placed in the appropriate groups. An independent-sample t-test was conducted to compare the scores for students who participated in four or more of the short instructional lessons and those who did not. There was a significant difference in the scores for the students whom attended 4 or more short instructional lessons (M= 84.19, SD=7.99) and those who did not (M=69.94, SD=26.83) conditions; t(24)=58.62, p =0.0014. These results suggest that attending the short instructional lessons does have an effect on academic achievement. Specifically, the results suggest that when students participate in traditional classroom activities in addition to the online modules academic achievement improves.

A correlation coefficient was computed to assess the relationship between the number of short instructional lessons that students attended and their overall score. There was a positive correlation between the two variables, r = 0.413, n = 57, p = 0.001. A scatterplot summarizes the results (Figure 4.7). Overall, there was a weak, positive correlation between the number of short instructional lessons attended and students’ final grades. Increasing the number of short instructional lessons attended was weakly correlated with increasing the student final grade scores.

![Figure 4.7: Correlation between the number of short instructional lessons and student grades](image-url)

\[ y = 3.1695x + 67.141 \]
The semester in which the study was conducted had a unique feature, if students completed the course in eight weeks or less they were given a bonus of 5% added to their final course grade. This incentive could skew the correlation between the number of short instructional lessons attended and a student’s final grade in the course. Students who completed the course in less than eight weeks did not have the opportunity to attend more than 4 short instructional lessons. A scatterplot summarizes the correlation results without those students who finished the course early (Figure 4.8).

\[ y = 4.1057x + 61.745 \]

Figure 4.8: Correlation between the number of short instructional lessons and student grades who did not finish the course early

There was a positive correlation between the two variables, \( r = 0.501, n = 49, p = 0.001 \). Overall, the relationship was still weak and positive between the number of short instructional lessons attended and students’ final grades in the students who did not finish the course early. The same conclusion can be indicated; increasing the number of short instructional lessons attended was weakly correlated with increasing the student final grade scores.
CHAPTER 5  DISCUSSION

The goal of the research study was to determine if the inclusion of traditional classroom experiences in a math emporium impacted student achievement and attitudes towards the math emporium. To determine the overall influence of the short instructional lessons, first, the researcher surveyed students on their opinion of the short instructional lessons and their feeling towards other aspects of the math emporium. Both the qualitative and quantitative data in the surveys were examined. Next the researcher analyzed the attendance at each of the short instructional lessons throughout the course of the semester. Finally, the researcher investigated the relationship between attending the short instructional lessons and students’ academic achievement. The results suggested that there was a connection between attending the short instructional lessons and students’ grades.

5.1 Student Attitude Findings

The literature on students’ opinions towards mathematics and the math emporium was split. Some research studies concluded that computer-based instruction increased student attitudes (Love, 2004; Nguyen et. al., 2006). Other research on computer-based instruction has shown that students’ attitude towards the math emporium and mathematics was lower than traditional classroom students (Bishop, 2010; Martin, 2005). A study conducted by Davies et.at. (n. d.) at Virginia Tech, the birthplace of the math emporium, reflected students’ dissatisfaction with the math emporium and raised a concern regarding its lack of effectiveness. When surveying students the researchers found, only 24 percent of the students found the math emporium effective, and that the majority of students stated that they would rather take math courses with an actual professor rather than teach themselves the material (Davies et. al., n. d.).

This current research suggested that students enjoy and found a benefit in the inclusion traditional classroom experiences in the math emporium. The most common theme from the qualitative data was that the addition of the short instructional lessons was beneficial and added value and enjoyment to the math emporium environment. Students free responses on this theme included,
“the [short instructional] lessons were great and very helpful in comparison to not teaching at all” and “if it wasn’t for the short [instructional] lessons I would have had a lot harder of a time to pass the course.” In fact, only 10.36% of student free responses were connected to Theme 2, which suggested that they preferred a math emporium without the inclusion of the traditional classroom experiences. When examining Theme 4, the researcher found that a majority of the students who reported having negative attitudes towards mathematics or the math emporium described their experience in the 1220 positively. Although, the conclusion cannot be drawn that the addition of the short instructional lessons increased students’ attitudes towards mathematics, the results suggested that the addition of the short instructional lessons positively impacted students’ experiences in the course.

Additionally, from the $\chi^2$ test performed, the benefits and helpfulness of the short instructional lessons significantly changed from the beginning of the semester to the middle. At the beginning of the semester students seemed unsure about the benefits of attending the short instructional lessons, but by the middle of the semester student opinions had changed. After gaining experience with the short instructional lessons the students reported seeing an increased benefit in attending the short instructional lessons. Later in the semester, an additional $\chi^2$ test revealed that the students’ opinion of the helpfulness of the short instructional lessons remained high from the middle of the semester to the end. This suggested that students find the short instructional lessons to be an important factor to academic success and class enjoyment.

When specifically asked about what factors aided in succeeding in the math emporium, the most frequent student response was the instructor’s attitude and willingness to help. With the inclusion of the short instructional lessons the role of the instructor in a math emporium shifted from being a resource for the students to a traditional provider of information. The shift in the instructor’s role allowed for a cherished relationship to grow between the students and the instructor. This was evident in survey 4 (Appendix D) when students were asked how to describe the relationship or rapport they felt they had with their instructor. An overwhelming amount of students (81.82%) reported that they had a personal relationship with their professor. Some students wrote, “I truly
appreciate my instructor altering her explanations to ensure that the students grasped the concepts in whatever way they learned best” and “my instructor does a great job of working with her students and finding the easiest ways to explain concepts” when commenting on their instructor. Responses like these along with the survey question results indicated that the inclusion of the short instructional lessons increased the level of student-professor rapport. The literature review showed ample amounts of research that supported the link between positive student-professor rapport and student academic success (Fraymeir & Housen, 2000; Swenson, 2010; Wright et.al., 2016). The conclusion that student instructor rapport was a valuable aspect to the math emporium connected a common theme from the qualitative data in the surveys. Theme 1 (interactions between students and the instructor or students and their peers are important and make for a more successful academic classroom) was cited 18.55% of the time. By including the short instructional lessons the students had the opportunity to interact with their instructor in a more traditional setting. Thus, creating more chances to talk to their peers because there was a common problem being discussed.

Unfortunately, like the literature (Bishop, 2010; Martin, 2005), student opinions on computer-based mathematics remained negative even with the inclusion of the short instructional lessons. Students used descriptor such as awful, challenging, and frustrating when asked what they think about mathematics in survey 4 (see Appendix D). Responses like these caused the Theme 4 (math is scary, difficult, and monotonous, which is why a math emporium is not comfortable for some students) to be the second most cited theme in the qualitative data from the surveys. Moreover, when asked specifically about what learning environment student felt was ideal the first choice was a traditional lecture classroom. Only 23.81% of students chose the math emporium as their ideal learning environment for mathematics. This aligned with Davies et. al. (n. d.) research since they concluded that only 24% of students found the math emporium to be effective. Even with the negative student opinions towards the math emporium and mathematics in general, results in this study suggested that the inclusion of the short instructional lesson positively impacted students experience in the course. Students who reported having negative feelings towards the math emporium and mathematics described a positive experience in their math emporium course.
In summary, the results advocated that students believed the short instructional lesson were helpful and increase the likelihood of success in the course. Furthermore, there was an indication that the inclusion of short instructional lessons increased student-instructor rapport and that students found the relationship and interactions with an instructor to be vital to academic success. Lastly, the results suggested that the student opinions on mathematic and the math emporium remain negative, but that a majority of these students had a positive experience in their math emporium course despite their negative opinions.

5.2 Attendance at The Short Instructional Lesson Findings

Analysis of the attendance patterns throughout the semester indicated no significant change in the number of students participating in the short instructional lessons as the semester progressed. On average, 21 students (36.21%) attended each short instructional lesson. This result suggested that a group of core students consistently attended the short instructional lesson with the addition or loss of a few students at each short instructional lesson. Perhaps, these core students found the short instructional lessons to be helpful and thus they continued to attend at each short instructional lesson. This result was both encouraging and disheartening. At the beginning of the research study the researcher hypothesized that attendance at the short instructional lessons would grow as the semester. This did not happen. The silver lining in the results was that the attendance at the short instructional lesson did not decrease as the semester continues.

One speculation as to why the growth never occurred was because of the individualized nature of the math emporium. If students did not attend the short instructional lessons then the interactions between students and instructor remained student initiated. The researcher did not observe many additional interactions between and amongst students outside of the short instructional lessons. It may be that this environment did not foster the opportunity for students to discuss academic advice with one and other. This could be a reason as to why the attendance did not grow throughout the study.

Moreover, when students were asked the likelihood of attending a short instructional lesson during class time if offered next semester, 81.82% of students who responded to survey 4 reported
that they are very likely to attend. From this statistic, one may infer that students see a benefit in attending the short instructional lessons and would like to opportunity to attend in the future. A strange finding was that although 81.82% of students reported they would attend future short instructional lessons, on average only 36.21% of students actually attended the short instructional lessons during the study. This could imply that some students recognized the benefits of attending the short instructional lessons too late or that some students acknowledged the short instructional lessons’ helpfulness, but simply chose to not attend. Another possibility for the strange finding could be that all of the students who participated in the study attended some of the short instructional lessons.

Lastly, upon further analysis of the attendance patterns at the short instructional lessons and the students’ overall percent of classes attended a moderately positive correlation was found. This result suggested that the more short instructional lessons the students attended during class time, the more frequently the student came to class. One speculation as to why this positive correlation existed was because short instructional lessons created an atmosphere where the students wanted to come to class. The earlier results implied that the addition of the short instructional lessons had a positive impact on students’ experiences in the math emporium. If the students enjoyed their time in class more, they may be more likely to attend on a daily basis. Additionally, the short instructional lessons may have strengthened the relationship between the students and the instructor. This potential fortified relationship could have helped give students a reason to attend class each day, whether there was a short instructional lesson or not. Hence increasing the number of short instructional lesson attended may have increased the students overall number of classes attended.

5.3 Achievement Findings

Statistical analysis of the exam scores indicated a significant difference between the achievement of student who attended four or more short instructional lessons and the achievement of the students who did not attend. The connection between including computer based instruction and student academic achievement in the literature was split. Researchers such as Martin (2005) or
Spradlin (2009), had show that total computer-based instruction was no more or less effective than sole lecture instruction. Although other researchers had concluded that the emporium experience enhanced student achievement when compared to a traditional classroom (Bowen, 2006; Demiroz, 2016; Twigg, 2011, p. 28). This divide gave Davies et al. the idea to conduct a study in the math emporium at Virginia Tech to see what students believed is the most effective and successful learning environment. At the conclusion of the study Davies et al. reported:

Most students identified opportunities for improving the instruction at Math Emporium, we [Davies, Falcone, McElhinney, and Vasquez] believe that a change to a hybrid, or blended, learning environment would be beneficial for the students (n. d.).

Davies et al. did not test their hypothesis that creating a hybrid or blended learning environment would boost student academic achievement, they merely developed the idea based upon student responses to their surveys. This current research study expanded and tested the hypothesis that including traditional classroom experiences, which created a blended learning environment, increases student academic achievement. Based on the findings in this research, the results suggested that when students participated in the traditional classroom activities, called short instructional lessons, academic achievement improved. Upon further investigation into the correlation between attending the short instructional lessons and academic achievement a positive, weak correlation was found. It seemed that increasing the number of short instructional lessons attended might increase the students’ score on the final grade. One reason the correlation was weak because there were seven students who did not attend any of the short instructional lessons and still received very high scores as their final grade. This was evidence that the math emporium in its current structure did work for a select number of students. Additionally, this evidence supported the researcher’s choice to hold the short instructional lessons as optional activities because there were students who did not need the traditional classroom experience to succeed in the math. Another possible reason why correlation was weak could be the six students who did not attend any of the short instructional lessons and received an extremely low score as their final grade. This could be evidence that even with addition of the short instructional lessons some students might
still struggle in the math emporium environment.
CHAPTER 6  CONCLUSION

The aim of this study was to address the following research questions; what is the nature of students’ perspectives of the benefits of incorporating short instructional opportunities into their emporium experiences, how does attendance at the short instructional opportunities change over the course of the study, and lastly what differences, if any, in student achievement were there between and among students who participated in short instructional opportunities and their peers whom did not participate? With regards to the nature of students’ perspectives on the inclusion of the short instructional lessons, the most common theme that occurred in student free responses was that the addition of the short instructional lessons was beneficial and added value and enjoyment to the math emporium environment. When asked how beneficial the students found the short instructional lessons a large portion of students responded that they found the lessons to be beneficial (or highly beneficial) to learning (see Table 4.3).

For the changes in the attendance at the short instructional lessons, the results demonstrated that there was no significant shift. Roughly the same number of students (21 students) attended the optional short instructional lessons each week.

Lastly, there was a significant difference in then academic achievement of those students who participated in short instructional opportunities and their peers whom did not participate (see Figure 4.7). This result suggested that students who regularly attended the short instructional lessons achieved at a higher rate than their peers who chose to not attend. This was an encouraging result because it indicated that including traditional classroom experiences in an emporium setting had a positive impact on students’ grades in the course.

6.1 Limitations

Participants in this study were limited to those who enrolled in one of the two mathematics courses taught by the researcher, in particular those students who enrolled in College Algebra II, at a public university in the Midwest. When conducting academic research studies, the larger the
population the more reliable the results, hence 58 students may not have been enough participants to conclude in dependable results. Ideally, participants of a study are randomly selected. In this research study the students were self-selected, so the results may be bias. The argument could be made that the students who attended the short instructional lessons were the students who cared the most about their grade. Without the randomness of the sample population the motivation of the students could create some uncertainty in the results. Another limitation to this study was the short time frame. The study was limited to the fall semester of 2016, and this short treatment period may not have been enough time to adequately investigate the effect of the inclusion of the short instructional lessons on student achievement and attitudes towards math or the math emporium. Next, the results were based on the used of Pearson’s computer-based instruction, MyLabsPlus software package. The results may not be valid if the University changes software package used in the math emporium. Lastly, the researcher and the instructor of the short instructional lessons was the same person. This was a limitation because it was not clear whether it was the addition of the short instructional lessons that helped the positive results or the instructor’s extensive background in teaching.

6.2 Recommendations

Continuing research to find better ways of implementing a math emporium is crucial. The effects of technology on teaching and leaning are a topic that requires continued study because academic tools are being created or updated frequently. Additionally, more research needs to be conducted on student achievement in mathematics, students’ attitudes toward their classroom environment, and the connection between the two variables.

The researcher suggests the implementation of the following recommendation at the university where this research study was conducted. Since the study results showed that there was a significant difference in the student achievement in mathematics between those students who attended the short instructional lessons and those who did not, it is recommended that instructors of the College Algebra II courses offer optional short instructional lessons. Based on the results of this study, the researcher believes that it is important that students have face-to-face interactions with
their instructor to help counteract for the limitations of the computer-based software. It is also recommended that, if instructors hold short instructional lessons that the lessons remain voluntary. Twigg said it best when stated, “the best time for students to learn math is when they want to learn math” (Twigg, 2011). If the short instructional lessons become a required aspect of the class students may not view the short instructional lessons as extra opportunities for success.

Further research could use a larger sample and the time frame of the study could be expanded. Future studies would benefit from having the surveys throughout the semester be linked. This way the researcher could track how one student’s opinion of the short instructional lessons and mathematics changed over the course of the study. Furthermore, future studies could benefit from conducting interviews with students in order to help clarify their opinions on the math emporium and the impact of the short instructional lessons. The last recommendation would be for multiple instructors to hold short instructional lesson during future studies. This would limit the bias that only have on researcher could bring to the study.
BIBLIOGRAPHY


APPENDIX A  SURVEY ONE

Block 1

Hello 1220 students,

My name is Andrea Alt and I am one of the instructors in the Math Emporium. I am researching the student opinion and effectiveness of short instructional opportunities in the Math Emporium.

These short lessons would taught by your instructor to explain the concepts on each Pre-Test as well as go over most missed questions before Exams. The short instructional opportunities would last 20-30 minutes during class time and be completely voluntary.

Block 2

Would having the opportunity to attend a short instructional lesson taught by an instructor over class material help you be more successful in the Math Emporium?

Yes, being able to hear the material from an instructor in addition to the online modules would aid in my success in the Emporium

Maybe, depending on how I am progressing through the course I may or may not need extra help

No, I believe the online notes are sufficient

How likely are you to participate in a short lesson given by an instructor over a trouble topic during class time?

Highly likely (i.e. going to the short lessons and hearing the material presented in a different way will help my learning)

Somewhat likely (i.e. my participation will depend on how I am doing in the course)

Probably not (i.e. I am successful with how the course currently runs, I would only attend if I am really struggling)

Definitely not (i.e. I do not see myself seeking out any additional help outside of the computer program)

Any additional thoughts or comments about the possible opportunity to participate instructor lead learning opportunities?

Thank you for completing the survey, by clicking the >> you are choosing to submit your survey.
APPENDIX B  SURVEY TWO

Hello 1220 students,

As you know, I am researching the student opinion and effectiveness of short instructional opportunities in the Math Emporium. Now that you have seen and possibly participated in a short instructional lessons I would like to get some feedback on how you believe they are going.

The purpose of this survey is to build an accurate representation of student opinion on the short instructional lessons that are held during the semester. The results from this survey can have an impact on whether or not the short instructional lessons will be offered again in the spring. The survey results can directly benefit you, as the student, if you are taking another Math Emporium course.

The procedure for this survey is simply, complete it and choose to submit. Your responses

How many of the short instructional lessons have you listened to and/or taken notes on?
Every time the instructor gives a short instructional lessons.
I have listened or taken notes on half of the short instructional lessons
I have listened and/or taken notes on 1 or 2 short instructional lessons
I have not listened and/or taken notes on any of the short instructional lessons.

In your opinion, how beneficial are the short instructional lessons?
Very beneficial, I enjoy hearing the material from an instructor before attempting the Pre-Test.
Somewhat beneficial, I understand most of the material on my own, but it is nice to go over the most commonly missed questions.
Not beneficial, I learn best through the MyLabsPlus system as opposed to listening to a lesson.

Do you have any recommendations of how to make the short instructional lessons more effective?

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APPENDIX C SURVEY THREE

Hello 1220 students,

My name is Andrea Alt and I am one of the co-instructors in your course (hopefully you already know that). As you know, I am researching the student opinion and effectiveness of short instructional opportunities in the Math Emporium. Now that the short lessons are over I would like to survey the class in order to gain an understanding of student’s opinions on these short instructional lessons.

The purpose of this survey is to build an accurate representation of student opinion on the short instructional lessons that were held during the semester. The results from this survey can have an impact on whether or not the short instructional lessons will be offered again in the spring. The survey results can directly benefit you, as the student, if you are taking another Math Emporium course.

The procedure for this survey is simply, complete it and choose to submit. Your responses will be

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Block 2

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Were you able to participate in any of the short lessons held throughout the semester?

Yes, I attended at least one of the short lessons offered.

No, I did not participate in any of the short lessons offered this semester.

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Yes Block

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How helpful did you find the short instructional lessons?

Very helpful, I feel as though the short lessons helped my understanding of the material.

Somewhat helpful, the short lessons occasionally aided in learning the material.

Not very helpful, in my opinion, attending the short lessons did not further my understanding of the material.

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If the short instructional lessons are taught by your instructor again next semester, how likely are you to participate?

Very likely (i.e. I found the experience beneficial to my learning and would participate often next semester)

Somewhat likely (i.e. The short lessons were helpful, if I need help on a topic I would attend the short lesson)

Probably not (i.e. I feel confident in my abilities to master the material on my own, but if I am struggling on a topic I might attend a short lesson)

Definitely not (i.e. The short lessons did not help further my knowledge in the course)
If the short instructional lessons are taught by your instructor again next semester, how likely are you to recommend a FRIEND to attend?

Very likely (i.e. I found the experience beneficial to my learning and think others should participate too)
Somewhat likely (i.e. The short lessons were helpful, but not everyone needs to listen to them all the time)
Probably not (i.e. If a friend is struggling then they should attend, but the course can be completed without aid)
Definitely not (i.e. I found the short lessons distracting, they should not be offered)

No Block

What explanation best describes why you chose not to attend in the short instructional lessons.

Successful using computer program only
Absent when short lessons were offered
Did not feel comfortable coming to short instructional lessons
Other

Block 5

Any additional thoughts or comments about the short lessons that were offered (i.e. Ways to make the short lessons more effective for everyone or things you wish you could change).

Any thoughts or comments about your instructor.

Thank you for completing the survey, by clicking the >> you are choosing to submit your survey.
Follow-up Questions

How would you describe the type of relationship or level of rapport you had with your 1220 instructor Andrea Alt?

We had an interpersonal relationship (e.g., I felt as though she honestly wanted me to succeed in 1220 as well as in my life outside of the math world)
We had a professional classroom rapport (e.g., I felt as though Andrea was willing to help me and explain concepts while in class)
We had a passing acquaintance rapport (e.g., Andrea was nice, but never went out of her way to talk to me. I felt as though my presence in class did not matter)
We had a poor rapport (e.g., Andrea made it unenjoyable to come to class)

Other

My confidence in my own mathematical abilities and my comfort level of the math emporium grew as the semester progressed due to which of the following (check all that apply).

My instructor’s attitude and willingness to help both inside and outside of the classroom
The MyLabsPlus software was instructional, the videos, explanations and homework gave me confidence to succeed.
Time. The more experience I had in the math emporium the more accustomed I became to the math emporium.
The undergraduate assistants aid.
My own hard work. The more time and effort I put into MLP the more confident I became.

Other

One word or a short phrase that best describes mathematics, in general, to me is,
Rank your ideal math learning environment for courses like 90X, 95X, 1210, and 1220.

100% Online

A traditional lecture class

A Flipped classroom (View lectures outside of class and work on activities in groups or as individuals in class)

Group work focused classrooms

Math Emporium

Complete the following sentences, based on your experiences in the math emporium in Fall 2016

My experience in the math emporium was

One word to describe the math emporium is

If I could change the math emporium in one way I would,

One common theme last semester was,
"Math is best learned/taught in a social setting"
What is your opinion about this common theme? Do you agree or disagree?

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APPENDIX E  HSRB APPROVAL

DATE: September 19, 2016
TO: Andrea Alt
FROM: Bowling Green State University Human Subjects Review Board
PROJECT TITLE: [947519-1] Supporting Math Emporium Students’ Learning through Short Instructional Opportunities
SUBMISSION TYPE: New Project
ACTION: HSRB APPROVAL NOT NEEDED
DECISION DATE: September 19, 2016

Thank you for your submission of New Project materials for this project. The Bowling Green State University Human Subjects Review Board has determined this project does not meet the definition of human subject research under the purview of the HSRB according to federal regulations.

This determination was made based on the following information in the application form:

- The purpose of the study is to understand the effectiveness of these short instructional lessons on improving ME student achievement. The results of the study will be used to determine how the short instructional lessons are implemented in future semesters.

We encourage you to continue to confirm with the HSRB whether future projects of this nature require review. We will retain a copy of this correspondence within our records.

If you have any questions, please contact the Office of Research Compliance at 419-372-7716 or hsrb@bgsu.edu. Please include your project title and reference number in all correspondence regarding this project.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Bowling Green State University Human Subjects Review Board’s records.