

Running head: STUDENT ACCESS TO COLLEGE ALGEBRA PRELIMINARY REPORT

**Student Access: Comparative Study of High School Math Students Using Distance  
Learning at Readiness with College Algebra Classroom Students**

Lee Alan Hanawalt Roher

University of Kentucky

### Abstract

This is a preliminary report on a study comparing traditional and distance learning versions of the same College Algebra course. The traditional cohort is a group of 32 college freshmen from the Appalachian area who are enrolled in a National Science Foundation (NSF) sponsored program while the distant cohort is comprised of 34 rural, primarily Appalachian high school seniors. This paper will discuss the efforts to provide a comparable content and instructional experience to both groups. All students do the same web-based homework and take the same uniformly graded examinations. The local tutoring support for traditional students is matched by real-time e-tutoring for the distant cohort. Using SPSS statistical software, data was analyzed using a two-way repeated-measure ANOVA regression model. There was no significant difference found between the Appalachian high school student achievement and the Appalachian college freshmen achievement.

**Student Access: Comparative Study of High School Math Students Using Distance Learning at Readiness with College Algebra Classroom Students**

Preliminary Research Report

*Introduction*

Access to Algebra is a program offered by the Appalachian Math Science Partnership (AMSP) and the University of Kentucky. AMSP is a National Science Foundation grant recipient. The program offers high school students the opportunity to do so independently using a distance learning format. The on-line course is offered concurrently with a traditional College Algebra class. The high school students and the college students complete the same coursework. All homework assignments are web-based, and exams are uniformly graded by a team of scorers. Both the college students and the high school students have access to tutoring outside the classroom. The high school students have access to on-line tutors provided by the college. The university students have access to two forms of free tutoring: the university supported Study for free tutoring and Mathskellar, a math lab. The significance of students having access to College Algebra in high school is the potential for students to achieve greater mathematical success in college than their peers who have not had the advantage of higher-level mathematics at the secondary level. “Many designs for distance learning open up possibilities for new kinds of interactions through alternative arrangements of space, time, and resources for teacher and students” (Hawkins, 1991). One of the best indicators for success in college and completion of a degree is the level of mathematics the student takes during the senior year of high school (Adelman, 1999, 2006). This paper will discuss the preliminary results and the program direction of the Access to Algebra study.

### *Purpose*

The purpose of this study is to compare student achievement between distance learning high school students and traditional classroom college students taking the same College Algebra course. “The distance education currently in practice has the potential to provide more effective learning with updated pedagogy, more experience, and greater understanding and knowledge of methods” (Cavanaugh, 2001). This study will address the following questions exploring critical elements of an effective model for a distance learning College Algebra course.

- How do distance learning high school students compare with traditional classroom college students in achievement in College Algebra in the central Appalachian region?
- What are critical elements of an effective model for a distance learning College Algebra course for high school students in the central Appalachian region?

### Method

#### *Population*

The sample population consists of three groups: 34 Appalachian Math Science Partnership (AMSP) high school math students, 32 college freshmen Appalachian Minority Science, Technology, Engineering, & Mathematics Majors (AMSTEMM), and 11 general population university students. The AMSP high school students complete the College Algebra course through distance learning. The university students, both AMSTEMM and the general population students are taking College Algebra through a traditional classroom setting. The 34 AMSP high school students are, in most cases, independent study students with support from a sponsor teacher and online tutors. There are a small number of cases where the participating high school student is actually in a classroom with the mathematics teacher. The high school teachers, working with the school counselor, identified students who would possibly benefit from

participating in the program, invited the students to participate in the program. Participating high schools had teachers were required to attend a summer institute. During the summer training, sponsor teachers were trained to use the communication software and focused on editing and aligning the course content. The 35 AMSTEMM students who needed to take MA-109 (College Algebra) were assigned into two designated MA-109 sections. The registrar randomly assigned 11 general population university students to fill these sections.

### *Procedure*

The first semester of the study was designed to give distance learning and traditional classroom students the same College Algebra course. The students were given a pre-test to ascertain current mathematical skills, followed by a survey to obtain demographic information. All students took the surveys online. As students completed the coursework free tutoring was made available either through an online tutor for the high school students, or through Mathskellar and the University of Kentucky Study for the college students. The Study is a tutoring system for the University of Kentucky students. The course work will consist of homework assignments and course exams. The online tutoring sessions will be recorded. The time spent with tutors will be self reported.

The dependent variable in this study is student course score. The independent variable is determined by group membership. The measure of student achievement in this study will be determined through homework scores and exam scores.

The coursework data was analyzed using two-way repeated-measure ANOVA regression. Comparisons were made between the distance learning AMSP high schools, the AMSTEMM students, and the general population university students.

Results

Initial analysis of the data indicates high school students outperform the AMSTEMM students and the general university students. This is demonstrated by the cumulative final exam scores. The top three quartiles are comprised of high-achieving students scoring A's and B's, as shown in Figures 1 and 2.

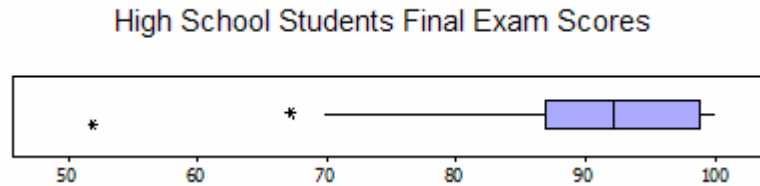


Figure 1. Box plot diagram of high school students' final exam scores.

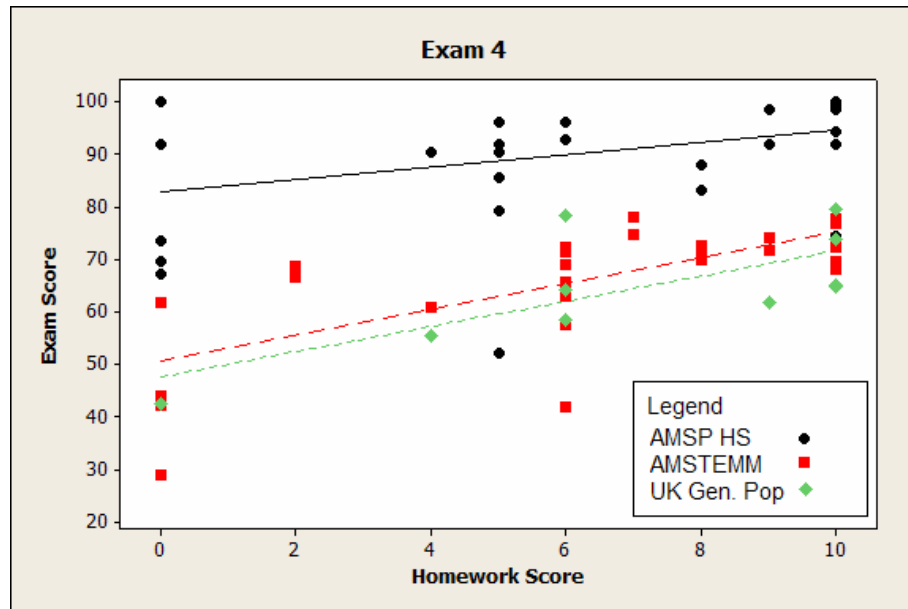


Figure 2. Scatterplot comparison of homework scores and exam scores for each group.

When comparing student achievement between the groups, no significant differences between groups for average homework scores and between groups for average exam scores were found. Comparing student achievement within groups, there was significant difference was

found within groups between average homework scores and exam scores for the high school and AMSTEMM groups. Within the general UK population group, there was no significant difference between average homework scores and exam scores. (See Figure 3.)

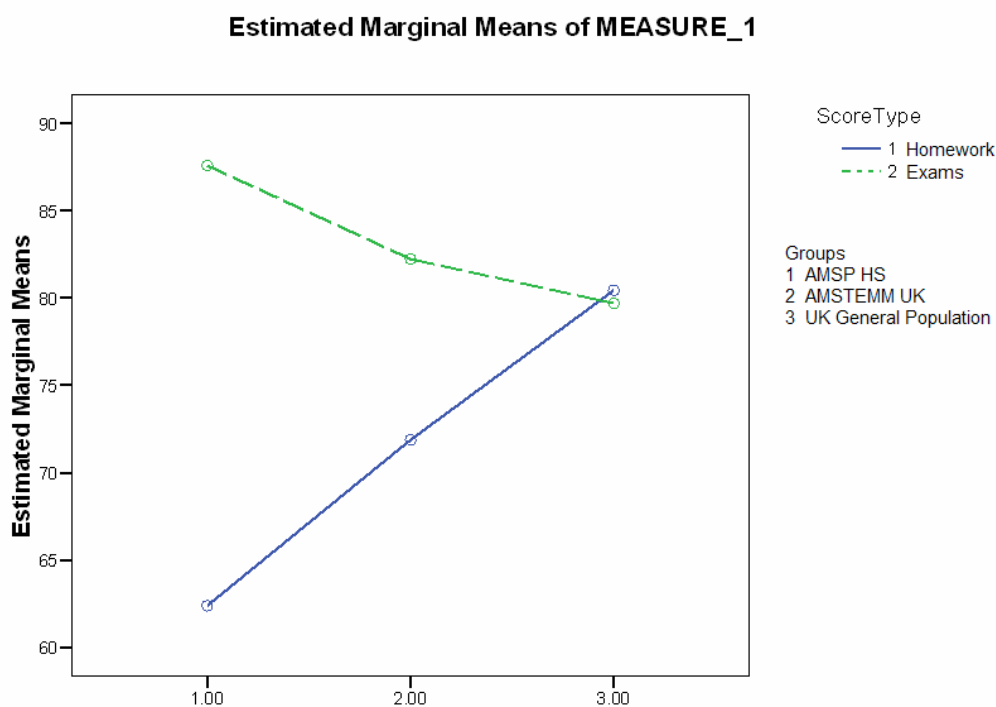


Figure 3. Differences between homework and exam scores for each group.

Further data analysis is being conducted.

### *Limitations*

Limitations to this study include the different level of mathematical ability between the high school students and the university students. In this study it has been noted that students in College Algebra may have lower mathematical skills than advanced high school students. Validity concerning the comparison with the general population students may be compromised because the number of students in this group is approximately one-third of the amount of students in the other two groups.

*Future Research and Implications*

During this study, it has been found that the paper shuffle of the exams through email, fax, and regular mail has put a burden on the scoring process. A method must be found to submit exams in a secure and reasonable time frame to maintain a sustainable program. Currently, the program is attempting to replicate the study with a new cohort of students piloting an exam submission process through an online medium.

Student Access to College Algebra is working toward expanding the program to 100 high school students per semester. In addition to the high school program, the University of Kentucky is developing a professional development program for high school mathematics teachers that will be imbedded in the high schools academic year. This professional development will be an examination of the Student Access assessments and student performance along with studying graduate level parallel algebra concepts.

In future research there will be investigation into how participating in a distance learning program impacts high school students' post-secondary plans. Another topic of interest is how working as an online tutor impacts college students' career choices toward a profession in education.



## References

- Adelman, C. (1999). Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment (Publication., from U.S. Department of Education: <http://www.ed.gov/pubs/Toolbox/Exec.html>).
- Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: U. S. Department of Education.
- Cavanaugh, C. S. (2001). The effectiveness of interactive distance education technologies in K-12 learning: A meta-analysis. *International Journal of Educational Telecommunications*, 7(1), 73-88.
- Hawkins, J. (1991). Technology-mediated communities for learning: Designs and consequences. *Annals of the American Academy of Political and Social Science*, 514(March), 159-174.