

USING TECHNOLOGY TO HELP ADDRESS DIFFERENT LEARNING STYLES IN A COLLEGE ALGEBRA CLASSROOM

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Abstract

The Institute for Mathematics Learning (IML) at West Virginia University is working to help students succeed in before calculus level courses. College Algebra historically had D, F, Withdrawal (D/F/W) rates that fluctuated between 45% and 55%. With the implementation of such things as interactive laboratories, on-line tests, on-line homework quizzes, and curriculum reform, the D/F/W rate has dropped to between 35% and 45% within the past five years. Currently, it is an IML goal to stabilize D/F/W rates to 30% while maintaining the integrity and rigor of the course. It is evident that many students who should be able to succeed, do not. In order to address this issue, course coordinators are exploring the learning styles of students in large sectioned college algebra courses to determine how the course components address their needs as well as to find other components that can be developed and implemented which would help them.

Background

West Virginia University (WVU) established the Institute for Math Learning (IML) in the Department of Mathematics in January 2001 with the mission to develop, implement, and evaluate new and successful approaches to mathematics teaching and learning. In 2004, West Virginia tied for having the 5th lowest average math ACT score in the nation. (Average ACT Test Scores, 2004). Hence, faculty members in the IML currently work with students who trail in mathematics achievement at both the international and national levels. Until recently, the

success of students in courses such as college algebra has been measured primarily by the drop/fail/withdrawal (D/F/W) rate. As shown in Table 1, prior to the creation of the IML, college algebra historically had a D/F/W rate of between 45% - 55%. This data includes all versions of college algebra offered at WVU during those years.

Table 1
College Algebra Grade Distribution Trends Fall 1998 – Fall 2000

| Semester | %A | %B | %C | %D | %F | %W | %D/F/W |
|-------------|------|------|------|------|------|------|--------|
| Fall 1998 | 7.3 | 16.9 | 20.4 | 13.9 | 19.8 | 21.7 | 55.5 |
| Spring 1999 | 6.2 | 17.6 | 22 | 15.1 | 15.5 | 23.6 | 54.2 |
| Fall 1999 | 8.7 | 20.2 | 23.2 | 14.4 | 17.7 | 16 | 48 |
| Spring 2000 | 7 | 20.8 | 22.6 | 15 | 16.5 | 18.1 | 49.6 |
| Fall 2000 | 12.5 | 20.7 | 19 | 12.8 | 16.5 | 18.4 | 47.7 |

Table 2 shows that since spring 2001, there has been a steady decline in the D/F/W rate for a 3-day College Algebra course where significant course design changes are taking place. (Complete data not available for Spring and Fall 2001.)

Table 2
3-day College Algebra Grade Distributions Trends Spring 2001 - Spring 2005

| Semester | %A | %B | %C | %D | %F | %W | %D/F/W |
|-------------|------|------|------|------|------|------|--------|
| Spring 2001 | 8.1 | 14.1 | 16.2 | 18.9 | 18.9 | NA | NA |
| Fall 2001 | 8.9 | 23.3 | 17.7 | 10.5 | 18.4 | NA | NA |
| Spring 2002 | 8.4 | 18.9 | 18.9 | 15.2 | 12.8 | 25.0 | 53.0 |
| Fall 2002 | 4.9 | 21.0 | 27.4 | 13.7 | 13.7 | 18.4 | 45.8 |
| Spring 2003 | 12.1 | 22.1 | 29.5 | 11.7 | 11.7 | 12.8 | 36.2 |
| Fall 2003 | 8.9 | 24.2 | 27.5 | 13.9 | 11.3 | 14.2 | 39.4 |
| Spring 2004 | 7.9 | 23.4 | 23.7 | 16.5 | 13.3 | 15.1 | 45.0 |
| Fall 2004 | 10.9 | 22.7 | 21.5 | 14.2 | 13.1 | 17.6 | 44.9 |
| Spring 2005 | 8.2 | 20.1 | 28.6 | 11.6 | 13.5 | 17.9 | 43.1 |

The IML has set a goal for a D/F/W rate of 30%; but with such a goal, it is important to watch the success rates of students in courses that follow. Data from Spring 2004 and Fall 2005 indicates that students earning a C in 3-day College Algebra have a 44% -100% chance of earning a C or better in subsequent mathematics courses such as trigonometry and statistics

while students earning an A or B have a 92% -100% chance of success. Even with these signs of improvement faculty members continue to search for ways to help more students succeed.

Why Study Learning Styles?

In Fall 2004, Butler, Pyzdrowski, Walker, and Yoho (2006) studied Personal Response System (PRS) use in 3-day College Algebra. PRS is a combination of hardware and software that allows instructors to pose multiple choice questions to students. The students then use handheld wireless transmitters to answer the question. Software aggregates the answers and displays a chart of how many students selected each answer choice. In the study, a control section of the course was compared to two other sections. One section used PowerPoint slide shows to guide the lecture and also had PRS questions embedded into the slides. The third section used only the PowerPoint. The study analyzed data from an anonymous survey on PRS which was given to the section using PRS at the end of the semester. In general, the results showed that students enjoyed using PRS. Student comments from the surveys, however, indicated that some students thought that PRS questions were not worth the class time and there was also a discrepancy in the amount of time that students thought should be spent on PRS questions.

After analyzing student comments, the researchers began to wonder if different student learning styles could explain the range of student responses on the survey. Upon reflection, it was decided to begin a study on learning styles in 3-day College Algebra in the Fall 2005 semester. It was hoped that the research would reveal if particular learning styles were correlated with the students' grades on course components. In particular, the researchers are interested to learn if there are any learning styles which are not drawn into the course with any of the current components.

Learning Styles Inventory

The C.I.T.E.(Center for Innovative Teaching Experiences) Learning Styles Inventory by Babich, Burdine, Albright, and Randol was formulated at the Murdoch Teachers Center in Wichita, Kansas to help teachers determine the learning styles preferred by their students (West Virginia Department of Education, 2006). The inventory is comprised of 45 questions. Students read a statement such as "When I make things for my studies, I remember what I have learned better.", and on an scale from 1 to 4, determine if the statement is most like them or least like them. This inventory was chosen because it was readily available to the researchers through the West Virginia Department of Education and it was being used in various other projects throughout the State. Three primary attributes are evaluated through its use: Information Gathering, Work Conditions, and Expressiveness. Information Gathering sections include auditory language, visual language, auditory numerical, visual numerical, and auditory visual-kinesthetic combination. The Work Conditions questions are used to determine if a student works better alone or in a group. The Expressiveness questions help to determine if a student prefers oral or written communication.

Scores on the inventory identify a student as having a major, minor or negligible style, for each of the categories. A student identified with Visual-Language as major style learns well from seeing words and uses information better if it has been read. Visual-Numerical learners must

see numbers in order to work with them. Those with strong Auditory-Language styles learn from hearing words spoken. An Auditory-Numerical learner prefers to hear numbers and oral explanations. Auditory-Visual-Kinesthetic students learn best by experience and self-involvement. A student with major Social-Individual tendencies prefers to work alone while a student with major Social-Group tendencies prefers to study with at least one other student. A student with Expressive Oral preferences will choose to talk about what they know while a student with Expressiveness-Written preferences will choose to write.

A Study Involving Learning Styles

The course structure for the 3-day College Algebra in the IML is not considered traditional. Because 3-day College Algebra has 200-student sections, coordinators have been creative in finding ways to help students. For example, a set of computer laboratory assignments, on-line homework quizzes and exams, and PowerPoint slides have been included into the course design. The PRS was introduced in Fall 2004 and a lecture/study guide was made available in Fall 2005. A study involving the use of an on-line version of the C.I.T.E. Learning Style Inventory was conducted in Fall 2005. In addition, student surveys and a retired version of the Math ACT were used.

Students in 4 sections of 3-day College Algebra participated in the study. All four sections used the same syllabus, text book, and course policies. Section A had approximately 192 students and Instructor A used PRS extensively, some PowerPoint slides, and the lecture guide. Participation points in Section A were calculated from attendance. Section B had approximately 200 students and Instructor B did not use PRS or PowerPoint slides during lecture. Participation points in Section B were calculated from attendance, but students lost points if they left class early. Section C had approximately 174 students and Instructor C used PRS, PowerPoint slides, *Derive* software, and the lecture guide. Participation points in Section C were calculated from in-class activities and from attendance, but students lost points for leaving class early. Section D had approximately 56 students and Instructor D did not use PRS or PowerPoint slides. Participation points in Section D were calculated from attendance.

Preliminary Results

Analyses were performed on the scaled math ACT scores for the Fall 2005 semester. There was a significant main effect of math ACT, with students performing better on the posttest ($M = 22.47$, $SD = 3.38$) than on the pretest ($M = 20.53$, $SD = 3.08$). There was no significant difference between instructors on the ACT measure.

None of the learning styles were highly correlated with each other. This might be expected if the different styles are indeed independent of each other. Correlations of statistical significance were: visual numerical with the laboratory, on-line quizzes and participation; auditory linguistic with participation; auditory numerical with laboratory; kinesthetic with laboratory, on-line quizzes and participation; and individual with laboratory.

Overall, 201 students returned surveys that were not blank. Since not every section used every course component, students were asked to skip questions that did not pertain to course

components used in their section. The first survey question asked students to check all of the course components that helped them understand the course material. One hundred sixty-seven picked the on-line homework quizzes, 116 picked the laboratories, 96 students picked the homework assignments from the text, 60 picked the lecture guide, 53 picked PRS, 33 picked the PowerPoint slides, and 17 picked reading assignments. The second question asked students to pick the course component that helped them the most. Some students did pick more than one component, but 104 students picked the on-line homework quizzes, 34 picked homework from the text, 34 picked the lecture guide, and 30 picked the laboratories. The fourth survey question asked students to check all of the course components that they thought worked well with their learning style. One hundred fifty-two students picked the on-line homework quizzes, 88 picked laboratories, 84 picked homework from the text, 53 picked the lecture guide, 41 picked PRS, 34 picked PowerPoint slides, and 18 picked reading assignments.

Of primary interest are the survey results of Section A where the instructor had the most experience using PRS and used the lecture guide to lead the course. In the guide, there are definitions and examples. Students are supposed to fill in the blanks and work out examples either in class with the instructor, working in class on their own, or outside of class using their text. Space is also available for extra examples. It was hoped that the guide would help all students including those with learning disabilities to keep organized notes and identify key concepts in the course. In Section A, 42 students picked the lecture guide and 25 picked PRS as helpful course components (survey Question 1). In this section, 31 students picked the lecture guide as the most helpful course component (over 63% of students responding) and 2 picked PRS. Thirty-six and 22 students, respectively, said that the lecture guide and PRS worked well with their learning style. Only 3 students said that the lecture guide did not work well with their learning style, while 10 said this about PRS. Question 18 on the survey asked students if they would like to use PRS in future classes. In Section A, 36 said yes and 11 said no.

The authors are conducting further analyses of the data from this study and a thorough discussion will be included in a future publication.

References

- Average ACT Scores by State*. (2004). Retrieved March 7, 2006 from <http://www.act.org/news/data/04/data.html>
- Butler, M., Pyzdrowski, L., Walker, V. & Yoho, S. (2006). Studying personal response systems in a college algebra course. Manuscript submitted for publication.
- West Virginia Department of Education. C.I.T.E. Learning Styles Instrument from WVABE Instructor Handbook, Section 3, 2003-04. Retrieved March 7, 2006 from <http://wvabe.org/CITE/cite.pdf>