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The Effectiveness of the Link2Success Program on Freshman Level Math Course Achievement

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Abstract: To improve college students' achievement and success rate in the College Algebra course, a new program called Link2Success (L2S) was implemented in several sections of the course at the study's university. The program required students to increase their class time to six hours. Three of those hours were spent with certified tutors who helped students with the content preview and homework preparation. The purpose of this study was to investigate the effectiveness of the Link2Success program based on the achievement of College Algebra students. One College Algebra class with embedded L2S and one College Algebra class without L2S were randomly chosen and the grades of several assignments and exams were compared. A survey was given to L2S students to explore their experience and opinion about the program. Another survey was given to non-L2S students to find out if they felt that learning with an L2S program was beneficial to them and would have improved their grades. The results showed that L2S did not have a positive effect on the College Algebra students' achievement. However, L2S students felt more confident and rated the program highly where as non-L2S students felt they would have benefited from the program if it were implemented in their class.

Keywords: *Link2Success, hybrid course, student mathematics achievement, completion rate of assignments, supplemental instruction.*

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Introduction

The *Link2Success* program (L2S) is among the initiatives that the studied university has taken in Fall 2013. The program was developed in Ferris State University (University of Texas Rio Grande Valley [UTRGV], 2014). Its purpose is to increase students' achievement and to improve their grades in freshman-level courses that have high levels of failure and low retention rate, such as Math, History, and English (UTRGV, 2014). L2S proposes adding extra class time to the course time so that students registered in the course would be more active and meet with trained and certified tutors for additional learning and support before and after the lecture time. The three-extra hours of class time are mandatory for all students unless the instructor determines that a student does not need nor require to take the extra hours of learning with the tutors. The Learning Enrichment Center (LEC) at the studied university has taken this initiative in the Fall of 2013. In collaboration with the Mathematics, English, and History departments, LEC has trained tutors to work with the instructors.

College Algebra with L2S

The freshman-level course of College Algebra is the target course for L2S in the Department of Mathematics. College Algebra is a hybrid course, which means that the instructor presents only a mini-lecture to the students who have prepared themselves beforehand by studying the content of the objectives of the day with the assistance of several instructional and learning resources such as PowerPoint presentations, Practice Exercises, Supplemental Instructional Videos, and the textbook. In addition, in this hybrid course, instructor assists students in a lab that follows each lesson. Students are responsible for completing assignments such as online homework, online quizzes, and written homework. They are encouraged to ask for their instructor's assistance or go to the tutoring labs if they are having difficulties with the content of a lesson or if they need help to solve problems on their assignments. Although resources have been available, students had been hesitant to do their part and frequently expressed that they prefer having the instructor

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deliver full lectures to them (personal communication with Prof. Azadi-Setayesh on February 28, 2014; UTRGV, 2014). To provide additional support for the students and assure their preparedness before the instructor's mini-lectures, tutors meet with students and preview the content of the lecture that will be covered by the instructor on that day (UTRGV, 2014). Tutors also review any specific previously learned skill that the new content requires students to know. After the instructor conducts the regular class and lab, students meet with the tutors to view a preview of their mandatory written homework. Prior to the sessions, tutors select mathematical problems that are similar to the five problems the students were assigned to complete by the instructor. Tutors review and demonstrate how to solve the problems during the session with the students. The grading system is by points. Students may earn up to 15 points for each online homework (15 questions with two possible attempts), up to 10 points for each lab (5 questions, one attempt), up to 60 points for each quiz (12 questions with two possible attempts), and up to 10 points for each written homework (5 questions, one attempt). The midterm and the final exam are worth 300 points each. Students are encouraged to bring questions regarding their online assignments to the tutorial sessions.

Study Purpose, Research Questions, and Research Hypotheses

The purpose of this study is to investigate the effectiveness of L2S on student achievement in College Algebra. The first research question seeks to answer whether embedding the new program of L2S in College Algebra course will increase students' achievement rate. Increased achievement rate in this study is defined as an individual student getting at least 220 points accumulated from the possible 270 points for written homework, 220 points from the possible 270 points for labs, 305 points from the possible 405 points for online homework, and 540 points from the possible 720 points for online quizzes, and 210 points from the possible 300 points on the midterm exam and 210 points from the possible 300 points on the final exam (all converted to percentages for easy comparison). The second research question asks if students who attend College Algebra with L2S have higher completion rates of the assignments than those in College Algebra without L2S.

With these research questions, two hypotheses were developed. The first hypothesis was that students who attend College Algebra with L2S would have higher achievement rates than those who attend College Algebra without L2S. The second hypothesis was that students who attend the L2S sessions would have higher completion rates on all the assignments than those without L2S.

Literature Review

The focus of the study was to investigate how the L2S program affects freshmen-year students' College Algebra course achievement, what college students think about the helpfulness of L2S, and if L2S and the support it provides is needed for student to succeed in this high-failure and low-retention course. This paper reviews related literature pertaining tutoring effectiveness in general, tutoring laboratories in a learning assistance center, student attitude toward math achievement, mathematics anxiety and its relationship with mathematics self-concept and achievement, social support, and teacher and student perceptions of mathematics learning.

Evaluating the Effectiveness of Tutoring: An Easier Way

Tutoring is being used in many higher education institutes across the nation. However, finding the most effective method of tutoring is challenging. Although tutoring involves answering questions, guiding students in the right direction of solving problems, using positive reinforcement and constructive criticism, and explaining a subject matter to students using one method over another or misusing a method could change the desired outcome of tutoring (Guerra-Martn, et al., 2017; Holliday, 2012; Maré & Mutezo, 2021). Holliday offers a convenient instrument to measure the effectiveness of tutoring. The results indicate a strong relationship between tutoring and student learning outcomes. Students who attended tutoring had better understanding of the concept they were studying after tutoring (Ömeroğulları et al., 2020). As previously discussed, L2S tutors provide support for students in different assignments and even prior to the lecture. The difference between L2S and tutoring labs is that in L2S, the tutors are already in the classroom providing assistance without differentiating whether a student is motivated to take advantage of the available tutoring but in tutoring labs students who are motivated to seek help in the subject area are working on assignments.

Assessment of Tutoring Laboratories in a Learning Assistance Center

Students at the Lincoln University, Pennsylvania, are required to attend tutoring labs if they did not score high in a reading, writing or math assessments on the SAT and are placed in the developmental courses (Fullmer, 2012). The goal is to provide aid to the students in order to increase their GPA and their retention in college (Fullmer, 2012). The trained and certified tutors assist students with learning or relearning the material followed by online tutoring programs of *My Reading Lab, My Writing Lab,* and *ALEKS* (2011) for Mathematics. Students, based on the subject they need assistance on, attend at least six hours of tutoring sessions. Patricia Fullmer (2012) examined the scores of pretests and posttests in writing and math and the scores of students in reading lab of 408 students who were required to attend the tutoring sessions in one or more areas in Fall of 2010. The results indicate a significant increase in students' academic achievement. Although tutoring is known as an important contributor in students' achievement and retention in general

(Hodges & White, 2001; Ömeroğulları et al., 2020), other factors, such as math anxiety and attitudes toward math contribute to the success and retention rates in developmental mathematics courses (Bonham & Boylan, 2011). Although L2S provides an extensive support for students in College Algebra class, students may not fully benefit from the program due to underlying issues such as anxiety or negative attitude towards math. The results of the present study would provide evidence on whether L2S tutoring can increase students' achievement regardless of attitude and anxiety.

Influence of attitude on performance of students in mathematics curriculum

Identifying the main factors contributing to weak performance in mathematics will allow educators to redesign the curriculum and use teaching strategies that eliminate the negative factors and enhances students' learning. Students' low math scores in Kenya has sparked the interest in Manoah et al., (2011), who focused on finding the existence of a relationship between students' attitude and their performance in mathematics. Equal number of boys and girls in secondary schools in a district were randomly selected. Students took a mathematics test and answered questions on an attitude test that used Likert scale and open-ended questions. The poor performance on math test was confirmed for both male and female students. On open-ended measures, students were asked questions about these four factors of curriculum: objectives, content, methods, and evaluation. Although overall, students can perform well in mathematics without necessarily having a positive attitude, students in the study showed a neutral attitude with boys being closer to a positive attitude than girls did (Schreiber, 2002). The impact of attitude in learning mathematics and mathematics performance is considered a main factor for mathematics achievement (Eccles, 1983; Schreiber, 2002). Thus, trying to increase students' interest in mathematics and treating their attitude towards mathematics by teaching the application of the content and using technology are recommended (Manoah et al., 2011). To maximize the potential benefits of L2S, the results of this study could provide valuable information. Instructors and tutors can be trained to implement ways to improve students' attitude toward math while working on their knowledge and skills in problem solving in College Algebra.

Effects of Math Anxiety on Student Success in Higher Education

Extensive research has been done on test anxiety, specifically in math tests, and students' negative attitude toward math in elementary, middle, and high school (e.g., Schreiber, 2002). However, only a limited number of research in this area has been conducted "in college level" (Núñez-Peña et al., 2013, p. 37). The study conducted by Núñez-Peña et al., focused on students in a Research Design course that requires students to use statistics and arithmetic calculations. The study analyzed the results of the questionnaires regarding students' academic background, their attitude towards mathematics, their motivation and enjoyment towards math, and their anxiety level of math courses and math tests. Núñez-Peña et al. found that students' low grades in the course were strongly related to their high level of anxiety and negative attitude towards math. In contrast, students with positive attitude and lower level of anxiety performed better on the test. Students in the study who did not have a strong background in math or technology, had more negative attitude, performed lower, were not motivated and did not enjoy the course (Núñez-Peña et al., 2013).

In general, students with more negative attitude and less motivation, those with higher levels of math anxiety, or those who did not take many math courses in high school, avoid choosing majors that require math courses (LeFevre et al., 1992). Since College Algebra is a basic math course required for many majors at the study university, students who register for the course are not necessarily STEM majors nor do they have a strong math foundation. Math anxiety in students could have been initiated by negative experiences students may have encountered in class at some point or by having math teachers who would cause negative experiences (Jackson & Leffingwell, 1999). As recommended in Núñez-Peña et al. (2013) study, teachers and college math instructors should employ ways to reduce the anxiety and increase students' motivation in math courses alongside teaching the content of the course. This is an important point to consider when using L2S in College Algebra course so that focus is not only on content learning but on enhancing students' learning and improvement of their performance by reducing their anxiety level and helping them build self-confidence.

Reciprocal Relationships Between Math Self-Concept and Math Anxiety

Often, students express negative self-evaluations regarding their ability in math learning and problem solving (Ahmed et al., 2012). In class activities and more during the tests, the anxiety is evident in students' sayings and actions. Ahmed et al. (2012), share the result of their study in finding a reciprocal relation between math self-concept and math anxiety. Former research based on finding relationship between self-concept and anxiety has intensified different views on the matter differing in which factor is the source of the other. Eysenck and Calvo's (1992) and Sedikides's (1992) studies support that anxiety is a source of low self-appraisal. Yet, another view suggests that low self-concept is the source of anxiety (Ahmed et al., 2012). Ahmed et al. (2012) continued the research based on the view supported by Bandura (1997), Pekrun (2006), and Zeidner (1998) to examine a reciprocal relation between math self-concept and math anxiety. After investigating the problem among 7th grade students measuring their math self-concept, math anxiety and their prior achievement, the results showed that a reciprocal relationship does exist and that self-concept has a higher effect on anxiety than anxiety does on self-concept. These results agreed with the formerly found points that confirmed a reciprocal relationship between self-evaluation and anxiety (Bandura, 1997; Krampen, 1988; Sarason, 1988; Zeidner,

1998). Considering the results of this article and the previous one in this section, students in College Algebra who have low math self-concept would deal with high math anxiety that may be strongly related to their low grades. L2S tutors that support students to be more confident and improving their self-evaluations may be of importance to improve students' achievement in College Algebra.

The Role of Social Support in Students' Perceived Abilities and Attitudes Toward Math and Science

Social support from parents, teachers and friends in areas of math and science is considered by Rice et al. (2013) as an effective factor in improving students' self-evaluation and their attitude towards those areas. Students may not enter STEM fields "due to the lack of support in addition to the stereotype name callings" (Rice et al., 2013, p. 1029). Rice et al. (2013) investigated the effect of support from three sources, teacher, parents, and friends, among students in different levels, fifth, eighth, eleventh, and college level. Results agreed with the Social Cognitive Career Theory (Lent et al., 1994, 2000). The Expectancy Value Model (Eccles et al., 1989) proposes that social support has a significantly positive effect on students' self-concept, self-efficacy, and more positive attitude towards math and science. Although attitudes towards math become more negative continuously as students enter middle and high school (Eccles et al., 1989; Midgley et al., 1989), having a strong support system from parents, teachers, and friends decreases the negative attitude and enables students to have a better self-concept towards math and science (Barile et al., 2012; Bowen et al., 2011; Corbett & Wilson, 2002; Crosnoe et al., 2010; Wang & Staver, 2001). In the study of the L2S and non-L2S College Algebra students, both sets of students receive friend/classmate support during lab time and in solving homework. As stated by the finding of the study by Rice et al. (2013), support from parents is higher for college students in math and science field than other levels. Thus, both the L2S and non-L2S students should receive parental support. Considering that L2S provides the additional support from tutors and instructor by providing previews and support during labs and preparation for homework, it is plausible to expect to see better results from students in College Algebra with L2S than those students in College Algebra without L2S.

Teachers' and Students' Perceptions of Self-Regulated Learning and Math Competence: Differentiation and Agreement

Friedrich et al. (2013) investigated if teachers differentiated between "students' math competence and their self-regulated learning methods" (p. 26). Self-regulated learning strategies refer to the ways students are goal oriented and motivated to be focused and learn (Sitzmann & Ely, 2011). Teachers continuously assess students on their performances by grading their work, however, the question is whether teachers have the capability of assessing students' self-regulated learning strategies. If teachers understand and can accurately assess students' learning abilities, they can help students achieve higher by focusing on their abilities (Vogt & Rogalla, 2009). The two variables of self-regulated learning strategies and math self-concept were the focus of the study as teachers and students assessed students and themselves. The results showed that teachers and students differentiate between the two variables. Both groups agreed on how they assessed students' math self-concept (Friedrich et al., 2013). Knowing students and their abilities and their learning styles would allow teachers to focus on teaching methods that benefit students the most. Those methods could be brought into action in L2S College Algebra classes.

Methodology

Study Design

To investigate the effectiveness of the Link2Success (L2S) program on freshman level mathematics achievement, the study implemented a causal-comparative research design (Mills & Gay, 2019). One class of College Algebra with L2S and one class of College Algebra without L2S were randomly chosen. Controlled variables were the institution (both being the study's university classes), time of the classes (both being mid-morning classes), content and objectives of the lessons (being exactly the same), type of assignments (being exactly the same), number of assignments (being exactly the same), location of the classes (being in the same classroom), same resources available to students, same type of technology use (graphing calculators TI-83, 84, 89 or Nspire), and the same textbook. Instructors were different for each class. However, there were both male and had similar positive evaluations from the students in the past. The independent variable was L2S and the dependent variables were achievement rates and completion rates of the assignments.

Participants

Two sections of the College Algebra courses were selected to participate in the study: one section was implemented with L2S with 55 students and the other was without L2S with 56 students (total N=111). Participants in this study had chosen the sections they attended at the time of registration, and thus they were not randomly assigned to these two sections of the course. The participants' demographics in each class are shown in Table 1. There were 49% of female (n= 27) and 51% of male (n= 28) students in the L2S section and 60% of female (n= 34) and 40% of male (n= 22) students in the Non-L2S section. Mean age of students in the L2S class was 20.5 and mean age of students in the Non-L2S class was 18.9. In the L2S class, 91% of students were Hispanic/Latino, 7% were White, and 2% were Indian American. In the Non-L2S class, 94% were Hispanic/Latino and 6% were White. The L2S class has 61% freshman, 28% sophomore, 7% junior, and 4% senior. The Non-L2S class has 86% freshman, 10% sophomore, and 4% senior. In the L2S class, 76% of the students

were taking this course as their first college level math course. In the Non-L2S class, 88% of students were taking the course as their first college level math course. The mean GPA of the L2S students at the time of the study was 2.91, compared to Non-L2S students' mean GPA of 3.08.

Table 1. Participant Demographics in the L2S and Non-L2S classes

	L2S	**Non-L2S**
Female (%)	49 (n=27)	60 (n=34)
Age (yrs.)	20.5	18.9
Hispanic/Latino (%)	91	94
Freshman + Sophomore (%)	89 (61+28)	96 (86+10)
First Mathematics Course (%)	76	88
Mean GPA	2.91	3.08
N	55	56

Materials and Instruments

Materials used for the study were two types of surveys; one for the L2S class and the other for the Non-L2S class. Grade books on *Blackboard* of each class were used to measure and compare.

To compare students' academic achievement of College Algebra, a quantitative method was implemented in the study. To collect data, complete grade books from the intervention (L2S) and comparison (Non-L2S) groups were obtained from the instructors. The means of all assignments were calculated and compared. Comparing the means of (1) labs, (2) online homework, (3) online quizzes, (4) written homework, (5) midterm and final grades of the intervention and comparison groups determined the effectiveness of L2S on students' achievement rate. Completion rates in overall labs, online home works, and online quizzes for the L2S and Non-L2S classes were calculated and compared as well. In addition to demographic questions, a questionnaire was designed and given to the students in the intervention group in the end of the semester asking about their level of interest in math, if they were self-sufficient when studying and doing assignments for math courses, if the students felt L2S was beneficial to them, what they thought about the extra mandatory class time, if they would register for another math course with L2S, and how independent they felt they were when solving College Algebra questions without the assistance of the tutors (e.g. on midterm exam). These questions were on a 5-point Likert scale, ranging from Strongly Agree to Strongly Disagree. See Appendix A for the survey given to the L2S group.

Procedure

Upon the obtainment of the IRB approval of the university, one of the researchers approached instructors of both classes, explained the purpose of the study and obtained permission to visit their classes to give the survey to the students. They asked instructors for their grade books in two occasion, one after the midterm and once at the end of the semester. Upon agreement of the instructors, the researchers visited the classrooms the same week and explained to the students the purpose of the study. The researchers explained that the participation was voluntary, that the surveys were completed anonymously, and that the responses had no effect on their grades and future relationship with the university. Forty-six surveys from the L2S class and 50 surveys from the Non-L2S class were completed. Surveys and grade books were later analyzed and means were calculated and compared.

Data Analysis

Surveys were analyzed question-by-question finding the mean percentage of Strongly Agree to Strongly Disagree responses or Scale 5 to Scale 1 responses. A great amount of data was found from the grade books. For each class, L2S and Non-L2S, mean of all the labs, all the online homework assignments, online quizzes, written home works, midterm and final exams were calculated. To test the first hypothesis, the means of the midterm and final exams of the experimental and comparison groups were compared using a t-test. The test is robust, and the underlying assumption of normality was met via Q-Q plots. To test the second hypothesis, the completion rates of all labs, online homework assignments, and online quizzes for both classes were calculated. Results in bar charts were shown below. Midterm retention (retention by midterm) was calculated by

$$\frac{number\ of\ students\ who\ took\ the\ midterm}{total\ number\ of\ students\ on\ the\ official\ record\ date}$$

Final retention (retention from after midterm to final) was calculated similarly by

$$\frac{number\ of\ students\ who\ took\ the\ final}{total\ number\ of\ students\ after\ midterm}$$

Total retention of both classes was calculated by

$$\frac{number\ of\ students\ who\ took\ the\ final}{total\ number\ of\ students\ on\ the\ official\ record\ date}$$

Results

L2S Students' Opinions

From analyzing the questions on the surveys, on a scale of 1 to 5 with 5 being the highest and 1 the lowest, 60% of the L2S students gave Scale 5 to the helpfulness of the preview part of the program (preview before lecture, see the Introduction). On the same scale, 55.6% of the L2S students gave Scale 5 to the helpfulness of the written homework preparation (see Introduction). The results are represented in Figure 1. On the same scale, in terms of the overall rating of the L2S program based on their experience, 53.3% of the L2S students gave it the Scale 5. See Figure 2.

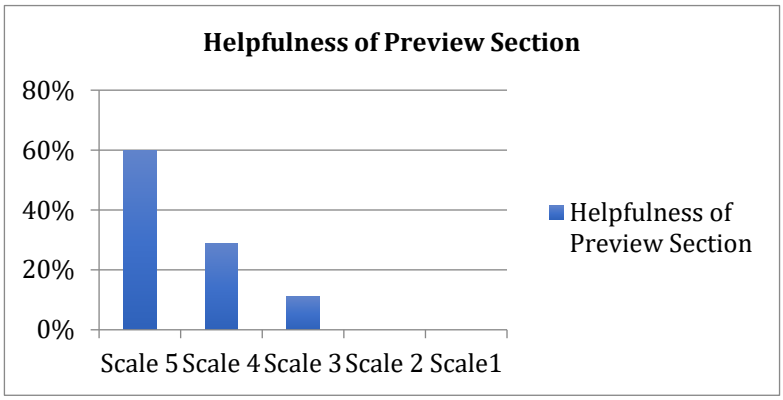

Figure 1. L2S Students on Helpfulness of Preview Section

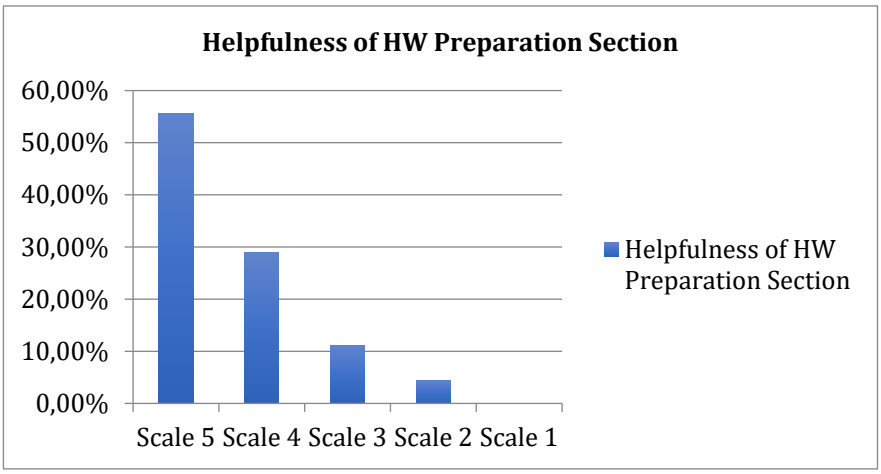

Figure 2: L2S Students on Helpfulness of Homework Preparation Section

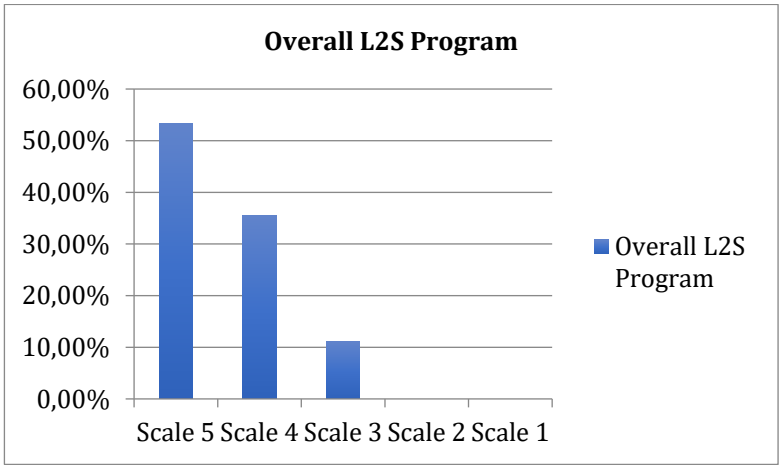

Figure 3. L2S Students on Overall L2S Program

In general, 89.1% of L2S students felt that the College Algebra with L2S had a positive effect on their grade (See Figure 3). Of all College Algebra with L2S participants, 70% reported they would register for another math course with L2S. Students in L2S College Algebra class were asked how independent they felt while working on the College Algebra assignments on their own without the assistance of the tutors or the instructor. On a scale of 1 to 5 with 1 being very dependent and 5 being very independent, 17.4% of students replied very independent (see Figure 4). In addition, 34.8% of L2S students declared attending L2S sessions increased their self-esteem when working on College Algebra assignment (see Figure 5).

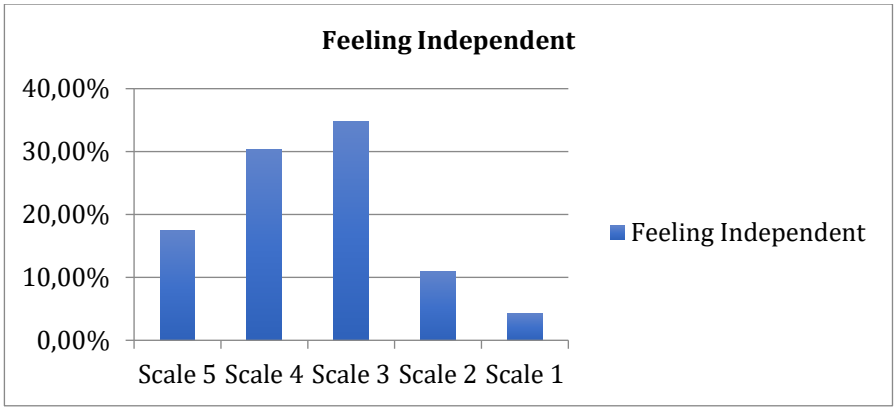

Figure 4. L2S Students on Independency

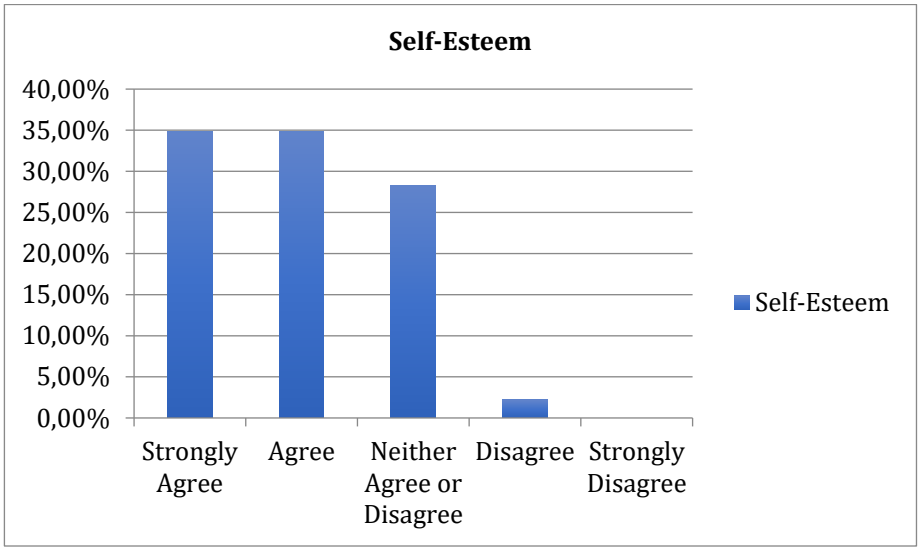

Figure 5. L2S Students on Self-Esteem

Non-L2S Students' Opinions

The Non-L2S students were asked if a program (with description of L2S) embedded into their College Algebra course would potentially improve their grades greatly in the course. In response, 32% of Non-L2S students chose Strongly Agree (see Figure 6).

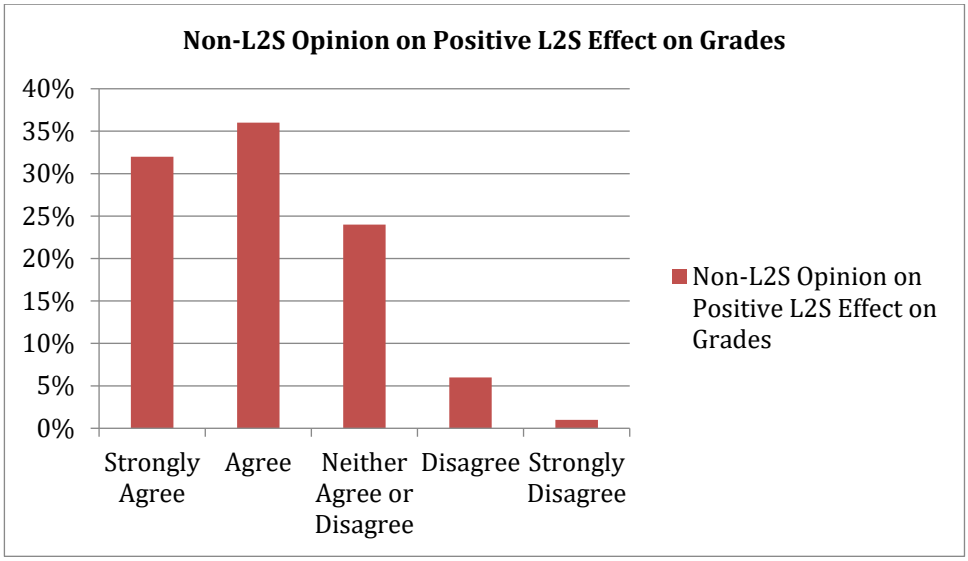

Figure 6. Non-L2S Students on Possible L2S Influence

Comparison between the L2S and Non-L2S Groups

There were 27 labs, 27 online homework, and 12 online quizzes in the course. The mean of all these assignments were calculated for both L2S and Non-L2S classes and the comparison is in Figure 7.

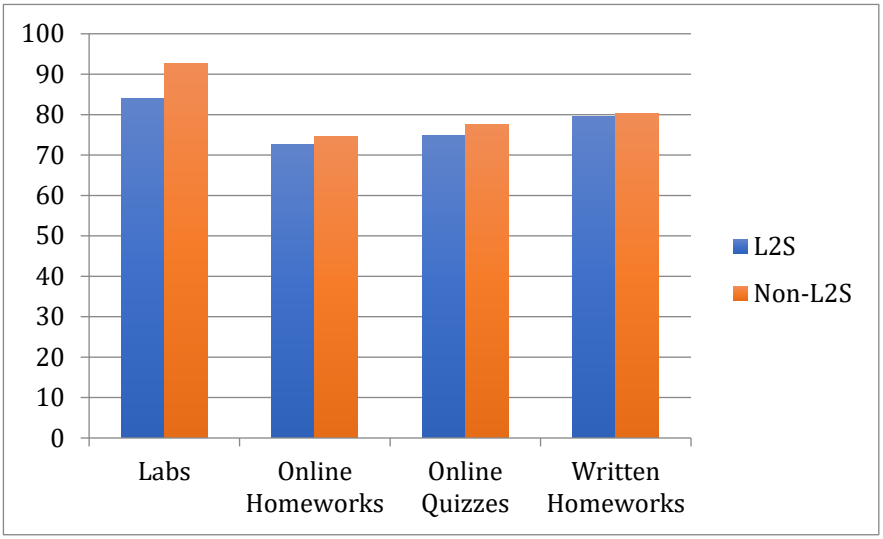

Figure 7. Comparison of Grades for All Assignments

Students in L2S class had a midterm mean grade of 64.9 where Non-L2S students had a midterm mean grade of 69.4. Students in L2S class had a final mean grade of 73.4 where Non-L2S students had a final mean grade of 78.2. Results are represented in Figure 8.

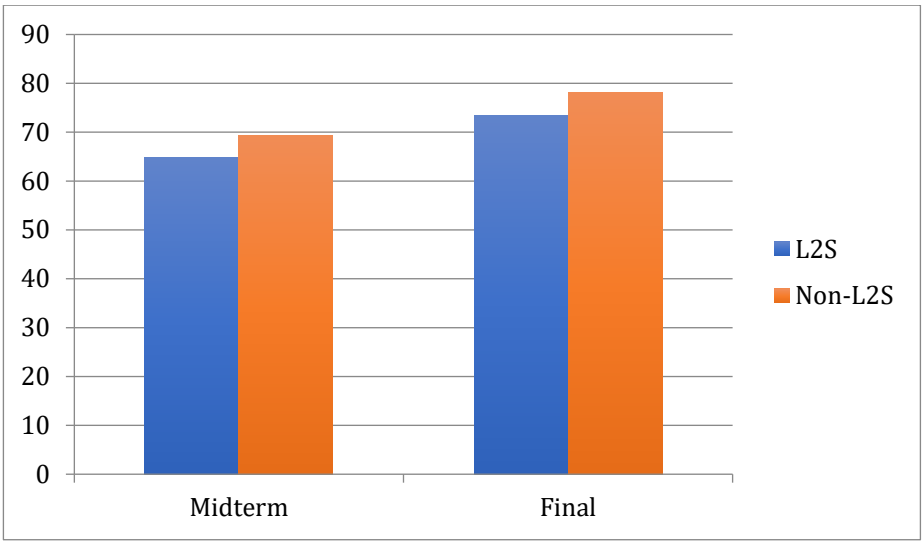

Figure 8. Comparison of Grades from the Midterm and Final Examinations

The t-tests were run to test the first hypothesis. For t-test comparing midterm grades, the following information was obtained and calculated:

L2S class: $n_1 = 55,\ s_1 = 17.24, \overline{x_1} = 64.9,\ \widehat{\sigma_1^2} = 297.3$

Non-L2S class: $n_2 = 56,\ s_2 = 15.85, \overline{x_2} = 69.4,\ \widehat{\sigma_2^2} = 251.3$

The independent samples t-test yielded: t (df = 109) = 1.427, p > .05 (ns). Therefore, it was concluded that there was no significant difference in midterm grades between the L2S and Non-L2S groups.

Similarly, the t-test was performed for the final grades' mean comparison using the following:

L2S class: $n_1 = 49,\ s_1 = 21.68, \overline{x_1} = 73.4,\ \widehat{\sigma_1^2} = 470$

Non-L2S class: $n_2 = 55,\ s_2 = 16.03, \overline{x_2} = 78.2,\ \widehat{\sigma_2^2} = 256.97$

The independent samples t-test yielded: t (df = 102) = 1.271, p > .05 (ns). Therefore, it was concluded that there was no significant difference in final grades between the L2S and Non-L2S groups.

Comparison of the Completion and Retention Rates between the Two Groups

The completion rates of all assignments in the College Algebra course except the written homework are represented in Figure 9. The Non-L2S group had higher completion rates in Labs, Online Homework, and Online Quizzes than the L2S group did.

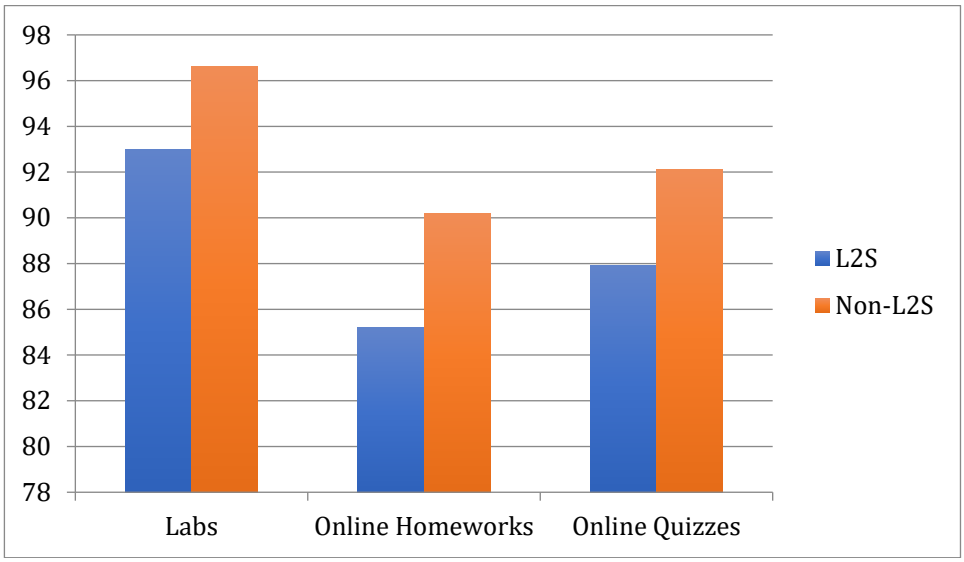

Figure 9. Completion Rates of the Assignments

The retention rates of midterm and final (see Data Analysis) and the overall retention of both groups were calculated. Results are in Figure 10. The Non-L2S group had higher retention rates in the Midterm Examination, the Final Examination, and the Overall Retention than the L2S group did.

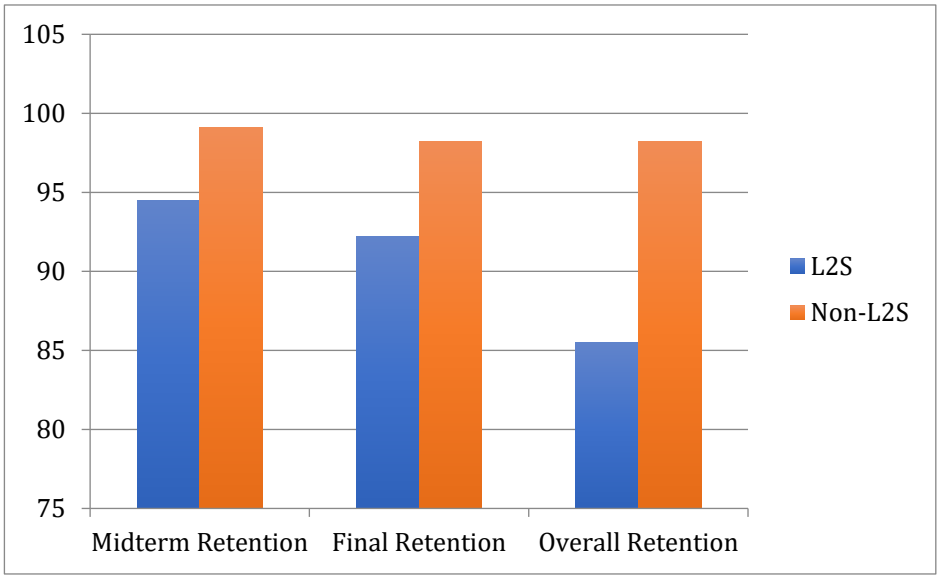

Figure 10. Retention

Discussion

Main Findings

The mean grades for labs, online home works, online quizzes, and written home works show that the L2S students did not perform better than the Non-L2S students in any of the assignments even with the advantage of having tutors previewing the content and the written homework sections for them. In every assignment category, the L2S students had lower overall grades than the Non-L2S students. Same results held when midterm and final exams of both classes were compared. Students in the L2S class had a midterm mean grade of 64.9 (SD = 17.24) where the Non-L2S students had a midterm mean grade of 69.4 (SD = 15.85). Neither group reached the operationally defined success rate in midterm that was set by the researchers (210 out of 300 points or 70%, see the Introduction) with the L2S students performing worse than the non-L2S students. Students in the L2S class had a final mean grade of 73.4 where the Non-L2S students had a final mean grade of 78.2. Both groups reached the operationally defined success rate in final exam that was set by the researcher (210 out of 300 points or 70%, see the Introduction) with the L2S students performing worse than the Non-L2S students. The results of the t-tests comparing the midterms and final exams of two groups also showed the same results. Therefore, it was concluded that there is no significant difference in the achievement of the L2S and Non-L2S students.

Overall, L2S did not bring students' achievement levels to a higher degree. The L2S students performed worse in all assignments and exams from the comparison of the mean grades. Comparison between the completion rates of assignments clearly showed that the Non-L2S students completed their assignments in a higher rate than the L2S students. Although L2S provided additional support and resources to enhance students' learning in the College Algebra, the results of comparisons are not in favor of L2S.

General Discussion

These results from the present study would provide some insight for the department of mathematics in determining if the current L2S program generates the desired results they hope it does for their College Algebra students. As the study found quite unexpected results from the study's research hypotheses, it is worth asking: Why did the L2S students not perform better than the Non-L2S students in College Algebra? It is highly likely that the students who were enrolled in the L2S program were different from those who were not interested in, and therefore not enrolled in, the L2S program. The L2S students were a little bit older (with a mean age of 20.5) than the Non-L2S students (with a mean age of 18.9). Age may play an important role (Jameson & Fusco, 2014). The L2S students had a lower GPA before they started the class (being 2.91 compared to the Non-L2S students' 3.08). Moreover, those who initially sought for extra tutoring help with the L2S program might have lower mathematics ability, skills and self-concept, and might be more anxious about, worried about, or afraid of mathematics in the first place before they enrolled in the class or started learning College Algebra (Lee, 2009; Parker et al., 2014). It is reasonable to assume that those Non-L2S students, who might be more interested in and capable of mathematics, should perform quite well if they initially started learning College Algebra with strong backgrounds and positive attitudes.

It was interesting to find that both L2S and non-L2S students believed that the L2S program is beneficial to them for their mathematics learning. Modifying and strengthening the L2S program therefore may be beneficial for students. Eliminating the L2S program may not be the best solution.

Conclusion

Findings of this study showed, students have positively rated the program and those students who did not have L2S in their course wished they did (even though they performed as well). Thus, keeping the program but modifying it to academically benefit students is suggested. As we continuously search for the best programs to assist students to become successful in their courses, more established programs and those that have been tested more and have generated positive results might also be good choices.

Recommendations

Despite high ratings of opinions that L2S gave to the program and the potential benefit that the Non-L2S students felt the program might have provided to them, the grades and completion rates say the opposite. To continue to research the L2S program, it may be useful to investigate more classes of L2S and in several more semesters. Observing the classes and interviewing the tutors and students could provide valuable information as well. It may be interesting to use a qualitative approach to find if investigating more students, tutors, instructors, and the LEC staff (along with more student grades) would change the result and if there are any psychological underlying reasons, such as anxiety and negative attitude towards math, for not improved grades and completion rates of the L2S students.

Limitation

One limitation was lack of official background information available for the Link2Success program. As it is a new program implemented at the study's university, the information available about it was mainly from the university website, the workshops held by the LEC, and some casual talks one of the researchers had with the LEC director and staff. Another limitation was the number of College Algebra session without L2S. Having more L2S and Non-L2S classes would provide more information and perhaps more accurate results. Lastly, a possible limitation was having different instructors teaching the two sessions. Although one of the researchers knows both instructors and is familiar with their methods of teaching and their high positive student evaluations, having the same instructor teaching both classes would add to the controlled variables and may provide more accurate results.

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Appendix

1. Gender: ☐ Male ☐ Female
2. Age: _____
3. Ethnicity:
   - o American Indian
   - o Asian
   - o African American
   - o Hispanic or Latino
   - o White
   - o Other: _____
4. I am a college: ☐Freshman ☐Sophomore ☐Junior ☐Senior
5. Is college algebra your first math course? ☐Yes ☐No
6. Your GPA is: _____
7. In a scale of 1 to 5, with 1 the lowest and 5 the highest point, how would you rate the **preview part** of the L2S program (preview of the content before professor's lecture time)? _____
8. In a scale of 1 to 5, with 1 the lowest and 5 the highest point, how would you rate the **homework preparation part** of the L2S program (preview of the written homework problems)? _____
9. Overall, in a scale of 1 to 5, with 1 the lowest and 5 the highest point, how would you rate the L2S program? _____
10. Do you feel the L2S has a positive effect on your grade in this course?
    ☐Yes ☐No
11. How independent do you feel you are when working on college algebra assignments/midterm without the help and support of tutors? *1 being very dependent and 5 being very independent* _____
12. Attending L2S has increased my self-esteem when working on college algebra assignments.

☐Strongly agree ☐Agree ☐Neither agree nor disagree ☐Disagree ☐Strongly disagree

13. Will you register for another math course with L2S program? ☐Yes ☐No
14. In a few words, please describe your attitude towards math in general: