

WvEB MATHEMATICS: WEB ENHANCED COLLEGE COURSES FOR HIGH SCHOOL SENIORS

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#### Abstract

West Virginia University offers two web enhanced college-level courses 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. High school mathematics teachers facilitate at each site and work with a university instructor of record to offer a sequence of algebra and trigonometry courses. The facilitator attends professional development sessions throughout the year. During the 2004-2005 academic year, a study using an alternate version of the math ACT test will be 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 gives an overview of the course structure, a brief description of the course components, and a description of the planned research design. Course components include *WEBCT* quizzes and tests, JAVA applets and CD lectures. This project is funded in part by the NSF, CCLI project number 0339117.

#### Introduction

In 1999, on behalf of the Chancellor of Higher Education in West Virginia, the chief academic officer of what is now the West Virginia Higher Education Policy Commission (HEPC) invited mathematicians and mathematics educators from its higher education institutions to participate in the design of a mathematics course that would be offered to high school students for early college credit. A primary goal of the HEPC as well as of the project was to increase the college going-rate in West Virginia ( HEPC, 2002). The HEPC also works in collaboration with the West Virginia Department of Education (WVDOE) in efforts to increase the ACT scores for West Virginia students ( West Virginia Department of Education, 2002). Mathematics was chosen as the content area of focus to help better prepare students in transition from high school to higher education. Steering Committee members undertook the project by choosing an

appropriate course as well the objectives and design for the project. The members of the *WvEB Algebra* Course Design Committee are state leaders in mathematics, mathematics education, and administrative governing bodies. The West Virginia Higher Education Policy Commission, the West Virginia Department of Education, and West Virginia University continue to support the project with total grant funds exceeding \$240,000 through the 2004-2005 academic year. A follow-up *WvEB Trig* course had its pilot semester in Spring 2003 and an NSF Curriculum grant has been awarded to make a year long seamless pathway for students enrolled in both courses. Since Fall 2000, approximately 700 students have completed *WvEB Algebra* and 244 have completed *WvEB Trig*. It is expected that an additional 250-300 students will participate in the project during the 2004-2005 academic year. The initial collaborative efforts, first year objectives, and preliminary outcomes of the project are found in more detail in *WVEB ALGEBRA: A WEB ENHANCED COLLEGE COURSE for High School* ( Pyzdrowski & Pyzdrowski, 2002) and more detailed results of preliminary studies can be found in *A WEBCT Enhanced Course For High School Students* ( 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)
- 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)\*

\*In the pilot year of the project, the web component of the course was not available to students. The lectures and interactive laboratories originally planned to be accessible to students via internet, were placed on a CD due to connection and video streaming problems. The on-line quizzes were not developed in time to use during the pilot year. Hence, the WEBCT components of the course were offered for the first time in Fall 2001.

*WvEB Math* is designed to meet the needs of high school students who have completed their secondary mathematics requirements but who wish to take further mathematics for college credit. It is designed for the “middle track” student, although those high school students in a higher mathematics track may also be interested in enrolling. It is not the intent for *WvEB* courses to replace any of the mathematics courses in the high school curriculum. Instead, it is developed as

a mathematics course that a student would take in lieu of a “mathematics void” in a given semester or year. The course is web enhanced and has a university professor instructor of record and a high school mathematics teacher facilitator.

### Findings from Previous Years

The following preliminary studies were conducted such that each course was offered over a typical university semester. All students enrolled in the *WvEB Algebra* course were required to have an overall high school grade point average, GPA, of 3.0 and a C or better in Algebra I, Algebra II and Geometry. Students who enrolled in the Trigonometry course must have passed the *WvEB Algebra* course. In addition, students enrolled passed, an institution mathematics placement test to determine course eligibility. All students used the same text book as the on-campus sections, had the same content outline and laboratory activities, and were provided a CD containing video lectures of course material. Since Fall 2001, multiple choice homework quizzes were given via the internet. Each high school was set up with a discussion group in WEBCT. Each student was asked to take a the *Accuplacer* test during the first week of the course; however, the test was not used to eliminate anyone from the course. The *Accuplacer* college level mathematics test was used. It is designed to provide placement, advisement, and guidance information for students entering two- or four-year institutions of higher education. Students were required to take a web version of a 20 item multiple choice test as both a pre test (common placement test) and post test ( common final evaluation) in the course. Students began the course by working through the material using the outline provided on the CD to guide their progress. Each student was guided through lessons that included a reading assignment, a video lecture, a homework assignment, and at times a computer laboratory or online quiz. Students could read, watch the lectures and do homework or homework quizzes at home or in school. However, the laboratory assignments were done in teams of two or three and in a facilitated school setting. Students were permitted to use notes and books when doing the homework quizzes. Every question on a quiz had multiple versions. Students were permitted to help each other with the individual quizzes; however, the facilitator could not help with quiz questions until the quiz was submitted. The high school facilitator helped with individual homework questions, supplemented the video lectures when necessary, and facilitated laboratory and quiz activities, thus taking on the role of a tutor which is a service offered by university learning centers. Four tests and a comprehensive final were developed by the professors of record. The tests for the Algebra Course were paper and pencil, with free response and open ended questions. The tests for the Trigonometry tests were given via WEBCT. After completing the university-of-record final for the course via WEBCT beginning Fall 2001, each student was asked to take a post *Accuplacer* test. This test did not influence the final grade of a student. All course grading was done by the instructor of record with some assistance from an on campus grader - with the exception of the pre *Accuplacer* placement test and the post *Accuplacer* common final. All tests at a site were given at a common time in a supervised setting.

#### Fall 2000 - The pilot course

The *WvEB Algebra* course was piloted in Fall 2000 with 29 students at three high schools in West Virginia. High school teacher facilitators were provided seven, one-day professional development workshops in content and pedagogy spread throughout the year. Only 21 of the

Table Course	t Test For Pre and Post Accuplacer Scores		Fall 2000	
	WVU <i>W<sub>v</sub>EB Algebra</i>	Total <i>W<sub>v</sub>EB Algebra</i>	WVU <i>W<sub>v</sub>EB Algebra</i>	WVU <i>W<sub>v</sub>EB Algebra</i>
Semester	Fall 2000	Fall 2000	Fall 2000	Fall 2000
Time of Test	M	S	t	
Average GPA	Pre 2.9	36.81	17.29	2
D/F/W rate	10%	49.04	28%	47%
	Post		22.29	

\*  $p < .005$

students completed the course and took both a pre and post *Accuplacer* test. In addition, high school facilitator and student course evaluation paragraphs were written and submitted to the project director. Students and facilitators were directed to document if they found the course to be beneficial and what changes could be made to make it better.

Grade	A	B	C	D	F	W
Number	6	11	4	0	1	7

A *t* test was computed to determine whether there was a significant difference between the pre *Accuplacer* placement test and the post *Accuplacer* common final of 21 pilot participants. The data concerning the results of the *t* test on Table 1 show that there is a mean difference of 12.23 between the pre and post test. The *t* was significant at the .003 Level of confidence. The grade distribution for the 29 students enrolled for the pilot semester of the *W<sub>v</sub>EB Algebra* course are found in Table 2. There were 6 A's, 11 B's, 4 C's, 1 F and 7 Withdraws. Table 3 shows that students in the *W<sub>v</sub>EB Algebra* course had a higher GPA average and a lower Drop, Fail Withdraw rate than the West Virginia University on campus sections.

There is a significant mean difference between the pre and post test *Accuplacer* scores. This is especially interesting since the posttest common final had no effect on a student's grade and there was no motivation for a student to do well on the test. Because the test was given twice in a four month period, an *Accuplacer* representative was contacted to find the normal gain for that time period. There are no studies documenting expected gains in a four month turn around time, so caution should be used when interpreting the results. Also, the pretest mean of 36.81 places the students on average in less than the 20<sup>th</sup> percentile for students taking this test. The posttest mean of 49.04 placed them in the next level according to *Accuplacer*, but on average this is still less than the 50<sup>th</sup> percentile. Of the 29 students enrolled in the course, 1 earned an F and 7 withdrew. It was found that 6 of those eight were enrolled in a Saturday section of the course. The high school facilitator felt that the students withdrew from the course because of the time of class. The student earning the F, also in the Saturday section, stopped attending and neglected to withdraw from the course. From a second school, a student withdrew after only a few weeks of class. The student was too busy and did not feel that the time commitment could be made. Only one of the students receiving a "W" withdrew due to poor performance. Due to these results, it is recommended that sites consider offering the course during a regular school class period. Although students in the *WvEB Algebra* course had a higher GPA average and a lower Drop, Fail Withdraw rate than the West Virginia University on campus sections, caution should be taken when making comparisons. Typically, the class size of college algebra at WVU is between 100-200 students. Difference in class size could be enough to make a difference in the GPA and D/F/W rates. What can be confirmed is that even though students in this course were in non-traditional college classrooms, they did not have a lesser GPA average or higher D/F/W rate than those students in the on campus course. The first semester pilot was considered to be a success.

#### 2001 -2002 Academic Year

Seventy-four high school students participated in the *WvEB Algebra* project offered through WVU. Once again, there was a significant mean difference between the pre and post test *Accuplacer* scores. The pretest mean of 47.06 and a post test mean of 56.43 places the students on average between the 20<sup>th</sup> to 50<sup>th</sup> percentile for students taking this test. A score of 63 is needed to place students in the next 50<sup>th</sup> to 80<sup>th</sup> percentile. As a group, the students gained in content knowledge but, they did not change in category according to *Accuplacer*. It was hoped that the implementation of a *WvEB Trig* course, to give year long sequence of courses, would influence an even greater gain in content knowledge. It is believed that because the post *Accuplacer* test in no way affected students grades, posttest scores did not give a true indication of their exit level of skill. Of the 74 students enrolled in the course, 42 earned A's, 26 earned B's, 4 earned C's, 1 earned a D and 1 withdrew. Students in the *WvEB Algebra* course had less than a 3% D/F/ Withdraw rate. The student who withdrew from the course was failing at the time. Although the "middle track" high school student is targeted for the course, many students who enroll have close to a 4.0 overall grade point average as well as much better than a "C" average in mathematics classes. The University requires an overall grade point average of 3.0 for early admittance students. So it is expected that this group of students will perform well. Seventy-two

students completed the final course evaluation. Fifty-five of the students indicated that the homework quizzes helped them learn the course content with 26 of the students indicating that it was the component that helped them the most.

2003-2004 Academic Year

Grade	A	B	C	D	F	W
Number	152	113	27	15	3	8

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Table 8 t Test For Accuplacer Scores For WvEB Math Fall 2003-Spring 2004

Grade	A	B	C	D	F	W	I
Number	99	48	8	1	2	2	1
Time of Test		M	SD				
Pre Alg		39.58	15.3				
Post Trig		59.55	25.9		-5.9 *		

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\*  $\alpha = .0001$

Table 6 t Test For Accuplacer Scores For WvEB Alg Fall 2003-Spring 2004

Time of Test	M	SD	t
Pre Algebra	43.24	17.7	-9.7 *
Post Algebra	54.9	21.6	

\* p< .0001

Table 7 t Test For Accuplacer Scores For WvEB Trig Fall 2003-Spring 2004

Time of Test	M	SD	t
Pre Trig	50	18.5	-3.30 *
Post Trig	59.55	25.9	

\* n= 0017

In the 2003-2004 academic year, 318 students enrolled in the *WvEB Algebra* course and 161 enrolled in *WvEB Trig*. There was an 8 percent D/F/W rate for *WvEB Algebra* and a 4 percent D/F/W rate for *WvEB Trig* as shown in tables 4 and 5. 265 students completed both the pre and post *Accuplacer* test for *WvEB Algebra*. Table 6 shows that there was a significant mean difference between the pre and post test *Accuplacer* scores. The pretest mean of 43.24 and a post test mean of 54.9 places the students on average between the 20<sup>th</sup> to 50<sup>th</sup> percentile for students taking this test. A score of 63 is needed to place students in the next 50<sup>th</sup> to 80<sup>th</sup> percentile. 53 students completed both the pre and post *Accuplacer* test for *WvEB Trig*. Table 7 shows that there was a significant mean difference between the pre and post test *Accuplacer* scores. The pretest mean of 50 and a post test mean of 59.55 places the students on average between the 20<sup>th</sup> to 50<sup>th</sup> percentile for students taking this test, but this score is closer to the 63 needed to place students in the next 50<sup>th</sup> to 80<sup>th</sup> percentile. It should be noted that the pre-algebra *Accuplacer* scores and post-trig *Accuplacer* scores can be seen in Table 8. This group started with a lower than whole group pretest mean of 39.58 and ended with a post test mean of 59.55. While this still places the students on average between the 20<sup>th</sup> to 50<sup>th</sup> percentile for students taking this test. A question posed is how the whole group would have performed since this subgroup had a lower pre-mean.

### Plans for Future Research

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. Improvements have been seen in the on-campus D/F/W rates for such courses as College Algebra and Trigonometry, but the D/F/W rates are nowhere near those experienced in the WvEB Project. The rigor of the WvEB courses has been maintained. So, two conjectures for the difference in the rates are that WvEB students are held to higher

pre-requisites than on-campus students, and that the much smaller class size affects student performance. In the 2004-2005 academic year, one WvEB high school will participate in a matched pair study investigating the question: Does the type of course delivery affect student achievement in College Algebra? Since one of the original goals of the WvEB project was to increase the ACT scores for West Virginia students, the instrument to be used to measure student achievement will be the ACT Mathematics Test.

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