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The Efficacy of the South Dakota State University Summer Jacks LeaP Program

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THE EFFICACY OF THE SOUTH DAKOTA STATE UNIVERSITY SUMMER JACKS LEAP PROGRAM

BY

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THESIS ACCEPTANCE PAGE

Tessa Sundermann

This thesis is approved as a creditable and independent investigation by a candidate for the master's degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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This thesis is dedicated to my wonderful husband, Rylee Sundermann. I couldn't have done it without you.

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CONTENTS

ABBREVIATIONS

Assessment in Learning Knowledgeable Spaces (ALEKS)

Desire2Learn (D2L)

Grade of D or Grade of F or Withdrawal (DFW)

Institutional Review Board (IRB)

Learning Partnerships (LeaP)

Math Index Score (MIS)

Non-Summer Jacks LeaP (non-LeaP)

South Dakota Board of Regents (SDBOR)

South Dakota State University (SDSU)

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ABSTRACT

THE EFFICACY OF THE SOUTH DAKOTA STATE UNIVERSITY SUMMER JACKS LEAP PROGRAM

TESSA SUNDERMANN

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Today, several studies detail the continuing struggle many students have with college mathematics courses at universities across the United States. The South Dakota State University Summer Jacks LeaP program is a summer bridge mathematics program aimed at improving incoming students' mathematics success.

This analysis used a mixed methods research design to examine the efficacy of the Summer Jacks LeaP program. First, we analyzed the LeaP students' homework averages, exam 1 scores, final exam scores, and overall grade scores to determine if they were finding success in their fall semester mathematics courses. We also used hypothesis testing to compare LeaP participants to non-LeaP students to see if there was a difference in their performances. Throughout the comparison, we looked at the total percentage of D grades, F grades, or Withdrawals from a course, time spent in the LeaP program, and Math Index Scores.

For the qualitative portion of the research design, we surveyed Summer Jacks LeaP participants to ask about their experience and conducted a focus group interview with a couple of former LeaP students. The survey responses were analyzed to determine if the participants found the program helpful in improving their mathematics success. From the focus group transcript, common themes emerged that helped us determine the value of the program to participants.

CHAPTER I

INTRODUCTION

The South Dakota State University (SDSU) Summer Jacks Learning Partnerships for Mathematics Success (LeaP) program is a student success program designed to help students prepare for their first college mathematics course or to improve their initial mathematics placement. Summer Jacks LeaP provides both a customized, online study plan designed to address problem areas for individual students and online mentor support. The program was created to provide an avenue for students who wanted to either practice their mathematics skills before beginning college or work toward a higher mathematics placement. If students are pursuing a higher mathematics placement, they eventually take a placement test to determine if they qualify.

The online study plan is hosted by a system called Assessment and Learning in Knowledgeable Spaces, or ALEKS, which is an artificially intelligent learning and assessment system that can be used to aid students in learning Mathematics, Chemistry, Statistics, and Accounting (McGraw-Hill). The ALEKS program uses an initial assessment to gauge students' understanding of mathematics concepts and provides extra practice for students in areas in which they need improvement. This system is the foundation of the Summer Jacks LeaP program, but there are other features of the program such as online mentoring available via Zoom and access to program materials via Desire2Learn (D2L), the SDSU online learning management system. The program materials include instructions on logging in to different platforms, on using each system, and on general program guidelines and rules.

Before enrolling in a mathematics course at SDSU, a student's initial mathematics placement was determined by the Math Index Score (MIS). The Math Index Score is a formula that uses the student's overall High School GPA and their Math ACT score. The formula for the MIS is as follows:

$$MIS = (17 \times \text{Math ACT Score}) + (250 \times \text{High School GPA}).$$

The analysis which led to the use of the MIS at all South Dakota Board of Regents Universities is outlined in a report from SDSU's Department of Mathematics and Statistics (Cogswell, n.d.). The MIS formula as well as cut-off values for each course was calculated based on data from SDSU's mathematics courses and has been used since 2012 at SDSU and 2016 at all SDBOR Universities (Cogswell, n.d.).

Once the MIS is calculated, the students are then placed into the initial college mathematics course based on that score. The course numbers, names, and descriptions for each mathematics course that incoming college students are eligible to take are listed below.

MATH 093 – Algebra for Mathematical Reasoning:

This course provides supplemental instruction in algebra to students co-enrolled in a quantitative literacy course. Algebraic topics are sequenced in a manner that supports the needs of the co-requisite quantitative literacy course.

MATH 094 – College Algebra Laboratory:

This course provides supplemental instruction in algebra topics to students co-enrolled in an introductory college algebra course. Topics are sequenced in a manner that supports the needs of the co-requisite college algebra course.

MATH 101 – Intermediate Algebra:

This course includes basic properties of real numbers. Topics generally include linear equations and inequalities, quadratic equations, systems of equations, polynomials and factoring, rational expressions and equations, radical expressions and equations, and an introduction to functions.

MATH 103 – Mathematical Reasoning:

In this course, students will work with authentic problems to develop logical, critical thinking, and mathematical skills. The student will build a cultural appreciation for the relevant and meaningful role that mathematics plays in many areas of life. Topics may include finance, introduction to probability and statistics, and linear and exponential models, among others.

MATH 114 – College Algebra:

This course includes a study of the theory and application of functions including function notation, graphs, inverses, polynomial, rational, exponential, logarithmic, and other functions. May also include additional topics such as sequences, series, the binomial theorem, linear systems, matrices, or complex numbers.

MATH 115 – Precalculus:

A preparatory course for the calculus sequence. Topics include: polynomial, rational, exponential, logarithmic and trigonometric functions and their graphs; systems of equations, inequalities and complex numbers.

MATH 120 – Trigonometry:

Topics include: trigonometric functions, equations, and identities; inverse trigonometric functions; and applications of these functions. Additional topics

may include exponential and logarithmic functions, trigonometric form of complex numbers; and polar equations.

MATH 121/121L – Survey of Calculus with Laboratory:

A survey of calculus including an intuitive approach to limits, continuity, differentiation, and integration with an emphasis on applications of the derivative and the integral as well as topics from multivariable calculus. A lab which supplements MATH 121 and provides the opportunity to study applications in more detail.

MATH 123 – Calculus I:

The study of limits, continuity, derivatives, applications of the derivative, antiderivatives, the definite and indefinite integral, and the fundamental theorem of calculus.

MATH 123L – Calculus I Laboratory:

A lab which supplements MATH 123 and provides the opportunity to study applications in more detail. (South Dakota State University 2021-2022 Undergraduate Catalog, p. 399).

As stated above, the requirements for placement into each of these courses are determined by a student's MIS. Table 1 outlines the MIS requirements for each course.

Table 1. ***South Dakota Board of Regents MIS Placement***

Course	MIS
MATH 021 OR MATH 101 OR MATH 103 WITH MATH 093	Anyone can take these courses. No MIS requirement.
MATH 114 WITH MATH 094	950 or higher
MATH 103 OR MATH 114 WITHOUT 094	1150 or higher
MATH 115 OR MATH 120 OR MATH 121/121L OR STAT 281	1300 or higher
MATH 123	Students who want to take MATH 123 – Calculus I can do so. Prior completion of trigonometry or precalculus is recommended.

During the Summer Jacks LeaP program, the students:

1. Take the initial ALEKS placement assessment to set up their customized learning plan;
2. Work in the ALEKS customized learning module to refresh and strengthen mathematical skills;
3. Meet with their peer mentor weekly to ask questions and get support; and
4. Retake the placement exam (if desired) once requirements are met.

Once students have completed these steps, they have finished the program. Students either work on the program for the entire 10-week summer term or students work for only part of the term if they have met all the requirements or if they decide to stop without completing their intended goal.

To determine the efficacy of the Summer Jacks LeaP program, we need to answer the following research questions:

1. Are students successful in a fall semester mathematics course immediately after completing the Summer Jacks LeaP program?

2. Do the Summer Jacks LeaP students perform as well as students who did not participate in the summer program?
3. Are mathematics students who participated in the Summer Jacks LeaP program finding value in it and succeeding in their degree program?

We will answer these questions using a mixed-methods approach that includes quantitative analysis of student performance in fall mathematics courses and qualitative analysis of a survey and focus group data.

CHAPTER II

LITERATURE REVIEW

In the United States today, there are many summer bridge programs aimed at improving student performance in college mathematics courses. Thus, before analyzing SDSU's Summer Jacks LeaP program, we researched similar programs at other universities to understand how they determined their efficacy.

After examining the literature, we observed the following research questions about similar summer bridge programs:

1. What is the motivation/mission behind these summer bridge programs?
2. Are summer bridge programs effective at achieving their unique goal(s) (i.e. placement improvement, test success, retention, etc.)?
3. What is the retention rate of college students who participate in a summer bridge program?
4. Are summer bridge programs effective at helping students succeed in their fall semester mathematics courses?

Once these questions were established, we read the literature for answers, which are outlined below.

Background and Motivation

Summer bridge mathematics programs are a result of the declining confidence, success, and preparedness of the average college student in mathematics. Although many summer bridge programs have different goals or problems to solve, many share the same core objectives. Since these programs have been implemented recently, the research is new.

Some of the interest in summer bridge programs has been driven by engineering departments. They want to find a solution to the derailment of on-time graduation caused by students not starting in the calculus sequence their first semester due to their lack of skills in prerequisite mathematics. This increases the number of mathematics courses they need to take, which can lead to students becoming discouraged and dropping out of their STEM program or simply just falling behind (Cancado, et al., 2018).

The midwestern region of the United States has many accredited engineering programs. In 2004, an analysis of these programs indicated that the majority of the students who dropped out of their STEM programs did so in their first two years of study. The first two years of a STEM program are when many of the mathematics courses are typically required (Cancado, et al., 2018). Before implementing their summer bridge math course in 2014, St. Mary's University noticed that many of their incoming STEM students had not met the prerequisite requirements, so they started college already behind the four-year graduation goal (Lecocke, et al., 2019).

The goal of most current summer bridge programs is to help incoming students who may not be prepared or may lack the confidence to start their college mathematics courses. These students may not persist in mathematics or aren't motivated in mathematics because of their self-perception, confidence, attitude, and anxiety.

There is often a relationship between mathematics anxiety and overall success or lack of success in mathematics (Kargar, et al., 2010). While there are several reasons behind this, sometimes anxiety can lead to avoidance of mathematics and practice is essential to success in any mathematics course. In addition, test anxiety can negatively

impact test scores, and test scores are usually a large portion of grades in college mathematics courses (Kargar, et al., 2010).

Two other major components discussed that impact mathematics success were self-perception and attitude. These are tied together, as a student's perception of their ability and their attitude towards a subject are closely related. According to the research, students who have a more negative attitude towards mathematics tend to score lower on mathematics assessments (Kargar, et al., 2010). In addition, a lack of confidence in one's mathematical ability can contribute to mathematics anxiety, leading to adverse effects on performance (Kargar, et al., 2010). If a summer bridge program can improve students' confidence in and attitude toward mathematics as well as alleviate anxiety, then it will likely increase student success in mathematics courses overall (Kargar, et al., 2010).

Length of Programs

The length of summer bridge programs varies greatly. At SDSU, the Summer Jacks LeaP Program is a 10-week summer program that runs from late May to early August and allows students to work at their own pace on the skills that they need to improve. At St. Mary's University, their summer bridge mathematics program is a twelve-day course immediately before the start of the fall semester (Lecocke, et al., 2019). This short course forces students to follow a more regimented schedule rather than rely on self-motivation over a long period.

One article highlighted a summer bridge program that was a six-week traditional summer course based on the mathematical level of the students (Doerr, et al., 2014). Another approach from a different university was a four-week residential program (Cancado, et al., 2018). The University of Rhode Island instituted a five-week summer

bridge mathematics program (Bertrand, et al., 2019). Both of these programs were implemented right before the beginning of the fall semester.

Methods of Implementation

The implementation of summer bridge programs also differs between institutions. Manhattan College uses its summer bridge program as a replacement for its Calculus Readiness Test, where participants prepare themselves for Calculus I in the fall. Students who completed their summer bridge program were allowed to take a calculus course in the fall even if they had previously not met the requirements to do so (Jura and Gerhardt, 2021).

The "Jump Start" program at St. Mary's is an intensive precalculus course taught by a university instructor. Throughout the program, students have access to academic mentors to answer any questions they may have. If students participate in "Jump Start" and earn a grade of C or higher, they earn college credit and then go immediately into calculus. (Lecocke, et al., 2019, p. 41).

One unnamed university implemented a summer bridge program for incoming freshmen who had placed into a mathematics course below Calculus I. This program was held on-campus for a portion of the summer with the intent of acclimating students to campus life and preparing them academically for their coursework. The goal of this program was to improve retention in mathematics courses as well as graduation rates at the university (Cancado, et al., 2018).

The University of Rhode Island observed that an overwhelming number of their incoming students were not prepared for Precalculus or Calculus I. Thus, they developed a five-week program that offered three to four virtual mini-lectures covering the

prerequisite knowledge needed for those courses each week (Bertrand, et al., 2019). The goals of this program were to improve students' skills and confidence in those courses.

Another summer bridge program, highlighted in the *Journal of Engineering Education*, included College Algebra and Precalculus lessons over a six-week timeframe. These lessons encompassed a review of prerequisite skills necessary to be successful in these courses as well as material that would be introduced in the course. The goal of this program was to prepare engineering students for success in Precalculus or Calculus I the first time they took it (Doerr, et al., 2014).

Retention

Summer bridge programs are often an effort to increase retention rates in United States universities. According to Bettinger et al. (2013, p. 93), "less than 60 percent of students at four-year colleges graduate within six years, and at some colleges, the graduation rate is less than 10 percent." Some attribute low college graduation rates to the fact that two-thirds of high school graduates are not adequately prepared for college. One of the main responses of universities to address this issue was to place 35-40 percent of incoming freshmen into remedial courses and to provide summer bridge programs (Bettinger et al., 2013).

An analysis of retention and graduation rates among incoming freshmen at one university investigated the impact the summer bridge mathematics program had on students who were placed into any introductory mathematics course below Calculus I. The study found that the summer bridge program had little impact on improving retention and graduation rates among students with a mathematics ACT score of 27 or lower. However, out of the students with mathematics ACT scores higher than 27, those that

were summer bridge participants had higher graduation and retention rates than non-summer bridge students (Cancado, et al., 2018).

Retention at SDSU can be tied to our rates of D grades, F grades, and Withdrawals in a course, or DFW rates, which will be discussed in Chapter III. Many of the SDSU introductory mathematics courses have high DFW rates each semester, indicating that many of these students may leave college because they struggle to pass their mathematics classes (South Dakota State Office of Institutional Research & Assessment, 2021).

Current Outcomes and Effectiveness

The effectiveness of summer bridge programs has been measured in several ways. The summer bridge program at St. Mary's was found successful for students who had sufficient algebra background to support learning precalculus, those with insufficient algebra backgrounds struggled in both the summer bridge program and further mathematics courses. However, providing academic mentors in this program had a positive impact, as the mentors helped students better prepare themselves for the entire college experience (Lecocke, et al., 2019).

At the University of Rhode Island, the summer bridge program increased students' prerequisite knowledge in algebra, but it did not improve students' organization skills. Students would often forget to turn in work unless specifically reminded. Thus, the program produced the intended boost in prerequisite skills but struggled to recruit and keep participants over time (Bertrand, et al, 2019).

The article, "Design and Effectiveness of Model-Based Mathematics in a Summer Bridge Program," found that the participants in the six-week College Algebra or

Precalculus summer bridge course earned a letter grade lower in their subsequent mathematics courses than students who did not participate in the program. After a program redesign, in which they implemented an approach that utilized models and more application-based mathematics problems, the summer bridge students did better than the students in the original bridge program, but still did not perform as well as non-bridge students (Doerr, et al., 2014).

Synthesis of Research Findings

Overall, the literature suggests that summer bridge programs can be helpful, but they do not always provide their intended results. Almost no summer bridge program in our research had participants perform better than the students who did not participate in the program. Although every program we analyzed had different goals, a common goal among them was the hope for these students to perform well in their subsequent college mathematics class, and this goal was only sometimes reached.

A common theme in the literature was that the summer bridge programs were designed to aid students in their prerequisite knowledge for mathematics courses, most specifically, knowledge of algebra. Thus, the target audience of these programs are often students who struggle with mathematics already, and this likely contributes to their lower scores in mathematics courses. Since the participants are often considered at-risk students, it isn't necessarily surprising that they do not do as well as students who did not participate in a summer bridge program.

Since the programs were almost always created to help students stay on track for graduation or to improve retention and graduation rates, their goals are similar to the Summer Jacks LeaP program. Their research findings helped create our research

questions and consider what data to analyze to determine the efficacy of the LeaP program at SDSU.

CHAPTER III

RESEARCH METHODS

In this project, approved under IRB-2109008-EXM, we used a mixed-methods approach. In the quantitative analysis, we looked at homework averages, exam 1 scores, final exam scores, and overall grade scores in the fall mathematics course following the summer that students participated in the Summer Jacks LeaP program. We also compared DFW rates between LeaP and non-LeaP students, student's time spent in ALEKS compared to their overall grades and homework averages, as well as the success of the placement improvement component.

For the qualitative analysis, an online survey was sent to former Summer Jacks LeaP participants asking various questions that were both quantitative and qualitative. Following the survey, two students agreed to participate in a focus group and answered additional questions. We then coded both the survey and the focus group to find themes and wrote a narrative from these themes. Finally, all data was analyzed together to answer our research questions.

QUANTITATIVE ANALYSIS

Data Collection

This data included information from Fall 2019 and Fall 2020 mathematics courses and the Summer 2019 and Summer 2020 Jacks LeaP Program. Before our analysis, all student identifiers were removed for confidentiality purposes, and each student was assigned a number so we could pair data for the summer and fall. The population included students that participated in the Summer 2019 and Summer 2020 Jacks LeaP program and all students in the following Fall 2019 and Fall 2020 mathematics courses: Intermediate Algebra (MATH 101), Mathematical Reasoning (MATH 103), College

Algebra (MATH 114), Precalculus (MATH 115), and Calculus I (MATH 123). These are the SDSU mathematics courses most commonly taken by freshmen.

The fall course data included students' homework averages, exam 1 scores, final exam scores, and overall grade scores in their fall mathematics courses. Course data was first sorted in Microsoft Excel based on student status as a LeaP student or a non-Leap student. Once separated, the data was further sorted by each course's homework averages, exam 1 scores, final exam scores, and overall scores. From previous data analysis in the SDSU Department of Mathematics and Statistics, these four grade components have been the best indicators of success in mathematics courses. We used these four grade components to compare LeaP students and non-LeaP students in the same mathematics course. Since there were so few students who took their first mathematics course in the spring semester following Summer Jacks LeaP, they were not included in the analysis.

Initial Data Observations

During the summer of 2019, we had 157 students registered for the Summer Jacks LeaP program, of which only 109 participated and worked in the ALEKS program. Whereas in the summer of 2020, 95 students registered and 72 participated. We suspect that COVID-19 played a role in the drop in participation as recruitment for the Summer 2020 program was done virtually, whereas in-person recruitment was used for the Summer 2019 program.

Table 2. ***Number of Participants in the Summer Jacks LeaP Program Sorted by Fall Mathematics Course***

Course Taken in Fall Semester	2019 Number of LeaP Participants	2020 Number of LeaP Participants
Intermediate Algebra	4	2
Mathematical Reasoning	5	8
College Algebra	54	17
Precalculus	12	3
Calculus I	17	6
Calculus II	1	1
Calculus III	1	0
Introduction to Statistics	1	1
Survey of Calculus	2	2
No Fall Math Course	12	32
Total in LeaP	109	72

Table 2 above excludes all LeaP students who enrolled in the program but did not spend any time in the ALEKS program. If a student did not register in ALEKS or spend any time in it, they were not considered a participant, even if they had registered for the LeaP program at the time of recruitment. Table 3 outlines the actual time spent in ALEKS for LeaP participants in 2019 and 2020.

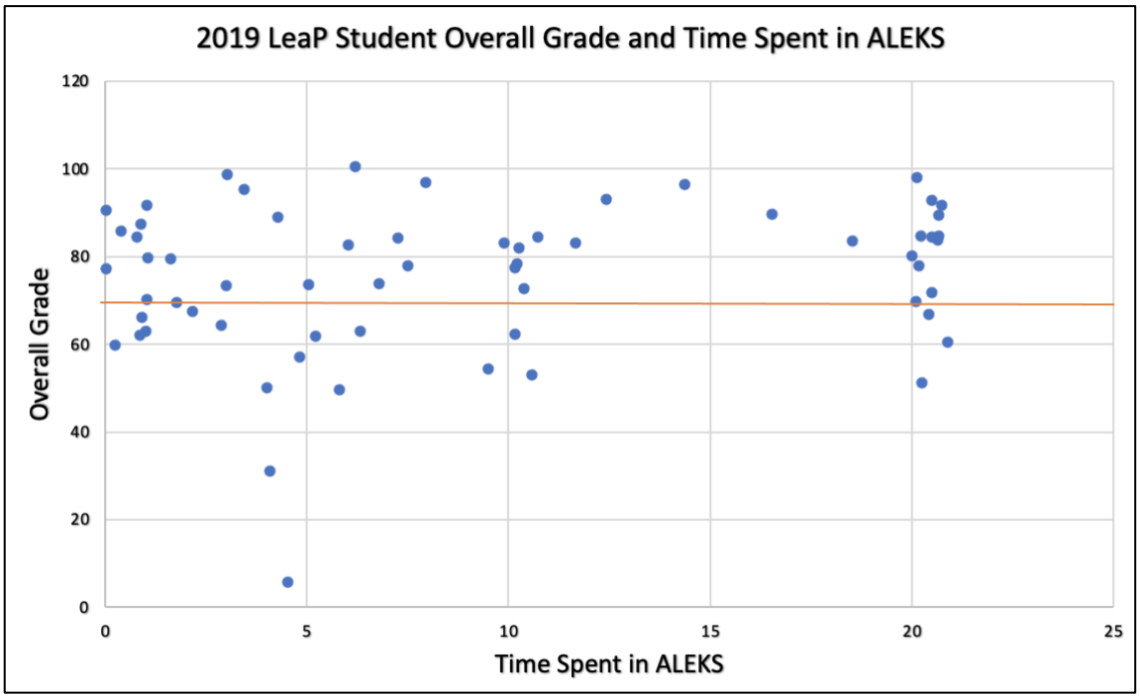
Table 3. ***Percentage of Students' Actual Time Spent in ALEKS***

Time Spent	Percentage of Students in 2019	Percentage of Students in 2020
1-5 Hours	30.28%	30.56%
6-10 Hours	10.09%	8.33%
11-15 Hours	18.35%	31.94%
16-20 Hours	5.55%	1.39%
21-25 Hours	23.85%	12.5%
26+ Hours	11.92%	15.28%

This table illustrates that most LeaP students are spending one to five hours in the program, which seems to be the cut-off point where most LeaP students give up on participating. Since the program is self-paced and LeaP students could stop at any time, the one-to-five-hour mark of time spent in ALEKS seems to be where the motivation of these participants decreased and they gave up. However, if the participants work past five hours, then they are likely to spend more than 11 hours in the program. It is important to note that students who worked at least 20 hours in ALEKS and earned a certain score on the placement assessment in 2019 were able to improve their initial placement. For Summer 2020, the minimum number of hours was decreased to 10.

After collecting the data on time spent in ALEKS, we wanted to determine if there was a correlation between this time spent and the student's overall scores or homework average scores in their fall semester mathematics course. These two grade components were chosen because overall grades show the students' performance in the course and homework averages show whether the student spent time working on the assigned material. Both of these components are important to students' mathematics success. Figures 1 and 2 represent scatter plots of the overall grades of students in the Fall 2019 and Fall 2020 Intermediate Algebra, College Algebra, Precalculus, and Calculus I courses, as well as the time they spent in ALEKS in their summer of participation. In each plot, we have also included a horizontal line at 70 percent, which is the lowest percentage to earn a C in each course.

Figure 1. 2019 LeaP Student Overall Grade and Time Spent in ALEKS



The correlation coefficient of the data in Figure 1 is $r = 0.21334$ and the r-squared value of $r^2 = 0.04552$. These low values and the plot itself illustrate that there isn't a linear relationship between these two variables. One observation we made was that students who worked over 20 hours in the program had quite a bit of variability in overall grades.

Students who land above the red line are those who earned a grade of C or better in their fall mathematics course. From the data, we determined that 64 percent of LeaP students earned a C or better in their Fall 2019 mathematics course. It is important to note that students may not need a C or better for their major, so a D would suffice. Since some majors require a C or better, we used 70 percent for the horizontal line.

Figure 2. ***2020 LeaP Student Overall Grade and Time Spent in ALEKS***

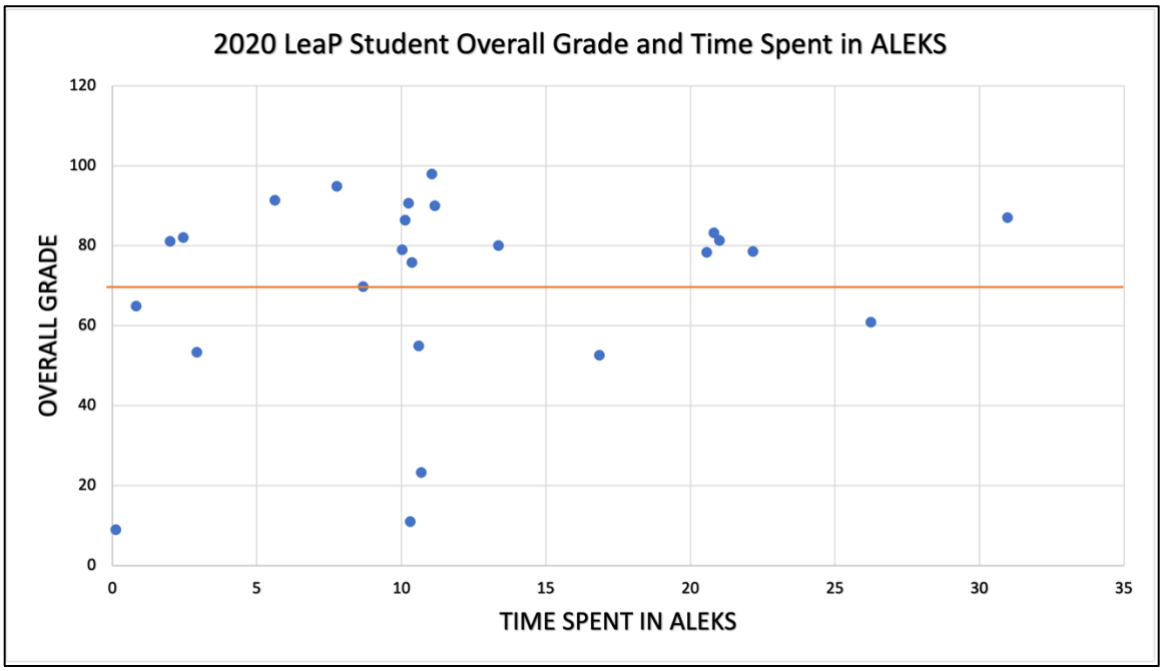


Figure 2 shows that the majority of the included LeaP students worked in ALEKS for under 15 hours. Of these students, there is a mixture of those who earned a C or better and those who were included in the DFW rates. The correlation coefficient for this data is $r = 0.1896$ and the r-squared value is $r^2 = 0.03595$. Again, there is little to no correlation between the LeaP students' overall grades in their Fall 2020 mathematics course and their time spent in ALEKS.

As previously mentioned, students needed to work a minimum of 10 hours in ALEKS to improve their placement, even if they had reached the required placement score. Looking at the 10-hour mark in Figure 2, there are mixed results in students' overall scores. The red line in Figure 2 is again at the 70 percent mark. In the fall of 2020, 67 percent of Summer 2020 LeaP students earned a C or better in their mathematics course.

Figures 3 and 4 are scatter plots of homework averages in Fall 2019 and Fall 2020, respectively, for students in Calculus I, Precalculus, or College Algebra plotted with their time spent in ALEKS. In both scatter plots, we graphed red horizontal lines at the 80 percent and 100 percent marks. These lines were drawn in to highlight that the majority of the LeaP students had homework averages of a B or higher.

Figure 3. ***2019 LeaP Student Homework Average and Time Spent in ALEKS***

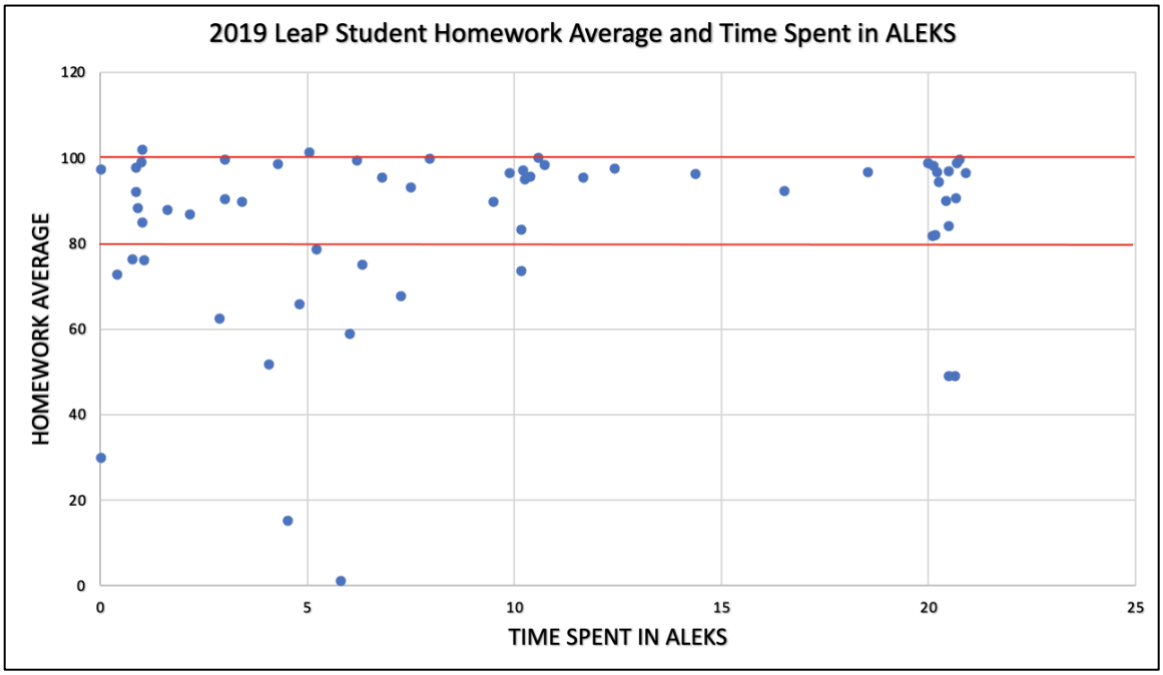
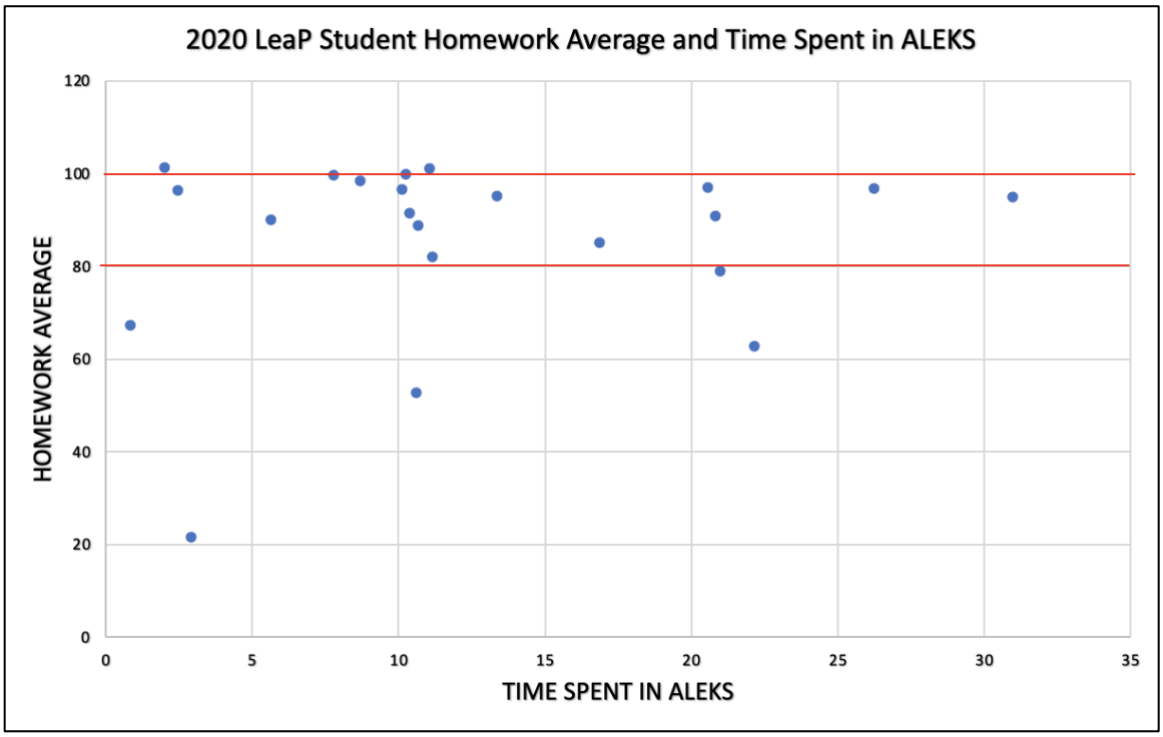


Figure 4. ***2020 LeaP Student Homework Average and Time Spent in ALEKS***



The data from Figure 3 has a correlation coefficient of $r = 0.181997$. Again, this value is close to zero, thus there is no correlation between homework average scores and time spent in ALEKS in 2019. In Figure 4, the correlation coefficient is $r = 0.07641$, so there is also no correlation in 2020. However, 77 percent of LeaP students in 2020 and 73 percent in 2019 earned an 80 percent or higher in homework averages, which may indicate that the Summer Jacks LeaP program helped them understand that practice is essential to being successful in a mathematics course.

Even though there was no correlation between their overall score or their homework average and the time the student spent in ALEKS, these plots are still helpful to our analysis. With 70 percent of all Leap students earning an 80 percent or better on their homework average, and over 60 percent earning a C or better in their mathematics course, we can say that there is some success from the Summer Jacks LeaP program.

Mathematics Placement Component

One of the major goals of the Summer Jacks LeaP program is to provide an avenue for students to improve their initial mathematics course placement, which is determined by their Math Index Score. Students may use the Summer Jacks LeaP program to improve their initial placement to a higher-level course or the same course without the co-requisite lab. Recall that Table 1 shows the MIS requirements for each SDSU mathematics course. The requirements for improving mathematics placement through the LeaP program were:

1. achieve the required score (dependent on the course) on the ALEKS version of the placement test,
2. work at least 20 hours in ALEKS in 2019, or 10 hours in 2020, and
3. meet with a mentor at least three times in 2019, or two times in 2020.

Students had to meet all three criteria to improve their placement. Many students did not meet all of them and were unable to improve their initial mathematics placement. In 2019, students had two test attempts available to improve their placement and in 2020, they had four.

Reviewing the Summer 2020 data, the percentage of LeaP students who wrote that their goal was to improve their mathematics placement at the time of LeaP registration was 62.5 percent or 45 students. Out of these 45 students, only seven, or 15.6 percent, completed all three requirements. This data was not available in the summer of 2019, as they did not have students complete a LeaP goal at the beginning of the summer. However, for Summer 2019, we can only tell if the participants took the placement in

ALEKS, reached the score they needed on that placement, and if they met all of the other requirements to improve their placement.

After digging through the data, we found that out of the 36 LeaP students who took an ALEKS placement test in 2019, 24 (about 67 percent) of the participants met all requirements to improve initial course placement. A large majority of the remaining 73 2019 LeaP students were likely not attempting to improve their placement or changed their minds during the LeaP program.

The opportunity to improve initial placement was a big recruitment tool for the program, but it seems like it was an underutilized feature. Most students who participated in the program did not take a placement test in ALEKS outside of the required initial assessment. In the summer of 2020, 47.5 percent of students went into the program only wanting to better prepare for their fall semester mathematics course, and as many as 75.23 percent of students did so in Summer 2019. One of the reasons that this component was underutilized could be that students did not want to meet the minimum time requirement in the ALEKS program or attend the required number of mentor meetings.

It was discovered in our qualitative research that some LeaP students who were taking Calculus I in the fall did not think they had taken a placement test in ALEKS, but rather that they had to participate in the program to be able to register for the course. This isn’t true, these students did take the ALEKS test and received high enough scores to improve their placement. However, it is important to note that these students did not know that they did so and thought they were only practicing in ALEKS as part of participating in the program. From this, we suggest that improving initial placement be

used as a recruitment strategy and that online mentors talk to students about the minimum requirements.

DFW Rates

As mentioned earlier, several SDSU mathematics courses have high DFW rates, which are the total percentages of D grades, F grades, and Withdrawals in a course. There were not many LeaP students in each of these courses and the LeaP data was not normally distributed so we did not perform any hypothesis testing, but we did look at the DFW rates of LeaP students compared to the overall DFW rates for each course. In a report from the South Dakota State Office of Institutional Research and Assessment (2021), Intermediate Algebra (MATH 101) had the second-highest DFW rate of any course at SDSU during the Fall 2019 semester and the highest DFW rate in the Fall 2020 semester.

From the Summer 2019 Jacks LeaP program, four students went on to take MATH 101 in the fall of 2019. One out of the four students ended up passing the course with a C in the fall, while two received D's, and one dropped, yielding a DFW rate of 75 percent. There were only three MATH 101 students in the fall of 2020 who participated in the Summer 2020 Jacks LeaP program. Out of these three students, two failed MATH 101, and one passed, so the DFW rate that summer was 67.7 percent.

The next mathematics course with a high DFW rate is Mathematical Reasoning (MATH 103). The SDSU report showed that it had the third-highest DFW rate of all courses at SDSU in Fall 2019 and the fifth-highest in Fall 2020 (South Dakota State Office of Institutional Research & Assessment, 2021). This report only included courses with a DFW rate of 30 percent or higher and it included multiple sections of courses. For

MATH 103, there were two sections listed, so the information in Table 4 combines these sections.

Table 4. ***MATH 103 – Mathematical Reasoning DFW Rates***

MATH 103 DFW FA 2019	MATH 103 DFW LEAP FA 2019	MATH 103 DFW FA 2020	MATH 103 DFW LEAP FA 2020
47.6%	60.0%	47.2%	66.7%

While the LeaP DFW percentages are very high, there were very few LeaP students who took MATH 103, only 5 from Summer 2019 and 9 from Summer 2020. Another thing to consider is that algebra is the main focus for practice in ALEKS and MATH 103 doesn't include a lot of algebra.

College Algebra (MATH 114), Precalculus (MATH 115), and Calculus I (MATH 123) all had high DFW rates for both the Fall 2019 and Fall 2020 semesters. Again, multiple sections of these courses are included in the SDSU report, so Table 5 combines all of the College Algebra sections on the report, and similarly with Precalculus and Calculus I in Tables 6 and 7.

Table 5. ***MATH 114 – College Algebra DFW Rates***

MATH 114 DFW FA 2019	MATH 114 DFW LEAP FA 2019	MATH 114 DFW FA 2020	MATH 114 DFW LEAP FA 2020
38.5%	53.7%	34.4%	33.3%

Table 6. ***MATH 115 – Precalculus DFW Rates***

MATH 115 DFW FA 2019	MATH 115 DFW LEAP FA 2019	MATH 115 DFW FA 2020	MATH 115 DFW LEAP FA 2020
30.9%	15.8%	34.6%	33.3%

Table 7. ***MATH 123 – Calculus I DFW Rates***

MATH 123 DFW FA 2019	MATH 123 DFW LEAP FA 2019	MATH 123 DFW FA 2020	MATH 123 DFW LEAP FA 2020
32.6%	23.5%	44.3%	50.0%

Within these three courses, there are some differences between LeaP DFW rates and the overall DFW rates. Summer Jacks LeaP students in Precalculus had a lower DFW rate than the overall DFW rate in both fall semesters. Calculus I had a lower DFW rate for LeaP students in Fall 2019, and College Algebra had a lower DFW rate for LeaP students in Fall 2020.

The higher DFW rate for Calculus I in Fall 2020 may be due to the virtual/in-class hybrid model the course had to use during the pandemic because of spacing in classrooms. Most of these courses had students attending class in person two days a week and on Zoom two days a week. This hybrid model can be difficult for students in a fast-paced, mathematics course. The high DFW rate could also have been because there were no requirements to register for Calculus I in the fall of 2020. The requirement to have a certain MIS or have passed the Calculus I Readiness Exam was waived due to the COVID-19 capacity restrictions of the SDSU testing center. Thus, anyone who wanted to could take the course, regardless of if they had met the previously required prerequisites or not.

Statistical Comparison of LeaP and non-LeaP Students

Four introductory mathematics courses had a decent number of participants ($N \geq 5$) in the Summer Jacks LeaP Program. These courses were Mathematical Reasoning (MATH 103), College Algebra (MATH 114), Precalculus (MATH 115), and

Calculus I (MATH 123). In Fall 2020, there were only three LeaP students in MATH 115 so we did not do a hypothesis test for the grade components, we simply compared the two groups' averages.

Since Mathematical Reasoning (MATH 103) is considerably different from the other lower-level mathematics courses at SDSU, we did not compare the grades of LeaP and non-LeaP students. Mathematical Reasoning is a course designed as an alternative to College Algebra and it has more application-based mathematics problems that require logical thinking. Other aspects of the course that differ from all other freshmen mathematics courses at SDSU are that students complete a final project instead of taking a final exam and the course is taught using a flipped classroom method. These big differences make it difficult to compare overall grades and final exam scores so we excluded this course from the statistical analysis.

College Algebra, Precalculus, and Calculus I were broken up by the four separate grade components mentioned earlier. Overall, none of the non-LeaP or LeaP data for any of the grade components of these courses was normally distributed. Thus, we had to use a nonparametric hypothesis test, and the best test for this data was the Wilcoxon Rank Sum test.

The Wilcoxon Rank Sum test was utilized because it compares the shape and location of data and checks if the two populations have the same continuous distribution of data (i.e. if the populations have the same shape or not). Since we were determining whether LeaP students performed better than non-LeaP students, we were able to perform a one-sided Wilcoxon Rank Sum test. When using the one-sided test, it determines whether the continuous distribution (i.e. shape) of each population is the same or if the

probability of population X performing better than population Y is higher than the probability of population Y performing better than population X. The null and alternative hypotheses of the one-sided test are as follows:

H_0: The Summer Jacks LeaP students performed the same as the non-LeaP students in the course. (The populations have the same shape).

H_1: The Summer Jacks LeaP students performed better than the non-LeaP students in the course. (The LeaP population is shifted higher on the grade scale than the non-LeaP population).

We can reject the null hypothesis if the calculated p-value is less than or equal to α, for which $\alpha = 0.05$ was used. This means that we can say with at least 95 percent confidence that Summer Jacks LeaP students performed better than the non-LeaP students. For simplicity, we will say that LeaP students likely performed better than non-LeaP students when $p \leq \alpha = 0.05$ is attained. All of this data analysis was completed using R-Studio.

Summer 2019

According to Table 2, the Fall 2019 semester had 54 Summer Jacks LeaP students take College Algebra (MATH 114), 19 take Precalculus (MATH 115), and 17 take Calculus I (MATH 123).

College Algebra. College Algebra was the fall semester mathematics course that had the largest number of participants in the Summer Jacks LeaP program for both summers. This makes sense because College Algebra is the most popular general education mathematics course.

To begin, we compared the averages of the LeaP and non-LeaP students for each of the four components. This comparison for Fall 2019 College Algebra is shown in Table 8.

Table 8. ***Fall 2019 Grade Component Average Scores for MATH 114***

Grade Component	Average of Non-LeaP N=501	Average of LeaP N=54
Homework	78.64	77.04
Exam 1	76.28	73.17
Final Exam	63.77	60.38
Overall	72.18	69.59

Table 8 illustrates that the non-LeaP students performed better than the LeaP students on average for each of the four categories in College Algebra. This was somewhat confirmed by the Wilcoxon-Rank Sum Test as seen in Table 9.

Table 9. ***Fall 2019 Wilcoxon Rank-Sum Test p-values for MATH 114***

Grade Component	*p*-value
Homework	0.752
Exam 1	0.859
Final Exam	0.894
Overall	0.915

The large *p*-values confirm that we cannot reject the null hypothesis so there is no difference in performance between the two groups in any of the four components for College Algebra during the fall of 2019. However, looking at the *p*-value (0.9147) of the overall grade component, there is some evidence (p-value > 0.90) that the non-LeaP students likely performed better than the LeaP students. Since these are not the results that we hoped for, we decided to split the College Algebra data further by using the Math Index Score (MIS).

Separating the MATH 114 data using the MIS allows us to compare groups with similar mathematical abilities. The data was separated into students with an MIS of 1150 or less and those with an MIS of 1150 or greater. The MIS of 1150 was used as that is the MIS needed to take College Algebra without the co-requisite remedial lab. If a student receives an MIS less than 1150, they will be required to take the MATH 094 lab. Thus, for MISs less than 1150, we are comparing LeaP and non-LeaP students both of whom had to take MATH 094, if the LeaP student had not improved their placement.

Table 10. ***Fall 2019 Grade Component Averages for MATH 114/MATH 094 Students with MIS < 1150***

Grade Component	Average of Non-LeaP N=198	Average of LeaP N=31
Homework	70.27	74.46
Exam 1	66.03	63.52
Final Exam	49.89	47.33
Overall	60.86	61.68

Table 11. ***Fall 2019 Grade Component Averages for MATH 114 Students with MIS ≥1150***

Grade Component	Average of Non-LeaP N=303	Average of LeaP N=23
Homework	83.85	78.33
Exam 1	83.39	80.47
Final Exam	72.74	70.22
Overall	79.68	75.73

In MATH 114, the averages of non-LeaP students were consistently higher among students with an MIS of 1150 or greater. However, there were mixed results among students with an MIS of less than 1150. The Wilcoxon Rank-Sum *p*-values are listed for both groups in Tables 12 and 13. In Table 10, we see that the LeaP students with an MIS less than 1150 had a higher homework average than non-LeaP students but the *p*-value in Table 12 does not indicate that this result is statistically significant. However, for

students with an MIS greater than or equal to 1150, there was statistical evidence (*p*-value >0.95) that the non-LeaP students likely performed better than the LeaP students in the homework average grade component. The remaining grade components showed no statistically significant difference between LeaP students and non-LeaP students.

Table 12. ***Fall 2019 Wilcoxon Rank-Sum Test p-values for MATH 114/MATH 094 Students with MIS <1150***

Grade Component by MIS	*p*-value
Homework	0.199
Exam 1	0.812
Final Exam	0.838
Overall	0.704

Table 13. Fall 2019 Wilcoxon Rank-Sum Test *p*-values for MATH 114 Students with MIS ≥1150

Grade Component by MIS	*p*-value
Homework	0.953
Exam 1	0.727
Final Exam	0.767
Overall	0.848

Precalculus. In 2019, the Summer Jacks LeaP program brought twelve students into the Fall 2019 Precalculus course. The following table outlines the percentages of LeaP and non-LeaP students in the four grade components.

Table 14. ***Fall 2019 Grade Component Average Scores for MATH 115***

Grade Component	Average Score of Non-LeaP N=95	Average Score of LeaP N=12
Homework	87.29	92.68
Exam 1	79.54	88.27
Final Exam	64.02	82.22
Overall	73.78	84.38

As seen in Table 14, the LeaP students had higher percentages in all grade components. We can see in Table 15 that three p-values are within $p < 0.08$, one of which is very close to 0.05, and the final exam p-value is much less than $p = 0.05$. Thus, we can say that there is some evidence that LeaP students likely did better than non-LeaP students in three of the four grade components with a significance level of $\alpha = 0.08$.

Table 15. ***Fall 2019 Wilcoxon Rank-Sum Test p-values for MATH 115***

Grade Component	p**-value**
Homework	0.480
Exam 1	0.078
Final Exam	0.005
Overall	0.054

Calculus I. Calculus I was the third course in the Fall 2019 semester that had a decent number of participants in the 2019 Summer Jacks LeaP program. Calculus I is an important course to analyze, as many summer bridge programs at other universities focus on the improvement of Calculus I grades and pass rates. Since SDSU has a prominent engineering department and many students in Calculus I go on to take many more mathematics courses, first-time success in Calculus I is essential to staying on track in the engineering programs.

Table 16 outlines the averages between LeaP students and non-LeaP students in Fall 2019 Calculus I in the same four grade components used in the other courses. It shows that LeaP students performed better on average in all four grade components. The Wilcoxon Rank-Sum Test p-values are listed in Table 17.

Table 16. ***Fall 2019 Grade Component Average Scores for MATH 123***

Grade Component	Average of Non-LeaP N=153	Average of LeaP N=17
Homework	83.29	90.87
Exam 1	76.99	77.24
Final Exam	71.05	75.96
Overall	76.70	81.17

Table 17. ***Fall 2019 Wilcoxon Rank-Sum Test p-values for MATH 123***

Grade Component	*p*-value
Homework	0.087
Exam 1	0.511
Final Exam	0.404
Overall	0.260

From the Wilcoxon Rank-Sum hypothesis test, we can conclude that the difference in performance is only somewhat significant (p-value < 0.10) in the homework average grade component. While it appeared that the LeaP students likely performed better in the other three components the difference was not statistically significant.

We considered breaking it down further by MIS, but Calculus I did not have many LeaP students with an MIS of less than 1150. This is most likely because in Fall 2019 students were only able to register and take Calculus I if they had taken the required prerequisite course, or had taken the Calculus I Readiness Exam. As mentioned previously, the policy changed in 2020 due to the COVID-19 pandemic, which will be addressed further in a later section of the paper. Thus, the comparison for Calculus I students would have had to be separated by an MIS of 1300, which was the score needed to not be required to take the corequisite calculus lab, but there weren't enough students with an MIS < 1300 to do an analysis using the MIS as a separator.

Summer 2020

In 2020, despite the COVID-19 Pandemic, the main parts of the Summer Jacks LeaP program operated the same as in 2019 such as being an entirely online program, operating the entire summer, online mentoring, and the ALEKS placement component. However, the requirements to potentially improve their initial placement were lowered, as mentioned earlier, and the recruitment for the program was completely virtual instead of in-person recruitment, as done in 2019. The recruitment change likely explains the lower number of participants during Summer 2020.

In Summer 2019, students had to meet certain MIS requirements to take Calculus I or they had to take a Calculus I Readiness Test. During Summer 2020, the Calculus I Readiness Exam was waved as a requirement as the SDSU testing center did not have the needed capacity due to the pandemic spacing requirements. Thus, any student could register and take Calculus I. This presented a unique situation for Calculus I in the Fall 2020 semester, as COVID was still a major concern, and many room capacity restrictions were still in place at South Dakota State University.

College Algebra. In the summer and fall of 2020, there was a significant drop in enrollment in both the Summer Jacks LeaP program and College Algebra compared to the 2019 numbers. The same analysis was completed on the 2020 data as was done with the 2019 data. Table 18 outlines the average score of non-LeaP and LeaP students in College Algebra for each grade component.

Table 18. ***Fall 2020 Grade Component Average Scores for MATH 114***

Grade Component	Average of Non-LeaP N=489	Average of LeaP N=15
Homework	74.79	75.13
Exam 1	75.49	76.14
Final Exam	62.43	60.97
Overall	71.01	71.08

Based on the averages of the non-LeaP students and the LeaP students alone, there were not any conclusions to draw. From Table 18, it isn't clear who performed better on average between the four categories. Thus, it was important to look at the Wilcoxon Rank Sum Test *p*-values to see if there were any statistically significant results.

Table 19. ***Fall 2020 Wilcoxon Rank-Sum Test p-values for MATH 114***

Grade Component	*p*-value
Homework	0.844
Exam 1	0.543
Final Exam	0.797
Overall	0.788

As you can see in Table 19, there were no statistically significant results for all College Algebra students in 2020, so we again decided to separate the LeaP and non-LeaP data by MIS. The separation was completed the same as in 2019 using an MIS of 1150. The averages between LeaP and non-LeaP students with an MIS less than 1150 are shown in Table 20. The same groups with an MIS greater than or equal to 1150 are in Table 21.

Table 20. ***Fall 2020 Grade Component Averages for MATH 114/MATH 094 Students with MIS <1150***

Grade Component	Average of Non-LeaP N=183	Average of LeaP N=10
Homework	63.75	76.38
Exam 1	63.98	68.39
Final Exam	51.52	58.47
Overall	59.58	66.20

Table 21. ***Fall 2020 Grade Component Averages for MATH 114 Students with MIS ≥1150***

Grade Component	Average of Non-LeaP N=275	Average of LeaP N=7
Homework	81.75	66.45
Exam 1	81.34	78.01
Final Exam	66.90	57.86
Overall	77.10	70.37

The tables show two different scenarios. In Table 20, we see that LeaP students with an MIS less than 1150 performed better than non-LeaP students within this same MIS range. A possible reason for this could be that LeaP students within this MIS range know they can struggle with mathematics concepts and participated in the LeaP program to help improve their mathematical confidence and skills. Thus, the program seemed to make a difference with the more at-risk group.

However, when looking at Table 21, LeaP students with an MIS of 1150 or greater did not perform as well as the non-LeaP students within this same MIS range. One reason could be that LeaP students did not feel as confident in their mathematical skills as students who did not take the Summer Jacks LeaP program. Hopefully, their participation in the LeaP program improved their performance from what it would have been if they had not participated in it, but that is not something that we could measure.

Using the Wilcoxon Rank-Sum hypothesis test, we found the *p*-values for each group, and these are listed in Tables 22 and 23.

Table 22. ***Fall 2020 Wilcoxon Rank-Sum Test p-values for MATH 114/MATH 094 Students with MIS <1150***

Grade Component	p-value
Homework	0.088
Exam 1	0.132
Final Exam	0.202
Overall	0.108

While some of the p-values in Table 22 are lower than others that we have seen, we cannot say with 95 percent confidence that there is a statistical difference between the LeaP and non-LeaP students with these MIS scores.

Table 23. ***Fall 2020 Wilcoxon Rank-Sum Test p-values for MATH 114 Students with MIS ≥1150***

Grade Component	p-value
Homework	0.972
Exam 1	0.546
Final Exam	0.779
Overall	0.728

Table 23 has higher *p*-values than Table 22. In fact, the homework averages grade component has a p-value of 0.972, which indicates there is statistically significant evidence ($p > 0.95$) that non-LeaP students outperformed LeaP students in this grade component. This is a confusing result, as the Summer Jacks LeaP program emphasizes the importance of working hard and practicing mathematics in order to succeed in a mathematics course.

Precalculus. The Summer 2020 Jacks Leap program did not have a significant number of students take Precalculus in the fall of 2020, with a total of three students taking the course after participating in the program. However, since there was a

significant number the year prior, we still investigated the grade component averages of the three LeaP students compared to the non-LeaP students in the course. These averages are compared in Table 24.

Table 24. ***Fall 2020 Grade Component Average Scores for MATH 115***

Grade Component	Average of Non-LeaP N=72	Average of LeaP N=3
Homework	91.26	100.30
Exam 1	74.91	71.19
Final Exam	66.99	86.07
Overall	72.70	82.93

As is clear from the table, the LeaP students did perform well in Precalculus during the fall of 2020. However, there were not enough students to run the Wilcoxon Rank Sum test and trust the results.

Calculus I. There were six LeaP students in the summer of 2020 who took Calculus I in Fall 2020. This was a decline from the Summer 2019 numbers, but that was not surprising due to the overall drop in LeaP enrollment. As can be seen in Table 25, there were varying results as to who performed better on average in each grade component between the LeaP and non-LeaP populations.

Table 25. ***Fall 2020 Grade Component Average Scores for MATH 123***

Grade Component	Average of Non-LeaP N=155	Average of LeaP N=6
Homework	80.64	88.05
Exam 1	71.13	69.56
Final Exam	64.59	49.89
Overall	70.23	61.76

In the homework averages grade component, LeaP students performed better on average. However, on the final exam, they performed lower than their non-LeaP counterparts. The *p*-values obtained from the Wilcoxon Rank Sum test are listed in Table 26. One can see

that there are no statistically significant results for any of the grade components for Calculus I.

Table 26. ***Fall 2020 Wilcoxon Rank-Sum Test p-values for MATH 123***

Grade Component	*p*-value
Homework	0.239
Exam 1	0.403
Final Exam	0.862
Overall	0.661

Throughout this analysis, we have seen that there are some potential conclusions from comparing averages, but averages do not tell the entire story of the data. Averages can easily be skewed higher or lower based on a small data set or outliers. Since the Wilcoxon Rank-Sum Test compares the shape of the two populations' data, the continuous distributions of the two populations might not be that different from one another regardless of the differences in the populations' averages.

Conclusions and Discussion

The results in Precalculus for the Fall 2019 semester were the most statistically significant results among all courses. There are many reasons this could be the case, but one might be that these LeaP students likely had higher Math Index Scores because of the requirements for mathematics placement found in Table 1. Students with a higher MIS are considered less at-risk since the MIS is based on prior academic performance.

Summer 2020 also yielded some positive outcomes for College Algebra students with an MIS of less than 1150. There was statistically significant evidence that LeaP students in this MIS score range outperformed the non-LeaP students in this same MIS range. This is exactly the outcome that the LeaP program wanted as the students with lower MISs are often those that need more time or assistance with math. Thus, the

students who participated in the program outperforming those who didn't in this lower MIS range illustrates that LeaP did make a difference in student success.

Grades are not always a clear indicator of a program's success as many uncontrollable factors contribute to student performance in each grade component. Thus, the DFW rates are also something to consider. LeaP students still had high DFW rates for MATH 101, which is a course that consistently has one of the highest DFW rates at SDSU and many other universities. MATH 101 is a course that the Summer Jacks LeaP program could try to promote more in the future and even tailor different aspects of the program to these students. The DFW rates of LeaP students were better than the overall DFW rate in both College Algebra and Precalculus during the Fall 2020 semester. The LeaP DFW rates were better than the overall rates in both Calculus I and Precalculus in the Fall 2019 semester. This is a huge accomplishment for the Summer Jacks LeaP program, as these DFW rates are always quite high for freshman-level mathematics courses.

The placement component of the program seemed to be utilized by about 40 percent of LeaP students each summer and not that many of those students improved their initial placement. The majority of the LeaP students participated in the program to practice their mathematical skills over the summer before starting college. These students are often those that feel less confident about mathematics, and that is why they wanted to or their parents encouraged them to get more practice in the subject before classes started. This may have led these students to earn average grades or better grades than if they had not participated in the Summer Jacks LeaP program. While we have a lot of positive

results from the quantitative data, it does not provide the entire picture needed to determine the efficacy of the Summer Jacks LeaP program.

CHAPTER IV

QUALITATIVE ANALYSIS

Data Collection

As we analyzed the quantitative data, we knew that we needed more information to help answer our research questions so we made a plan for the qualitative data we wanted to collect. The first part was an online QuestionPro survey that was emailed to all Summer 2019 and Summer 2020 Jacks LeaP participants. The last question asked whether the student was willing to participate in a focus group about their experience in the Summer Jacks LeaP program. This focus group was the second major part of the qualitative research. Only 12 of the 252 students who registered for LeaP completed the survey in its entirety. Of those, five indicated 'yes' or 'maybe' in response to their willingness to participate in a focus group, and two of those five followed through and participated in the focus group.

The survey data was exported from QuestionPro as a Microsoft Excel file and then analyzed. From the Likert-scale responses, percentages were calculated for each of the responses. The focus group was conducted via Zoom, and the students were asked 22 questions about their experience in the Summer Jacks LeaP program as well as their responses to the survey. The transcript from the focus group was generated via Zoom, edited for correctness, and then sent to the participants to review their responses and make any corrections. From the focus group transcript, common themes were identified, coded, and analyzed.

Survey Analysis

The QuestionPro survey was sent out to all 252 students that registered for LeaP during the summers of 2019 and 2020. Four student emails bounced back, resulting in only 248 of the LeaP participants receiving the survey email. We received 12 completed responses, for a response rate of 4.8 percent. The survey showed that 92.31 percent of respondents found the Mentor Meetings and the ALEKS program useful while Desire2Learn (D2L) was helpful to 83.33 percent of the respondents.

Another important aspect of the LeaP program is the amount of time the participants spent in the program. As mentioned previously, the survey was sent to any student who initially signed up for the program, regardless of how much time they spent. For data analysis purposes, time spent in the program was measured as the time spent in ALEKS, as ALEKS is the most important and time-consuming portion of the LeaP program.

Table 27 combines both summer 2019 and 2020 participants' self-reported time spent in ALEKS from the survey respondents with the actual time spent in both summers combined. In Table 3, the breakdown between both summers' actual time spent in ALEKS can be seen. The results in the table aren't necessarily surprising as we know that self-reported data always contains some level of error, but the large difference between column percentages is interesting. This indicates the respondents of the survey were either unsure of the time they spent in ALEKS, as it was over a year ago, or they are very bad at estimating time spent on tasks. Most of the respondents indicated they worked over the entire summer while the others worked on the program during different parts of the summer.

Table 27. ***Self-Reported vs. Actual Time Spent in ALEKS - Summers Combined***

Time Spent	Self-Reported Percentage of Students	Actual Percentage of Students
1-5 Hours	7.69 %	30.39%
6-10 Hours	46.15 %	9.39%
11-15 Hours	7.69 %	23.76%
16-20 Hours	15.38 %	3.87%
21-25 Hours	0 %	19.33%
26+ Hours	23.09 %	13.26%

The classes that respondents planned to take in the fall included Mathematical Reasoning with Lab (MATH 103/093), College Algebra without Lab (MATH 114), Precalculus (MATH 115), Calculus I with Lab (MATH 123/123L), and Calculus I without Lab (MATH 123). About 92 percent of the survey respondents took a fall semester mathematics course following their summer participation in LeaP, while the remaining 8 percent took a mathematics course in the spring semester following their summer participation.

Around 58 percent of the survey respondents indicated that they were trying to improve their initial placement, and out of those respondents, 85 percent were able to improve their mathematics placement through the Summer Jacks LeaP Program. The other 42 percent of respondents participated in LeaP to prepare themselves for their fall semester mathematics course. When asked which factors helped them improve their mathematics placement, 43 percent said reviewing material was a major factor, and 13 percent said the support provided by LeaP was a factor.

When asked how Summer Jacks LeaP prepared them to be successful in their fall semester mathematics courses, 67 percent of respondents said reviewing the mathematical content before starting the course was a major factor. This was also a common theme among the focus group respondents. It is clear that LeaP students recognize the importance of reviewing mathematics consistently to be successful in college mathematics courses. This was also seen, to some extent, in the quantitative analysis.

Before starting the Summer Jacks LeaP program, 58 percent of survey respondents were not confident or somewhat confident in their knowledge of mathematics, while 25 percent were confident, and 17 percent were very confident. One or more semesters after the Summer Jacks LeaP program, only 17 percent were not confident to somewhat confident in their mathematical knowledge and abilities, while 50 percent of the respondents said they were confident, and 33 percent said they were very confident. This shift in confidence is significant as we know that a lack of confidence in mathematics can hinder students' success.

The survey respondents provided the following advice that they would give to an incoming mathematics student:

- 42 percent said time management was very important,
- 50 percent recommended reviewing and practicing mathematics consistently,
- 25 percent mentioned reaching out for help when you need it.

It is also important to note that 100 percent of survey respondents said they would recommend the Summer Jacks LeaP program to an incoming mathematics student. This is a great statistic to use to promote the program in the future.

Focus Group Analysis

Two of the respondents said they would be willing to participate in a focus group, and provided contact information. In addition, three students checked ‘maybe’ about participating in a focus group. Once contacted about the focus group, students were given an interview protocol form and a consent form. These forms detailed everything that would be asked in the focus group and everything the students would be agreeing to upon participation, including the use of their responses in this research project. Ultimately, only the two respondents that indicated ‘yes’ to participating filled out these forms, and the three that indicated ‘maybe’ did not. Therefore, only two students were included in the focus group interview.

After the Zoom focus group, both students had the opportunity to review the transcript of the focus group to clarify statements and make corrections. The interview questions are listed in Table 28.

Table 28. ***Interview Questions***

Interview Questions	
Number	Question
1.	Tell me about yourself. Please include your full name, major, where you are from, and math background.
2.	How did you hear about the Summer Jacks LeaP program?
3.	Why did you decide to participate in the Summer Jacks LeaP program?
4.	What mathematics courses did you take in high school?
5.	Did you take a mathematics course your senior year of high school?
6.	Had you taken any college math course or attempted to take any college math course prior to participating in Summer Jacks LeaP?
7.	What was your confidence level in math before starting the Summer Jacks LeaP program? Please explain your rating from this survey question.
8.	Was the Aleks program helpful in learning math? Why or why not? Please elaborate on your experience with the Aleks program overall.

9. Was it helpful to have a Jacks LeaP mentor, someone to meet with regularly and to answer your questions?
10. Please elaborate on why you found the Summer Jacks LeaP program overall successful or unsuccessful at preparing you for your fall semester math course, if you took one.
11. What part of the program do you believe most benefited you? (i.e. mentor meetings, working in Aleks, etc.)
12. What part of the program do you believe was not as beneficial to you if any? (i.e. mentor meetings, working in Aleks, etc.)
13. What was your confidence level in math while participating in the Summer Jacks LeaP program? Please explain your rating from this survey question.
14. After participating in Summer Jacks LeaP, did you feel better prepared for your fall semester math course, if you took one?
15. If you did not take a fall semester math course, did Summer Jacks LeaP play any role in that decision?
16. Was the Summer Jacks LeaP program what you thought it would be? If not, what did you envision it to be?
17. What could have been a helpful addition to the Summer Jacks LeaP program, if any?
18. If you were working towards improving your placement, was the Summer Jacks LeaP program set up for you to be successful in improving your placement? Why or why not?
19. What was your confidence level in math during your first math course after participating in Summer Jacks LeaP? Please explain your rating from this survey question.
20. Did Summer Jacks LeaP play a role in this confidence level? If so, what was the role it played? (i.e. Did it make you more confident, make you feel less confident, etc.).
21. Did success or lack of success in math courses influence your success overall in college?
22. What are some of your final thoughts on the Summer Jacks LeaP program?

For the second part of the qualitative analysis of the Summer Jacks LeaP program, we analyzed the transcript of the Zoom focus group. The two focus group participants' responses had four common themes among their answers. These themes were then analyzed to find meaning in the data. The four themes were: preparedness for college, practice in ALEKS, continued success in college, and seeking help.

Preparedness for College

The first major theme that was identified was how the Summer Jacks LeaP program prepared the students for college. Throughout the interview, there were many positive references about the program preparing them for college. These two students were both just below the required mathematics placement score to take Calculus I in the fall, so they participated in LeaP to improve their initial placement, but also to practice mathematical topics that were less familiar to them.

Both students discussed how their success in mathematics courses directly related to their success in college. One student stated, “studying concepts, more studying problems, and I think just in those habits and in those ideas, it translated into my relative success in college.” And the other student felt strongly that the program was integral in preparing them for college mathematics courses, and stated, “I definitely did feel more prepared just because there's a lot of people that went into their first semester of college with essentially taking this complete summer off” and “it definitely helped to know that I was actively still exercising my mind” during the Summer Jacks LeaP program.

Not only did the LeaP program benefit the students by providing them with opportunities to review mathematical concepts and problems they may have forgotten, but it also introduced students to the SDSU course management software, Desire2Learn (D2L). The program allowed the students to familiarize themselves with the software over the summer leading up to college. The students interviewed noted how important this introduction to the platform was, and one student stated, “it was very, very helpful to walk into my general chemistry class my freshman year and already be familiar with

D2L," and "through the LeaP program, I already knew where to find my classes, and how to navigate the different tabs on D2L."

Practicing in ALEKS

Throughout the interview, it became apparent that the ALEKS program was a major component that led to the overall success of LeaP. Thus, another major theme from the interview was the practice students completed in the ALEKS program. The students discussed how they believed the ALEKS program was the most helpful part of the LeaP program and that it was integral to their success in LeaP and their fall mathematics courses. One student even suggested that the ALEKS program was one of the best online learning programs that they had ever used.

The students found the most helpful part of the ALEKS program was that it customized their learning experience. As they were working through the material in the modules, they would take concept quizzes and ALEKS would then assign them more problems or fewer problems on certain topics based on the results. This customization helped encourage the student as well as challenge them. One student stated, "I actually tested out of most of those concepts (in ALEKS)" so the program could focus on the math content the student struggled in most. That same student stated that: "I really liked how (ALEKS) was detailed to my individual knowledge levels."

When asked what advice these students would give incoming freshmen about mathematics courses, the students both agreed that practice was essential to success. Both students stated that the Summer Jacks LeaP program offered them the opportunity to practice and hone their mathematical skills before starting college, and both said they would recommend the program to any incoming mathematics student for that reason.

Continued Success in College

Continued success in college was also a major theme in the interview. Already discussed was the importance of the ALEKS program for practicing mathematical skills, as well as the Summer Jacks LeaP program's overall ability to prepare students for college, but these two themes also tie together into improving students' continued success in college. Ultimately the question is, did the program provide participants with the ability to continue achieving success in all of their college classes?

A large factor behind the continued success of students is often confidence in their mathematical knowledge, as was discussed in the literature review. Throughout the 10-week summer program, the students worked on topics in mathematics in which they needed to improve their skills. As a result, over the length of the program, their mathematical confidence likely increased or decreased.

One student stated "I was definitely pretty confident coming out of high school because I took the optional mathematics course that I could, and I always did really well in math classes, but then it came to the (Summer) Jacks LeaP (program) and then I would say I kind of got humbled a little bit. There's a lot more math to all these courses than I really thought." However, this same student went on to discuss that by the end of the LeaP program they grew in their mathematical confidence and began to perform better on their concept quizzes in ALEKS. The student stated, "every time I would test out of (a concept in ALEKS) and finally passed the test, my confidence grew, especially as the summer went on." Thus, the program did strengthen this student's confidence in their algebra knowledge over the summer. A lack of confidence was likely an obstacle for incoming students who did not participate in LeaP.

However, the responses from the two students also noted that the Summer Jacks LeaP program did not teach them any calculus, but provided a review of algebra skills. The program was not designed to teach students any calculus before taking the Calculus I course, but it is worth noting that this was something these students were initially expecting. When asked if the Summer Jacks LeaP program improved their overall confidence levels and success during their fall semester mathematics course one student stated, "(the program) definitely made me slightly more confident, but not a whole lot. But, it definitely did not hinder my confidence level at all. (Calculus I) was pretty humbling. You know, it's difficult, but I would say (the Summer Jacks LeaP program) definitely helped me just to stay warmed up."

The other student had taken AP Calculus in their last year of high school and mentioned that the Summer Jacks LeaP program was not the key to improving their success in Calculus I. The key for them was having taken the course in high school. They did state that "the (Summer) Jacks LeaP program aided my confidence to take a college class (in general)," and discussed that they felt more prepared for their other courses, having had been successful in their mathematics course. According to the student, "as a biochemistry major, I do a lot of math in my other classes, just applied a little bit differently, and so it gave me those concepts on how to study for those classes, without necessarily studying concepts, more on studying problems, and I think just in those habits and in those ideas, it translated to my relative success in college."

The second student discussed that they were successful in several more mathematics courses beyond Calculus I. This student attributed their success in their major to their overall success in their mathematics courses. They stated, "One-hundred

percent of my success in the math courses I've taken directly correlates to my overall success in college." The student went on to discuss how the mathematics courses they took were difficult but, through achieving success in them, they built the skills they needed to be successful in any course. We can conclude that achieving success in mathematics classes is important to overall continued success in college, particularly for STEM majors.

Seeking Help

The two interviewees expressed that the Summer Jacks LeaP program provided ample opportunities to ask for help. When discussing the benefits of the mentor component of the program, the students both agreed that the mentor was a nice resource for asking college-related questions. However, both interviewees stated that the mentor was the least helpful portion of the program since they did not need to ask many math-related questions due to the self-guided nature of the ALEKS program. As one of the students stated, "I never really did have any questions and the ALEKS program was pretty much all I needed."

While the two students found the mentor the least helpful component of the program, one student did note that "the idea behind the (mentor meetings) is very, very good, but I don't think they were utilized to their full potential in my case, at least. I don't know about others." And the other student stated "(The mentor meetings) definitely didn't hurt anything, and I would say that I wouldn't change anything if I had to go through (the Summer Jacks LeaP program) again."

While both interviewees said that the mentor meetings were the least helpful part of the program, they don't think that they should be eliminated from the program altogether.

The students thought it would be helpful if the number of mentor meetings required was reduced to once a month or on an as-needed basis rather than once per week

The Summer Jacks LeaP program not only provided help through mentors, but it helped students to gain a better understanding of their mathematical skills and needs. Thus, students were encouraged to seek help during their school year mathematics courses because the program reminded them of the importance and the benefits of doing so.

CHAPTER V

OVERALL CONCLUSIONS

Through the mixed-methods approach to this project, we were able to answer our research questions. A summary of those answers follows each question below.

1. Are students successful in a fall semester mathematics course immediately after completing the Summer Jacks LeaP program?

During both summers, the placement improvement component of the Summer Jacks LeaP program was utilized by less than half of the students participating, and only a select few of these students improved their placement. Thus, this component of the program could be utilized more, but it was the component that survey respondents appreciated the most.

The DFW rates of LeaP participants who then took College Algebra, Precalculus, and Calculus I were better than the overall DFW rates for these courses some semesters. While the DFW rates for Summer LeaP students in Intermediate Algebra and Mathematical Reasoning were not better than the overall rate in any semester, the number of LeaP students in these classes was so small it wasn't a fair comparison.

2. Do the Summer Jacks LeaP students perform as well as students who did not participate in the summer program?

The data analysis revealed that there were few courses where the Summer Jacks LeaP students performed better in comparison to the non-LeaP students. However, this makes sense because Summer Jacks LeaP students are often at-risk, and normally wouldn't be expected to outperform the non-LeaP students. Although the hope was that the students in the program would produce better results than those that weren't, there

were few instances where the LeaP students' better performance was considered statistically significant.

There was statistically significant evidence that 2019 Summer Jacks LeaP students outperformed non-LeaP students in Precalculus. In addition, 2020 Summer Jacks LeaP students had much higher averages in Precalculus than the non-LeaP students in three of the four grade components. This could be explained by the fact that incoming freshmen need a higher MIS to take Precalculus in their first semester of college. Thus, these students are already less at-risk. Another reason could be that these students may have taken a high school precalculus course, and thus may have already seen most of the topics.

It is also worth noting that there was some statistically significant evidence that the Fall 2020 College Algebra Summer Jacks LeaP students with an MIS of less than 1150 outperformed non-LeaP students in the same MIS range. Based on our quantitative analysis, in most classes and grade components, there was no statistical significance that the Summer Jacks LeaP students' performed better than non-LeaP students. However, when our *p*-values indicated to not reject the null hypothesis, the Wilcoxon Rank Sum test indicates that the two groups are similar. This is actually a positive outcome as some of the LeaP students were considered at-risk and yet were able to do as well as all other students in most of the courses.

Many LeaP participants only worked in the ALEKS program for five hours or less over the entire summer. Although we did not find any correlation between the amount of time spent in ALEKS and students' overall grades in their fall mathematics course, we know that the more time the student spent in the program, the more they practiced

mathematics. Practicing mathematics is an extremely important element of success. In addition, there was evidence that the more a student worked in the program the more likely they were to improve their initial placement. Thus, there is always a possibility that if students were to work longer in the program, their likelihood of success could improve. Perhaps a new goal for the LeaP program would be to increase the required time students spend in ALEKS.

3. Are mathematics students who participated in the Summer Jacks LeaP program finding value in it and succeeding in their degree program?

The survey results as well as the transcript of the focus group were overwhelmingly positive. The only major critique of the program was the implementation of the mentor meetings. The students suggested fewer mentor meetings throughout the program, or even making them optional. The rest of the feedback was largely about the positive impact the program had. The respondents of the survey as well as the two students interviewed highlighted the importance of practicing mathematics to maintain and grow their knowledge.

According to our research, the ALEKS program was the most utilized and positive aspect of the Summer Jacks LeaP program. This is no surprise, as the LeaP program was built around this software. It was continually praised during the focus group interview as well as in the survey responses, which highlighted the impact its personalization had on their ability to focus on the mathematical skills in which they needed to improve. Thus, we can conclude that ALEKS should continue to be used in the Summer LeaP program.

The consensus among the survey respondents was that the program offered students an opportunity that they want future students to also have. Every survey respondent indicated that they would recommend the program to future mathematics students, and both of the focus group interviewees strongly believed the program impacted not only their success in mathematics classes but also their overall success in their degree program. From these two pieces of information alone, we can say that the Summer Jacks LeaP program is providing a lot of value to its participants.

Overall, the program has many great components that students loved, as well as some that need improvement. Building the Summer Jacks LeaP program around the ALEKS software, with its ability to assess and personalize the mathematics content for each student, allowing students to practice mathematics at their own pace, and the opportunity to improve initial mathematics placement is essential to continued success. While the placement improvement was not used by over half of the LeaP students, the students who did utilize this component greatly appreciated the opportunity. Ultimately, the Summer Jacks LeaP program could be improved by changing the requirements of the mentor meetings, increasing the required amount of time spent in ALEKS, better advertising the opportunity to improve initial mathematics placement, and decreasing the dropout rate of participants.

APPENDIX A

Institutional Review Board (IRB) Application Acceptance Email

DN

Dianne Nagy <support@inforeadyreview.com>
Wed 9/29/2021 8:00 AM
To: Sundermann, Tessa M - SDSU Student
Cc: Sundermann, Tessa M - SDSU Student

Hello Tessa Sundermann,

Your application **An Analysis of the SDSU Jacks LeaP Program** is exempt from further review by the Institutional Review Board of South Dakota State University. Exemption is claimed under exemption criterion 2 outlined in 45 CFR 46, section 104(d).

Note: If the project is changed, it should be re-submitted to the IRB for a determination of whether it still satisfies exemption criteria.

Your approval number is: IRB-2109008-EXM.

I wish you the best in your study.

Sincerely,

Dianne Nagy
Research Integrity and Compliance Officer

APPENDIX B

QuestionPro Survey Questions

You are being asked to participate in an evaluation of the South Dakota State University Jacks LeaP Summer Program. This survey will take approximately 30 minutes of your time and you must be 18 or older to participate. In this questionnaire, which will be open from October 1st-October 15th, you will be asked to answer questions that will help us determine the overall success of the program.

Your responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. The data will be saved on a password-protected computer and may be used to advocate for needed changes within the program. Information collected about you will not be used or shared for future research studies.

You may be asked to voluntarily participate in a focus group upon completion of this survey. Being in this study is up to you, there are no penalties or consequences of any kind if you decide that you do not want to participate. You can decide not to participate in this research, or you can start and then decide to leave the study at any time, and it will not be held against you. To do so, simply exit the survey. Any data collected up to that point will be used. This survey is hosted by QuestionPro who may use the data you provide according to their user privacy agreement, available here: https://www.questionpro.com/help/privacy-policy.html. Data may exist on backups or server logs beyond the time frame of this research project. We believe there are minimal risks associated with this research study; however, a risk of breach of confidentiality always exists. Your confidentiality is only as secure as your equipment; no guarantees can be made regarding the interception of data sent via the Internet. Your IP address will not be collected.

If you complete the survey in entirety, your name will be entered into a drawing for one of five $20 gift cards to Amazon. If you complete this survey before October 8th at 12pm, your name will be entered into the drawing twice. If you have questions at any time about the survey or the procedures, you may contact Tessa Sundermann by email at tessa.sundermann@sdstate.edu, for questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact SDSU's Research Integrity and Compliance Officer at 605-688-5051 or sdsu.irb@sdstate.edu. By clicking "I agree" below you are indicating that you are at least 18 years old, have read this consent form, had any questions answered, and agree to participate in this research study. Please print a copy of this page for your records. Thank you very much for your time and support. Please start with the survey now by clicking "I agree", filling out your contact information below, and then clicking on the "Start" button**.**

1. I agree

First Name

Last Name

Email Address

Major

What summer did you participate in Summer Jacks LeaP?

1. Summer 2019
2. Summer 2020

Are you still a student at SDSU?

1. Yes
2. No

Why are you no longer a student at SDSU?

1. I graduated
2. I no longer attend a university
3. I am attending a different university

How helpful were the following:

	Not Useful	Somewhat Useful	Useful	Very Useful	N/A
Mentor Meetings	❑	❑	❑	❑	❑
Aleks	❑	❑	❑	❑	❑
D2L	❑	❑	❑	❑	❑

How many hours did you spend working in ALEKS during Summer Jacks LeaP?

1. 1-5 hours
2. 6-10 hours
3. 11-15 hours
4. 16-20 hours
5. 21-25 hours
6. 26+ hours

When did you work on the Summer LeaP Program the most?

1. Beginning of Summer
2. Middle of Summer
3. End of Summer
4. Equal Amount All Throughout Summer

How would you rate the problems you worked on in ALEKS?

1. Too Easy
2. Somewhat Easy
3. Just About Right/Neutral
4. Somewhat Difficult
5. Too Difficult

What was your Summer Jacks LeaP Goal?

1. To Prepare for Fall Math Course
2. To Improve Math Placement
3. Other _____

What course placement were you working towards?

1. MATH 103 w/Lab - Mathematical Reasoning with Lab
2. MATH 103 - Mathematical Reasoning
3. MATH 114 w/Lab - College Algebra with Lab
4. MATH 114 - College Algebra without Lab
5. MATH 115 - Precalculus
6. MATH 120 - Trigonometry
7. MATH 121 - Survey of Calculus
8. MATH 123 w/Lab - Calculus I with Lab
9. MATH 123 - Calculus I without Lab
10. STAT 281 - Introduction to Statistics

Were you successful at improving your math placement?

1. Yes
2. No

Why were you successful at improving your math placement?

Why were you unsuccessful at improving your math placement?

Did you take a math course your fall semester immediately after participating in the Summer Jacks LeaP Program?

1. Yes
2. No

Did the Summer Jacks LeaP Program prepare you to be successful in your fall semester math course?

1. Yes
2. No

How did Summer Jacks LeaP prepare you to be successful in your fall semester math course?

Why did Summer Jacks LeaP not prepare you to be successful in your fall semester math course?

Please indicate why you did not take a fall semester math course immediately following your participation in the Summer Jacks LeaP Program.

Has your major changed since participating in the Summer Jacks LeaP Program?

1. Yes
2. No

Did math courses play a role in changing your major?

1. Yes - due to success in math courses
2. Yes - due to lack of success in math courses
3. No

Did participating in Summer Jacks LeaP encourage you to change your major to one requiring more math, less math, or did it have no impact on this decision? Please specify which and explain.

Rate your confidence in math during the following timeframes:

	Not Confident	Somewhat Confident	Confident	Very Confident	N/A
Before Summer Jacks LeaP	❑	❑	❑	❑	❑
During Summer Jacks LeaP	❑	❑	❑	❑	❑
Immediately After Summer Jacks LeaP	❑	❑	❑	❑	❑
One or More Semesters After Summer Jacks LeaP	❑	❑	❑	❑	❑

Would you recommend Summer Jacks LeaP to an incoming math student?

1. Yes
2. No

What advice would you give to an incoming math student?

How has COVID-19 impacted your experience in your math course(s)?

Would you be willing to participate in a voluntary focus group on your Summer Jacks LeaP experience?

1. Yes
2. No
3. Maybe

APPENDIX C

Interview Protocol and Consent Forms

Interview Protocol

Tessa Sundermann

Purpose of the study: To determine the efficacy of the Summer Jacks LeaP Program in achieving its goal of preparing students for their academic year math courses.

Research Question: Is the summer Jacks LeaP Program effective at preparing students for their academic year math courses, specifically fall semester courses.

In order to help answer this question, we have the following sub questions. These questions have been included in the online survey so we hope that the responses will help us select participants for the Focus Group.

1. Did students find the Summer Jacks LeaP Program helpful overall in preparing them for their fall semester math course? Why or why not?
2. Did students find the Summer Jacks LeaP Program helpful in preparing them for their courses, math or not, beyond that immediate fall semester? (i.e. If the program was helpful for their math course, was the success in their math course helpful for future courses, math or otherwise?)

Date_____

Time_____

Location_____

Interviewee_____

Interviewer_____

I am conducting a research project on the Summer Jacks LeaP Program as part of my Master's thesis at South Dakota State University. The purpose of this study is to determine the efficacy of the Summer Jacks LeaP Program in achieving its goal of preparing students for their academic year math courses.

You have been selected to speak with me today because you took the Summer Jacks LeaP survey and indicated your willingness to participate in a focus group on this topic. The following questions will be asked during the focus group interview:

1. Tell me about yourself. Please include full name, major, where you are from, and math background.
2. How did you hear about the Summer Jacks LeaP Program?
3. Why did you decide to participate in the Summer Jacks LeaP Program?
4. What mathematics courses did you take in high school?
5. Did you take a mathematics course your senior year of high school?
6. Had you taken any college math course or attempted to take any college math course prior to participating in Summer Jacks LeaP?
7. What was your confidence level in math before starting the Summer Jacks LeaP Program? Please explain your rating from this survey question.
8. Was the Aleks program helpful in learning math? Why or why not? Please elaborate on your experience with the Aleks program overall.
9. Was it helpful to have a Jacks LeaP mentor, someone to meet with regularly and to answer your questions?

10. Please elaborate on why you found the Summer Jacks LeaP Program overall successful or unsuccessful at preparing you for your fall semester math course, if you took one.
11. What part of the program do you believe most benefited you? (i.e. mentor meetings, working in Aleks, etc.)
12. What part of the program do you believe was not as beneficial to you, if any? (i.e. mentor meetings, working in Aleks, etc.)
13. What was your confidence level in math while participating in the Summer Jacks LeaP Program? Please explain your rating from this survey question.
14. After participating in Summer Jacks LeaP, did you feel better prepared for your fall semester math course, if you took one?
15. If you did not take a fall semester math course, did Summer Jacks LeaP play any role in that decision?
16. Was the Summer Jacks LeaP Program what you thought it would be? If not, what did you envision it to be?
17. What could have been a helpful addition to the Summer Jacks LeaP Program, if any?
18. If you were working towards improving your placement, was the Summer Jacks LeaP Program set up for you to be successful in improving your placement? Why or why not?
19. What was your confidence level in math during your first math course after participating in Summer Jacks LeaP? Please explain your rating from this survey question.

20. Did Summer Jacks LeaP play a role in this confidence level? If so, what was the role it played? (i.e. Did it make you more confident, make you feel less confident, etc.).
21. Did success or lack of success in math courses influence your success overall in college?
22. What are some of your final thoughts on the Summer Jacks LeaP Program?

Thank you for your time!

Consent Form
Participation in Research Project
South Dakota State University
Brookings, SD 57007

Department of Mathematics & Statistics

Project Director: Tessa Sundermann

Email: tessa.sundermann@sdstate.edu Date: Fall 2021

Please read the following information carefully.

You are invited to participate in a research project under the direction of Tessa Sundermann. This research project on the Summer Jacks LeaP Program is part of the research for my Master's thesis at South Dakota State University. The purpose of this study is to determine the efficacy of the Summer Jacks LeaP Program in achieving its goal of preparing students for their academic year math courses.

If you consent to participate in this research project, you will be involved in a recorded focus group interview with several participants, conducted by the project director. The focus group interview will take about 1 hour, depending on the number of people in the group and the number of follow-up questions. Participation in this project is completely voluntary, and you have the right to withdraw at any time without penalty. If

any of the interview questions make you uncomfortable, you may state that you do not want to answer that question. There are no known risks to your participation in this study, and there are no benefits for your participation in the study. You must be 18 years or older to participate in this study.

Your responses to all questions are strictly confidential. Data will be saved on a password protected computer. All identifying information will be separated from the study data. Interview and focus group transcriptions will be coded using a thematic reduction technique. Major themes in the data and deidentified direct quotes from participants may be included in final reports. Your major is being requested for informational purposes, and your email is being requested so that you can read the interview transcript, correct any mistakes in the transcript, and approve the transcript via email. This interview will be recorded but only the project director and her advisor, Dr. Sharon Vestal, will have access to the recording and once the interview has been transcribed and approved by you, the recording will be destroyed. Information collected about you will not be used or shared for future research studies. We believe there are minimal risks associated with this research study; however, a risk of breach of confidentiality always exists. Your confidentiality is only as secure as your equipment; no guarantees can be made regarding the interception of data sent via the Internet. Your IP address will not be collected.

Being in this study is up to you. There are no penalties or consequences of any kind if you decide that you do not want to participate. You can decide not to participate in this research, or you can start and then decide to leave the study at any time, and it will not be held against you. To do so, simply exit the interview. Any data collected up to that point will be used. You will not be identified in any report or publication of this study. Even though we will tell all participants in the study that the comments made during the focus group should be kept confidential, it is possible that participants may repeat comments outside the group.

As a research participant, I have read the above conditions and have had all questions answered. I understand that if I want a copy of this sheet, I may ask the project director.

Signature:_____ Date: _____

Name: _____ Major: _____

Email: _____

If you have any questions regarding this study you may contact the Project Director. If you have questions regarding your rights as a participant, you can contact the SDSU Research Compliance Coordinator at (605) 688-6975 or SDSU.IRB@sdstate.edu.

APPENDIX D

Link to Quantitative and Qualitative Data on Open Prairie

https://openprairie.sdstate.edu/etd2/275/

APPENDIX E

R-Studio Code

Run for each course: MATH 114, MATH 115, and MATH 123 as well as each grade component: Homework, Exam 1, Final Exam, and Overall Grade.

```
#20XX math YYY w/o 0 timers'

x = SU20XX_Math_YYY_tests_gradecomponentZ
wilcox.test(x$NONLEAP, na.omit(x$LEAP), alternative = "less")
hist(x$LEAP,
    main = "LeaP",
    xlab = "Grades")
hist(x$NONLEAP,
    main = "NonLeaP",
    xlab = "Grades")
mean(x$NONLEAP)
mean(na.omit(x$LEAP))
boxplot(x$NONLEAP)
boxplot(x$LEAP)

#20XX math YYY MIS

x = SU2020_Math_YYY_tests_MIS_gradecomponentZ
wilcox.test(x$NONLEAP..1149, x$LEAP..1149, alternative = "less")
hist(x$LEAP..1149,
    main = "LeaP",
    xlab = "Grades")
hist(x$NONLEAP..1149,
    main = "NonLeaP",
    xlab = "Grades")
mean(x$NONLEAP..1149)
mean(na.omit(x$LEAP..1149))
boxplot(x$NONLEAP..1149,na.omit(x$LEAP..1149))
boxplot(x$LEAP..1149,na.omit(x$NONLEAP..1149))

x = SU2020_Math_114_tests_MIS_gradecomponentZ
wilcox.test(x$NONLEAP.1150., na.omit(x$LEAP.1150.), alternative = "less")
hist(x$LEAP.1150.,
    main = "LeaP",
    xlab = "Grades")
hist(x$NONLEAP.1150.,
    main = "NonLeaP",
    xlab = "Grades")
mean(na.omit(x$NONLEAP.1150.))
mean(na.omit(x$LEAP.1150.1300))
boxplot(x$NONLEAP.1150.,na.omit(x$LEAP.1150.))
boxplot(x$LEAP.1150.,na.omit(x$NONLEAP.1150.))
```

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