

WvEB Algebra: A Web Enhanced College Course for West Virginia High School Seniors
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Abstract

West Virginia University, WVU, offers a web enhanced college-level algebra course for high school students as a part of the State funded WvEB Math Project. The main goal of the project is to allow students a smooth transition into college level mathematics. During the 2004-2005 academic year, a matched pair study using a retired version of the math ACT test was performed to find if students in the high school sections have mathematics achievement change that is significantly different than the mathematics achievement change of those enrolled in the on campus sections. This paper will briefly introduce the project and discuss preliminary findings of that study. This project is funded in part by the NSF, CCLI project number 0339117.

Introduction

In 1999, the Higher Education Policy Commission (HEPC) in West Virginia began to collaborate with the West Virginia Department of Education (WVDOE) in efforts to increase the college going rate in West Virginia as well as the ACT scores for West Virginia students (West Virginia Higher Education Policy Commission, 2002; West Virginia Department of Education, 2001). In order to better prepare students in transition from high school to higher education, mathematics was chosen as the content area of focus and a web enhanced course in college algebra was developed. A previous publication outlines an overview of the course structure (Pyzdrowski, Pyzdrowski & Mays, 2005). In addition, other publications detail first year objectives, project outcomes and the formative assessments performed (Pyzdrowski & Pyzdrowski, 2002 and Pyzdrowski & Pyzdrowski, 2003).

The WvEB Math project has the following objectives:

- Make available a college level courses for concurrent enrollment, thus helping students remain in a mathematics pathway while in high school, and allowing for a smooth transition into entry level college mathematics.
- Systemically collaborate statewide to improve student mathematics achievement and the number of high school students taking college courses while in high school.
- Provide professional development in content and pedagogy for high school mathematics

teachers.

- Implement a statewide partnership between high school and higher education.
- Engage the support of superintendents, principals, counselors and parents.

The components of the WvEB Math project are:

- Reading Assignments (Text Component)
- Lectures (CD Component/Video Streaming)
- Laboratories (CD /WEB in High School Laboratory)
- Homework (Text Component)
- Homework Quizzes (Web Component)
- Tests (Given at High School Site via WEBCT)
- Facilitator Input into part of the course grade
- Instructor/Facilitator/Student Communication (via WEBCT)

The project continues to become more popular among teachers and students. Since Fall 2000, approximately 940 high school students have completed *WvEB Algebra* and 409 have completed *WvEB Trig*, a follow-up course. It is expected that an additional 450 students will participate in the combined project during the 2005-2006 academic year. Enrollment figures are shown in Table 1.

Table 1: Student Participation in WvEB Project.

WvEB Algebra Student Participation		WvEB Trigonometry Student Participation	
Fall 2000	29 students		
Spring 2001	50 students		
Fall 2001	20 students		
Spring 2002	107 students		
Fall 2002	105 students		
Spring 2003	67 students	Spring 2003	83 students
Fall 2003	218 students		
Spring 2004	100 students	Spring 2004	161 students
Fall 2004	181 students		
Spring 2005	94 students	Spring 2005	165 students

Background

WVU has created the Institute for Math Learning within the Department of Mathematics and strong efforts are being made to find ways to assist students in learning, understanding, and doing mathematics. Until recently, the success of students in courses such as college algebra and

trigonometry has been measured primarily by the drop/fail/withdrawal (D/F/W) rate. As shown in Tables 2 and 3, these courses have had a D/F/W rate of between 40% - 60%. The data for college algebra includes two versions of on-campus college algebra offered at WVU which are described later. Since the spring of 2003, the two versions of College Algebra have not used the same text nor have they shared any common tests. It should be noted that trends are showing improvement in the on-campus D/F/W rates.

Table 2: 3-day and 5-day College Algebra Comparison

		%A	%B	%C	%D	%F	%W	%DWF
Fall 2002	3 Day	4.9	21	27.4	13.7	13.7	18.4	45.8
	5 Day	7.6	15.5	22.2	18.8	21.3	13.4	53.6
Spring 2003	3 Day	12.1	22.1	29.5	11.7	11.7	12.8	36.2
	5 Day	13.1	18.9	25.7	11.2	14.1	17	42.2
Fall 2003	3 Day	8.9	24.2	27.5	13.9	11.3	14.2	39.4
	5 Day	9.3	20.1	22.4	13.3	17.2	17.6	48.1
Spring 2004	3 Day	7.9	23.4	23.7	16.5	13.3	15.1	45.0
	5 Day	21.5	23.6	24.6	11.0	9.9	9.4	31.9
Fall 2004	3 Day	10.9	22.7	21.5	14.2	13.1	17.6	44.9
	5 Day	9.6	20.5	21.1	15.2	15.4	18.2	48.9
Spring 2005	3 Day	8.2	20.1	28.6	11.6	13.5	17.9	43.1
	5 Day	12.7	25.4	23.4	5.6	18.3	14.7	38.6

Table 3: Trigonometry Grade Distribution Trends Fall 2000– Spring 2005

	%A	%B	%C	%D	%F	%W	% DWF
Fall 2000	11.8	16.8	20.4	13.9	18	19.2	51
Spring 2001	14.2	21.1	22.1	13.9	16.5	12.2	42.6
Fall 2001	7.7	24.1	24.1	9.9	11.6	22.4	44
Spring 2002	11.7	23.7	23.7	12.3	11.7	17	41
Fall 2002	9.9	29.1	26.5	10.6	6.6	16.9	34.1
Spring 2003	22.3	29.5	21.5	6.8	8.8	11.3	26.8
Fall 2003	8.4	28	28	9	7.6	19	35.6
Spring 2004	7.5	28.2	30.0	9.8	10.4	14.1	34.3
Fall 2004	5.6	26.5	27.7	10.3	11.8	18.2	40.3
Spring 2005	6.2	28.3	28.9	11.5	8.1	17.1	36

However, the D/F/W rates are nowhere near those experienced in the WvEB Project. In the Fall 2004, 181 students were enrolled in WvEB Algebra. Students earned the grades as shown in Table 4. There was a 1.7% D/F/W rate.

Table 4: Total Grade Distribution for WvEB Algebra Fall 2004

A	B	C	D	F	W
98	61	19	1	1	1

In the Spring 2005, 94 students were enrolled in WvEB Algebra. Students earned the grades as shown in Table 5. There was a 4.5 % D/F/W rate.

Table 5: Total Grade Distribution for WvEB Algebra Spring 2005

A	B	C	D	F	W
38	45	7	1	3	

In the Spring 2005, 165 students were enrolled in WvEB Trigonometry. Students earned the grades as shown in Table 6. There was a 6.3 % D/F/W rate.

Table 6: Grade Distribution for WvEB Trigonometry Spring 2005

A	B	C	D	F	W	I
96	45	16	2	2	2	2

Given the obvious differences in the D/F/W rates, a study was conducted in college algebra in the Fall 2004 in order to determine if there is a significant change in student achievement when comparing on and off campus students.

WVU offers three different versions of college algebra. Students enrolled in 5-day College Algebra attend classes 5 days a week. They are placed into the course by either having credit for an algebra workshop, a passing score on a departmental placement test or a math ACT score falling between a 20 - 22, inclusive. The class size is capped with approximately 40 students. No graphing technology is used and the lectures are fairly traditional. In comparison, the course structure for the 3-day college algebra is not considered traditional, and its curriculum design is the same as that of the WvEB Course where graphing utilities, computer laboratories, collaborative learning, and web quizzing and testing are used. The 3-day College Algebra students attend class 3 days a week. Students are placed into the course by either having credit for an algebra workshop, a passing departmental placement test score, or a math ACT score of at least a 23. Most of these students will not have a math ACT score of a 26 or more, which is the required score for Calculus. Each section is capped with approximately 200 students. The WvEB Algebra students are high school students, mostly seniors. Students are placed into the course by passing a departmental placement test. At the time of enrollment, most of the students do not have ACT results. They must also have an overall high school grade point average, GPA, of a 3.0 and must have a "C" or better in each of Algebra I, Algebra II and Geometry. Class sizes tend to be small with no more than 30 students in any given section.

The course structure for the 3-day college algebra and WvEB Algebra at WVU are the same and are coordinated by the same faculty member. For the purposes of this study, students enrolled in those two courses are compared. The course coordinator has maintained the rigor in the WvEB course. All tests and quizzes both on and off campus pull from a common question

bank and all tests are proctored. Tests and quizzes are multiple choice and are automatically graded within the web shell. The laboratory requirements are the same with a WVU graduate student grading the laboratory assignments. However, WvEB students are held to seemingly higher pre-requisites than on-campus students and have class sizes that are much smaller. During the 2004-2005 academic year, a matched pair study using a retired version of the math ACT test was performed to find if students in the high school sections have mathematics achievement change that is significantly different than the mathematics achievement change of those enrolled in the on campus sections when the same pre-requisites are required.

Method

Participants

During the Fall 2004 semester, 59 students enrolled in the WvEB College Algebra course from one local high school were matched with students enrolled in on-campus College Algebra. Students were matched according to gender using a series of papers drawn from a hat and coin tosses. The matching was done by a research graduate assistant not affiliated with the course. The on-campus students had all graduated from West Virginia high schools. They all successfully completed Algebra I, Algebra II, and Geometry in high school with a “C” or better and had at least a 3.0 high school grade point average. In addition, the on-campus students were first semester freshman who had just graduated from high school the spring prior to the study. The goal of the matched pairs was to get a homogenous sample of the on-campus students for comparison against the WvEB students.

ACT Test

The math section of a retired ACT form was administered at the beginning of the course and again at the end of the course to provide a standardized pre- and post-test measure of math performance. The 60 minute test contains 60 items. A special research version of the test was purchased from ACT to use in this study. This test was chosen for several reasons. Most students in West Virginia high schools take the ACT test if they are interested in pursuing higher education. Therefore, comparisons can be made to state performance results. There is currently an ACT Math Task force in West Virginia. Task force members are searching for ways to improve the college going rate and student performance on the ACT test. Therefore, the test design and the scores are readily recognized when groups of secondary and higher education teachers meet to discuss student performance. Finally, it is the intention that similar studies will be done in follow-up courses such as Trigonometry. Therefore, an instrument is required that can be used over time and can measure more than algebra skills. The same version of the test was used as a pre and post test. Approximately 3 months separated the time of the pre and post test.

Data Collection

All students enrolled in 3-day College Algebra and WvEB Algebra were given the Math ACT test twice. The scores from these tests were used to calculate bonus points for the course. Therefore, students were motivated to do well on each occurrence. The first occurrence of the test was given to all students after they had completed the review material. The review material is skimmed through quickly during the first week of classes on campus. Due to enrollment fluctuations at the beginning of the semester, the test can not be given any earlier on campus.

The post ACT math test was given to all students prior to the final, but after the 4th exam and last laboratory assignment.

Data Analysis

Using scaled scores, paired-samples t-tests were used to determine whether differences existed between the two groups on the ACT.

Results

Table 7 below provides the means, standard deviations, *t*-values, and significance levels for all analyses. The analysis for the pre-test yielded no significant results between the two groups, suggesting that the students were comparable prior to the course. Analysis of the post-test data, however, showed that there was a significant difference between the two groups, $t(49) = 2.302$, $p = .026$, with the on-campus students ($M = 22.66$, $SD = 2.94$) outperforming their WvEB counterparts ($M = 21.12$, $SD = 3.63$). This suggests that given comparable high school demographics and math courses, students enrolled in the on-campus course gain more on a standardized test of math performance than students enrolled in the web-enhanced course. It should be noted, however, that both groups recorded considerable gains in the scaled scores of the ACT, with the WvEB students improving nearly 1 scaled point, and the on-campus students improved nearly 2 scaled points.

Table 7. Scaled ACT analyses for matched-pairs of WvEB and on-campus students enrolled in College Algebra.

	Group	N	Mean	SD	t	Sig.
ACT Pretest	WvEB	59	20.19	4.99	0.808	.423
	Campus	59	20.78	2.96		
ACT Posttest	WvEB	50	21.12	3.63	2.302	.026*
	Campus	50	22.66	2.94		

Note: The asterisk (*) denotes statistical significance at the .05 level.

Discussion

Preliminary results show that when such things as high school GPA and grades in preceding courses are held constant, students enrolled in on-campus sections gain significantly more in achievement than students in the high school sections. In either case, students having a significant gain in scaled score on the ACT test is considered a success. In 2005, West Virginia's math ACT average of 19.3 as compared to the National average of 20.7 had West Virginia tied for having the 5th lowest average math ACT score in the nation (<http://www.act.org/news/data/05/states-text.html>). A phone call to an ACT representative confirmed that at the national level, scaled scored gains of 0.1 are considered significant. So any significant gain is celebrated by all who work with the courses. Also of interest is that both the campus pre score of 20.78 and post score of 22.66 are less than the score of 23 required by the department to be admitted into the course. Although on-campus students are also admitted into the course by either having credit for an algebra workshop or a passing departmental placement test score, it is conjectured that students are not putting in the effort that they would in a real ACT testing environment. All students are motivated to do well on the ACT tests since the scores from these

tests were used to calculate bonus points for the course, so it is assumed that both the on-campus and off-campus participants are equally motivated in the study.

It is conjectured that the D/F/W rate for on-campus students in this study will be higher than that of students enrolled in the WvEB Algebra course. Course components that contribute to the final grade of the student are: participation/attendance, quiz average, laboratory average, regular exams and final exams. Further study will be done comparing the D/F/W rates and student data.

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