Implementing a Computer-Based Math Intervention Program

Introduction

Eighth grade students who are below grade level (MAPs scores of 231 and below) are not ready for the current 8th grade course of Algebra. Due to their demonstrated deficits in math knowledge and skills, these students are placed in an introductory course called Algebra Readiness. Many other schools would offer an intervention class for this group of at-risk students, targeting specific critical math skills. However, due to limited funding, there is currently no intervention class offered at our school. Could a computer-based program, such as Learning Upgrade Pre-Algebra, prove to be an effective means to fill the gaps of knowledge and accelerate the growth and math fluency in these specific intervention students?

The purpose of this study is to determine if a cost-effective, computer-based augmentation program such as Learning Upgrade can deliver an accelerated growth in students who do not have access to a dedicated intervention class. The research question this study seeks to answer is whether Learning Upgrade improves student performance on school-wide interim assessments. In recent years, students in Algebra Readiness have not reached optimal growth on Measures of Academic Progress (MAPs). MAPs scores have been shown to directly correlate to student math knowledge and ability and indicate how a student will do in a specific math class. It is essential for these students to reduce/eliminate the gaps in their math knowledge and abilities so they can successfully complete Algebra in high school. A significant growth in MAPs (exceeding yearly expected growth) will show that a student is advancing and ready for more rigorous courses. Also, increased growth in MAPs for this year's 8th grade Algebra Readiness students, compared to last year's 8th grade students without the computer intervention program, will indicate if using the Learning Upgrade program had a

positive effect and if it could prove to be an effective alternative to an intervention course. Other variables were controlled as much as possible between the two groups studied. For instance, all groups had the same teacher and used the same primary curriculum.

Review of Literature

Yessedyke, Betts, Thill, and Hannigan (2004) conducted a study of 101 3rd through 6th grade Title I students that investigated how the introduction of a curriculum-based instructional management system that enhanced mathematics instruction affected performance. To study this, the researchers used STAR Math, a computer adaptive test, as a pre-test and post-test for all students in the study. The students used the math intervention for a 5-month period between the pre-test and post-tests. The researchers found that students who participated in the interventions as an enhancement to the regular mathematics instruction they were receiving in their general education classes consistently demonstrated significantly higher math achievement gains than students in those same math programs who did not receive the enhancement. The management system is similar to this research project, in that the program provided students with instant feedback on their performance, gave the teacher printouts showing the progress of all students, and allowed the students the opportunity to develop their mathematics skills at an individualized pace.

Haelermans and Ghysels (2013) conducted a randomized field experiment that explored the effect of using an interactive online skill drill tool on basic math skills for first year secondary students. They studied 430 secondary students who had to practice with the tool at home every week and were tested at school regularly, ranging in age from 11 to 14. Their preliminary findings indicate a positive and significant effect of 7 percent increase in score growth per 30 additional minutes practiced per week. They also conducted a cost-benefit

analysis and found that the potential cost savings of using the online tool was significant, especially when compared to the costs of hiring a full-time teacher.

Burns, Kanive, and Degrande (2010) conducted a study that investigated the effectiveness of using a computer-based math fluency intervention to improve the math fact fluency of 216 3rd and 4th grade elementary students identified as "at risk" in the area of math. Each student used the STAR Math test as a pre- and post-intervention measure. The students used the math fact intervention program at least 3 times a week (for 5-15 minutes) in their classes, for an average of 11 weeks. The researchers found that the intervention participants made significantly larger gains on the STAR Math test than control group participants. 42.8% of intervention participants raised their STAR math score to above the 25th percentile and thus were no longer classified as "at-risk" in the area of math.

Maloy, Edwards, and Anderson (2010) suggest that blending online and in-person learning activities through structured practice and problem solving can be an effective alternative to whole class math instruction. Their study involved 125 fourth graders during 10 weeks in 2007-2008. The project's overall goal was to improve the problem-solving and test-taking skills of students. Their research focused on whether a web-based tutoring system might encourage students to spend more time working through math word problems strategically. Initial results of the study showed scores improved from pre-test to post-test for 70% of the students. They found a mean gain of 25.51% in test scores from pre-test to post-test among all student participants, while 36 students registered gains of 40% or more. The web-based program provided two types of practice: "supported practice," where test questions are presented with hints, and "test practice," where no support is offered. This bi-level approach is designed to develop student problem-solving skills in a supported way, and in so doing, build

the confidence and positive mental attitude necessary to succeed on math tests. This two-pronged approach is similar to the Learning Upgrade program used in this research project.

These research articles informed this research project by providing background and evidence that using a computer-based math intervention program can increase student performance and close the achievement gap. Although each study used a different intervention tool, they all showed student gains because the tool was carefully chosen and results were closely monitored. The teachers did not rely solely on the tool for instruction but used it to augment what was already being done in the classroom and to target critical, identified needs/gaps.

Methods

This study was conducted at Black Mountain Middle School in Poway Unified School District, San Diego, California. The participants were 63 8th grade Algebra Readiness students, spread between two sections. This study included a very diverse population. Students had varying abilities and gaps. These students have struggled in math from year to year and are not yet ready for the rigor of the 8th grade Algebra class. The purpose of Algebra Readiness is to increase math ability and fill knowledge gaps so students can succeed in Algebra in 9th grade.

This study utilized the MAPs test as the primary source of showing growth. MAPs was given in the Fall (October), as a baseline. It was administered again in Winter (February) and Spring (May.)

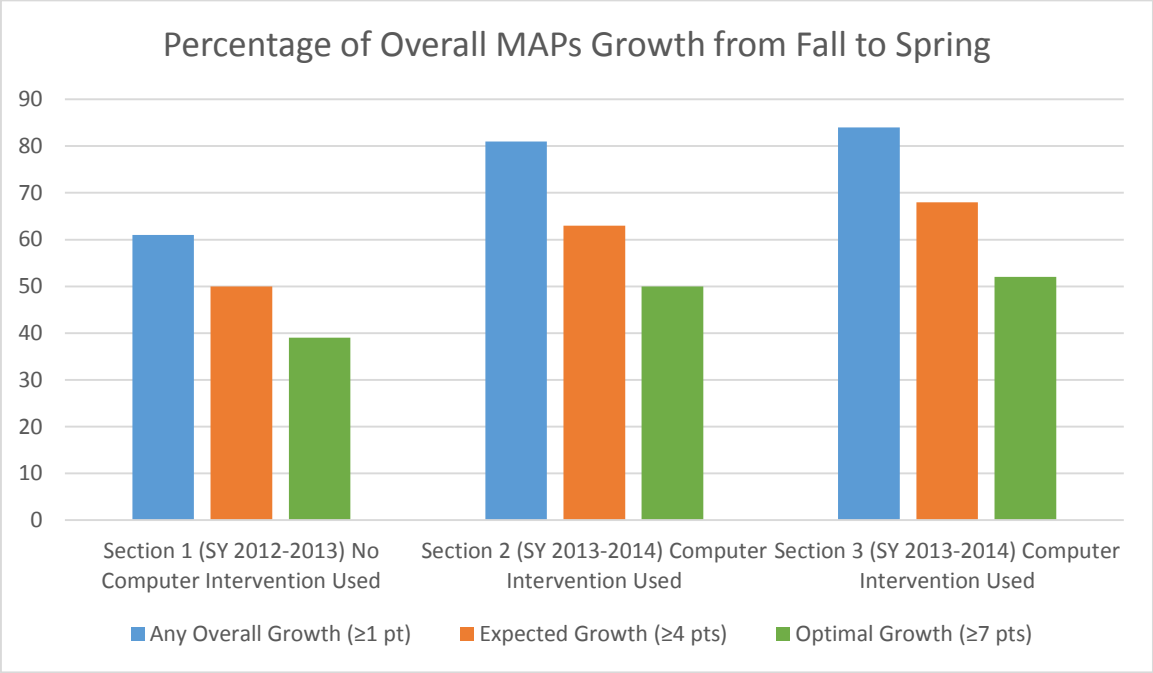
Students began using the Pre-Algebra Learning Upgrade course in October. One day a week was dedicated to Learning Upgrade in class throughout the year. Additionally, students were expected to do at least 1 hour (20 min 3x) per week, at home. In class, students received a

netbook/headphones and worked independently on their current level of Learning Upgrade, while the teacher would circulate and offer help as needed. The teacher would also put up the Student Monitor screen in class so students could see their current levels. Each session, the teacher discussed intermediate goals with the students so students would be able to complete the entire program (all 60 levels) by the class deadline of May 15th.

Fall, Winter, and Spring MAPs results were pulled from NWEA, through our district Student Reports Center. Learning Upgrade completion status was pulled through the Learning Upgrade program teacher interface. A comparison was made with the Fall, Winter, and Spring MAPs scores from last year's 8th grade Algebra Readiness students (SY 2012-2013.) Additionally, how far a student worked through the Learning Upgrade program during the time of the study was analyzed. Surveys were also given to students and parents to collect and assess their opinions of the computer intervention course.

Results

With regard to the research question, "Could a computer-based program, such as Learning Upgrade Pre-Algebra, prove to be an effective means to fill the gaps of knowledge and accelerate the growth and math fluency in these specific intervention students?," this study compared the MAPs growth of three groups of students: two classes of 8th grade students in SY 2013-2014 (63 total) who used the Learning Upgrade computer intervention course, and one class of 8th grade students in SY 2012-2013 (36 total) who did not use the Learning Upgrade program. Over the course of a school year, expected MAPs growth for a student is 4 points, while optimal MAPs growth is 7 points.



This study found the following results:

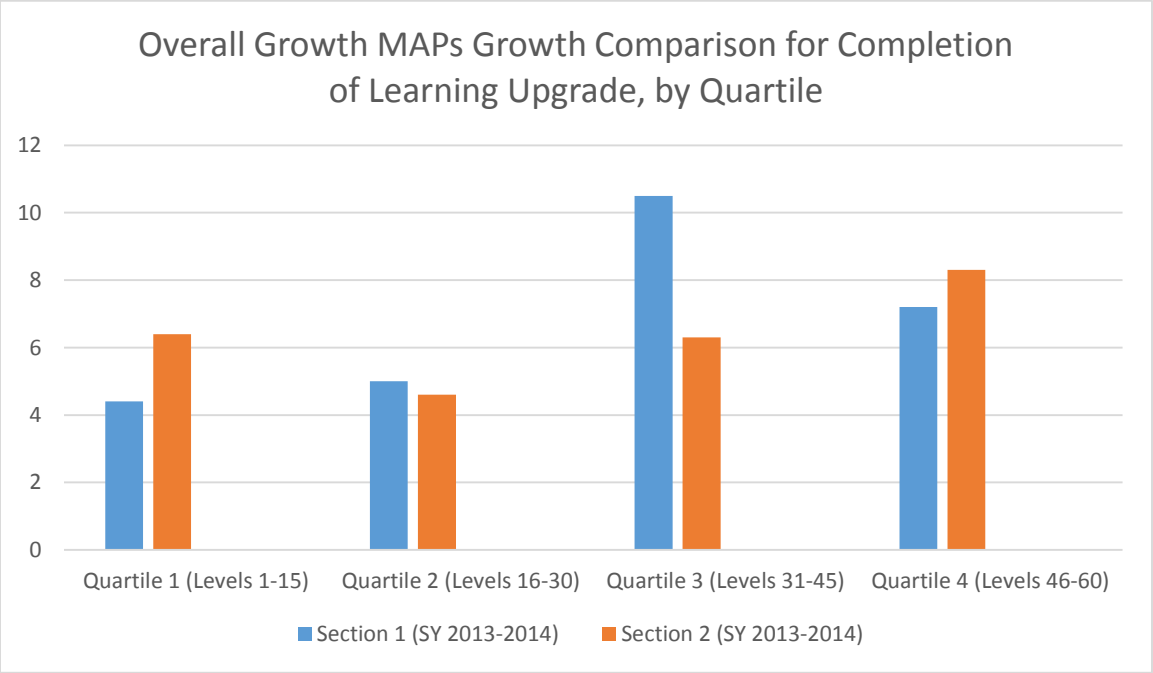
- Of the two SY 2013-2014 classes (Sections 2 and 3), both showed significant MAPs growth over the school year when compared with Section 1. Both Sections 2 and 3 had overall growth rates of 20% and 23% higher, respectively, than Section 1. Sections 2 and 3 exceeded expected growth by 13% and 18%, respectively. The sections also exceeded optimal growth by 11% and 13%, respectively.
- In March 2014, 85% of the students surveyed responded that they feel Learning Upgrade has increased their math learning ability and understanding this year.

Other student survey responses showed that 58% of the students felt they put forth great effort on Learning Upgrade in class. By contrast, only 23% said they did the required 1 hour at home a week, while 30% said they never did it at home. 75% said they would have improved more

had they put in more effort. 64% of students felt that the Learning Upgrade program was worth the additional money spent to purchase the year-long license. A parent survey was administered as well. 83% of parents felt Learning Upgrade was either a good or excellent addition to the curriculum.

A t-test was conducted comparing the Fall to Spring MAPs scores for students in SY 2012-2013 and for students in SY 2013-2014. Since these were two sample groups, compared for the same time period, an independent t-test was conducted. The t-test had a combined number of 99 participants (36 from SY 2012-2013 and 63 from SY 2013-2014.) The mean was 2.9722 and the two-tailed P = 0.028748.

For the two sections who used Learning Upgrade this school year, a quartile comparison was conducted. The 60 levels of Learning Upgrade were broken down into quartiles, each 15 levels. This comparison measured the MAPs growth of students based on the highest level of Learning Upgrade they completed.



The above data shows a significant increase in growth for students in the upper two completion quartiles.

Conclusion

The question to be answered by this study is could a computer-based program, such as Learning Upgrade Pre-Algebra, prove to be an effective means to fill the gaps of knowledge and accelerate the growth and math fluency in these specific intervention students? When looking at the student-to-student data comparison, the data shows a significant difference in growth between this year's classes (Sections 2 and 3) that used Learning Upgrade and last year's class (Section 1) that did not use it. Additionally, the quartile study showed a significant increase in growth for those that finished at least half of the 60 level program. The two-tailed P=0.028748 result means that the data shows that the results are not random and that there is a systemic cause for the increased growth. There is a significant enough difference between the two groups to definitively conclude that adding the Learning Upgrade program to the curriculum had a large impact on the increased growth.

The literature showed a growth in student achievement, based on the addition of specific interventions. In the two class sections using Learning Upgrade analyzed in this study (Sections 2 and 3), students showed a distinct growth in their overall MAPs, especially when compared to last year's class without the Learning Upgrade intervention (Section 1). Although students were at varying degrees of Learning Upgrade completion at Spring MAPs testing, the data does show that students did indeed show improved overall MAPs growth this year while using the Learning Upgrade intervention.

Reflection

Adding Learning Upgrade as an intervention program does provide a means to help students fill their knowledge gaps in a fun and personalized way. The next steps to consider are to find time to incorporate this program more consistently, outside of class time. The major drawback to piloting Learning Upgrade this year was that it had to be done inside the math classroom and used about 20% of the instructional minutes for the course. If intervention time could be found outside of the math classroom, then this program could be an effective, cost saving alternative to having a traditional intervention course. Additionally, many of the students in this study did not meet the expectation of at least 1 hour of Learning Upgrade at home per week. Designing a consistent, alternative time at school that is just for this program would alleviate this requirement and still provide students with more math instructional minutes. This first year of implementation has shown me that in addition to our yearly completion goal, it may be beneficial for this group of students to have monthly, or even weekly goals, with a grade attached to each goal.

In summary, the data shows that this intervention does prove useful as an additional support, and it is cost effective, especially in a time of reduced budgets. However, I would prefer to find additional time in the school day to use this intervention, whether that be an elective, during part of lunch, or as an afterschool tutorial commitment. This would remove the burden of requiring students to spend time at home using the intervention, allowing students to get more out of Learning Upgrade's lessons and ultimately see even stronger learning growth.

References

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