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Abstract: *Student preparedness in entry level college mathematics courses has decreased in the past. In order for students to be successful in these courses, early intervention is required. Texas A&M International University (TAMIU) has implemented an early intervention program, the Mathematics Enrichment Program (MEP), which will target freshman students entering College Algebra courses in Spring 2009. This project is part of the STEM Recruitment, Retention, and Graduation program, recently funded by the US Department of Education. This paper will highlight the components of the project, most importantly the extent of the intervention, how the project is planned, and preliminary results.*

Keywords: early intervention; collegiate mathematics education; retention; STEM RRG programs; Assessment and evaluation

Introduction

There has been a question for academics and institutions of higher education: why are students dropping out and performing poorly in entry-level college mathematics courses? From a recent poll, 76% responded saying it is because school is boring and 42% say it is because they are not learning enough (Education Trust West, 2004). In addition, it was also learned, as concluded by Hodges's study (Hodges, 1998) that a critical factor in the success of a student was an adequate and effective prerequisite for the class. Students who take

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rigorous mathematics courses are much more likely to attend college (U.S Department of Education, 1997). Accordingly, if the prerequisite necessary for college algebra does not prepare students to be successful in college algebra, then the system needs to be revisited, remedial actions be generated, and early intervention must be implemented.

Early intervention programs can provide college preparation for more minority students so institutions of higher educations can address the lack of representation of minorities in certain career fields, including mathematics and science. Most minority students (83.7%) are enrolled in lower-cost and public institutions (Wilds & Wilson, 1998).

This paper reports on a project that offers a pre-freshman camp for incoming Hispanic and other low-income minority students to help them make connections between mathematics and science, to encourage success in freshman courses, to develop more sophisticated understanding of their own study skills and strengths, and to create and develop a learning communities of peers.

This workshop has been designed to expose students to adequate mathematics foundations and emphasizes basic skills, critical thinking and problem solving capabilities required to be successful in college courses. Sessions are conducted by experienced TAMIU mathematics faculty. Each workshop participant is promised a weekly stipend of up to $300.00, at the completion of the sessions. The goal is that after these sessions, participants will be able to succeed in freshman-level mathematics courses at TAMIU or elsewhere. Participants also gained experience by working in groups.

Program Synopsis and Format

Six hours of activities were planned for each day of the week from January 5 to 9, 2009, before the beginning of the Spring semester at TAMIU. This exposes students for up to 30 hours of mathematics instruction and activities, equivalent to a three semester credit course at the college level. There were two sessions in the morning, each 1 hour and 25 minutes long separated by a 10 minutes break. Students were dismissed for an hour lunch, and would come back to work for three hours in ALEKS. ALEKS is a web-based system that

diagnosis the knowledge of a student. ALEKS does this by asking questions of various difficulty levels, under the assumption that if a student can answer correctly a question of a certain difficulty, then the student can answer correctly an easier question in the same subject. Through questions of different levels of difficulty ALEKS can accurately diagnose the level of understanding and knowledge of a student in a specific subject. Once the current level of knowledge and understanding have been determined, ALEKS determines what the student is ready to learn, and offers a "learning path", through topics that a student is ready to learn, based on earlier assessments. In order to work in ALEKS students needed Internet access, and so all sessions were held in the University's Technology & Enrichment in Mathematics (TEMA) Computer Lab equipped with 28 personal computers with Internet access. It is widely known the technology makes a difference in college mathematics teaching (Adams, 1997) and that the introduction of software tools and other hybrid structures have resulted in some partial success (Kinney, 2001).

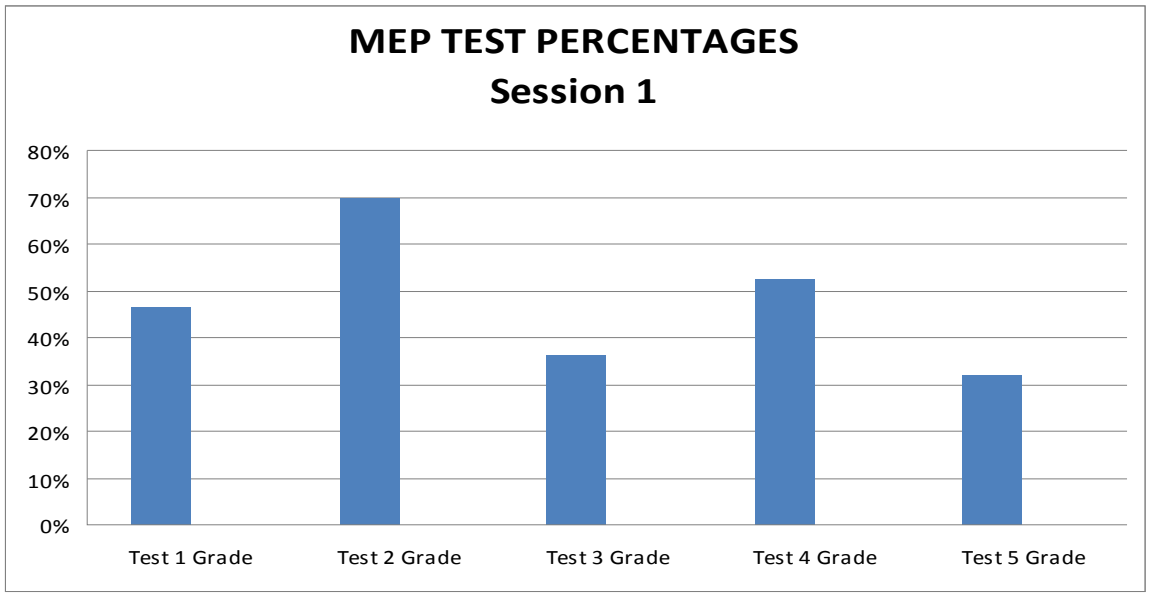


Figure 1: *Average scores by tests*

The first morning session was conducted in a mixed setting. This included an instructional session followed by a list of problems to be completed by the participants. This list of problems determined the type of lessons for the next day, and was determined also by the performance of students in ALEKS in previous sessions. It is anticipated that the students' use of software will contribute to a higher performance in the sessions. Figure 1 shows that

students are progressing well in some selected areas, as also still need to learn from the assigned topics as the workshop progresses. A list of problems based on a review chapter of a standard college algebra textbook similar, to the review chapter of the College Algebra book by Barnett, Ziegler, and Byleen, 2008, was divided equally for five days. Students attempted to solve these problems at the end of the first morning session. Figure 1 reflects the average scores received by the participants in each assignment given in the five morning sessions of the workshop. It is evident that there is a lot to learn after each day of activity.

The second morning session was in a lecture format. Participants were involved in the topics throughout discussion and analysis. Students were encouraged to think about basic concepts and procedures that they took for granted from their earlier education, discuss why a method would work, or how could geometrical objects be modeled by mathematical equations. Before the workshop, students had studied mathematics mostly from an algorithmic point of view. In this setting, students discussed why these algorithms worked. This would prepare them to solve more complex equations in their future courses in mathematics.

During the afternoon session, students worked in ALEKS. On the first meeting, students were explained what ALEKS was, registered into ALEKS and completed an initial assessment. In subsequent sessions, students worked in ALEKS in learning mode. A group of two participants was assigned to a single ALEKS license. Their task was to complete the ALEKS pie consisting of 197 items.

Students were told to work through ALEKS in groups, in the way that best suited their styles. Even though most people would feel that a license for ALEKS should be personal (and not a group activity), we believe through this experience that there is good value in working ALEKS in groups. On the one hand, students were working cooperatively and so the strengths of one member were passed to the weaker student. On the other hand, it gave students a reason to come back to ALEKS when one of the members needed a break from the strenuous amount of work that ALEKS demands from each student. Group load was shared equally among group members, and we feel that this system served them well.

Workshop facilitators and two students supervised their activities and provided help as needed. The two group members worked on a problem completely and collectively before one of them entered the answer into ALEKS. If students had a problem they could not solve, they could either raise their hands to have a tutor explain the problem to them or they could click on the "Explain" button, which would provide a complete explanation of the problem the student was presented to solve. After having read an explanation in ALEKS, a student would press the "Practice" button to solve a problem of similar difficulty to the one the student had missed.

Once a group of students had spent some considerable time in learning mode, ALEKS would switch to assessment mode and check that the student had retained what he they had been practicing mode. Students worked together during learning mode and assessments. What ALEKS believes that a student has mastered is shown in a way of a bar, and students, as well as instructors, can check the growth of that bar. It is refreshing for both the student and the faculty member in charge of preparing the student to see the bar grow and provides an extra incentive to continue. In the experience that we got in this workshop, the average group bar grew by at least 25%. This is a very impressive accomplishment of the students in the workshop. We expect that the students that participated in this workshop will use ALEKS more effectively in College Algebra than those who did not participate in the workshop and that this will be shown in their final grades at the end of the Spring 2009 semester.

An interesting characteristic of the group was that most of them had the same strengths and weaknesses. While students showed that they understood basic properties of the real numbers, they also showed that they had problems with expression containing radicals or with rational expressions as revealed on the first day of sessions. Students were encouraged to work in the topics that they were the weakest in, given that they had available at that time all the help that they needed in order to overcome their problems.

Finally, at the end of last day, all participants shared the lessons learned and appreciation for the workshop activities and organizers before they received a certificate of completion reflecting the number of hours they had spent in the workshop.

Curriculum

The curriculum is mainly confined to pre-algebra lessons for college students. The number of ALEKS Preparation for College Algebra licenses was adequate to provide this background. The ALEKS software was the main focus for applications, tutorials, and problem solving. Tables 1, 2, and 3 provide the list of items covered in these sessions based on the review chapter of the College Algebra book by Barnett, Ziegler, and Byleen (2008).

Table 1: *Topics for Algebra I: Lesson/Activity (9:00 am – 10:25 am)*

Basic Algebraic Operations

Day 1: Algebra and Real Numbers

Day 2: Exponents and Radicals

Day 3: Polynomials: Basic Operations

Day 4: Polynomials: Factoring

Day 5: Rational Expressions: Basic Operations

Table 2: *Topics for Algebra II: Lesson/Activity (10:35 am – 12:00 noon)*

Equations, Inequalities and Graphs

Day 1: Linear Equations and Applications

Day 2: Linear Inequalities

Day 3: Quadratic Equations and Applications

Day 4: Cartesian Systems and Equation of a Line

Day 5: Distance, Mid Point and the Equation of a Circumference

Table 3: *Topics for ALEKS Mathematics Tutorials (1:00 pm – 4:00 pm)*

Learning with ALEKS

Day 1: Registration, Introduction, Initial Assessment and Learning Mode

Day 2-4: Learning Mode and Assessment

Day 5: Final Assessment

Methodology and Evaluation of the Workshop

Recruitment of participants was done by using e-mail contacts. E-mail addresses of all registered college algebra students enrolled for Spring 2009 as of December 15, 2009 were obtained from the Office of the University Registrar. Students were sent an e-mail inviting them to participate and apply. A reminder was sent a week later. Participants need to submit an essay describing their career plans and goals for future in order for them to be accepted for the workshop.

Among a series of week-long workshops to be held in the next two years, this first cohort of the participants consisted of 23 students who planned to take College Algebra in the Spring 2009 semester. Of which, there were 13 female participants and 96% are Hispanics. The rest is represented by other minority students. Almost of all of them attended workshop regularly. Holidays hampered some of the recruitment efforts that had been previously planned, but since we had originally planned to conduct this workshop for 20 students, the total of 23 students that attended this workshop exceeded our expectations.

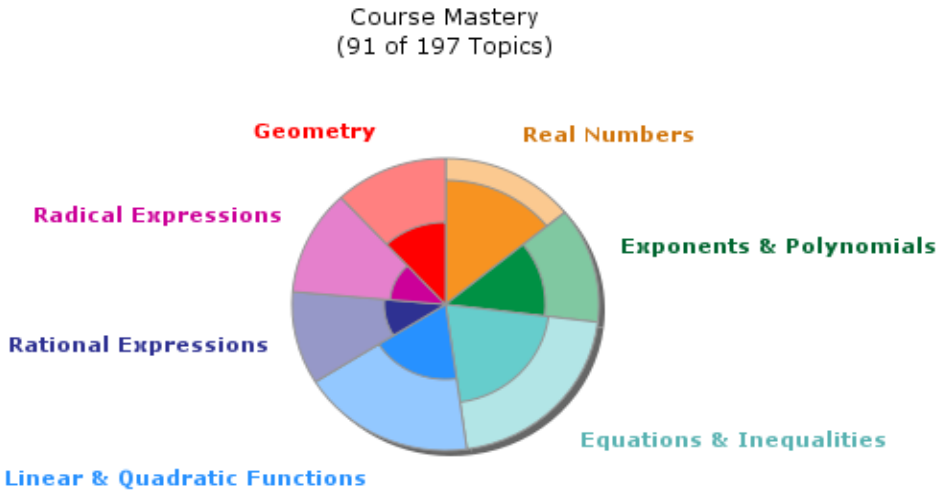


Figure 2: *Average composition of a pie after the initial assessment*

Figure 2 outlines the typical composition based on participants' knowledge as they enter the workshop. Their course mastery is 91 items from a total of 197 topics (46%) as depicted in Figure 2.

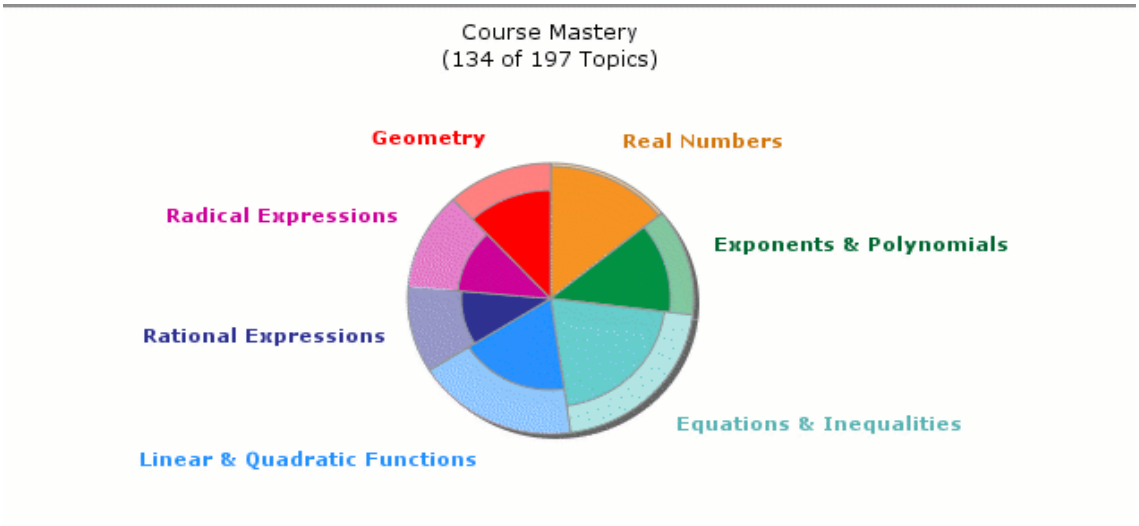
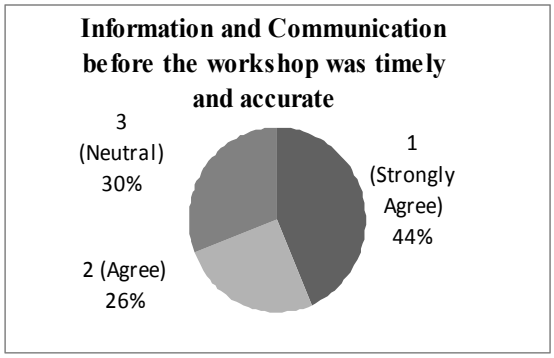


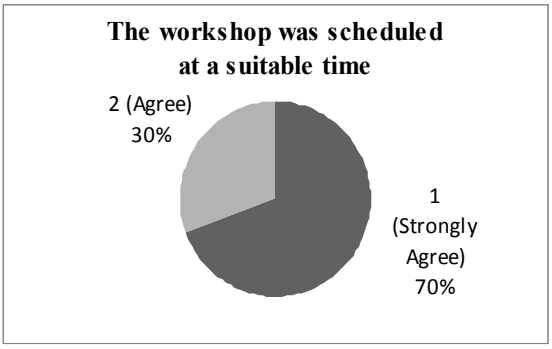
Figure 3: *ALEKS pie average items completed by the end of the last day*

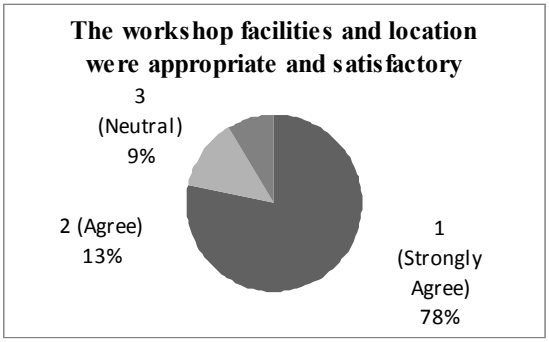
Figure 3 shows a dramatic improvement in their knowledge base including to some extent recovery of their knowledge from their early years after successful completion of the workshop sessions. It was evident that 68% from the 197 topics assigned to participants throughout the workshop for ALEKS tutorial effectively provided this knowledge transfer.

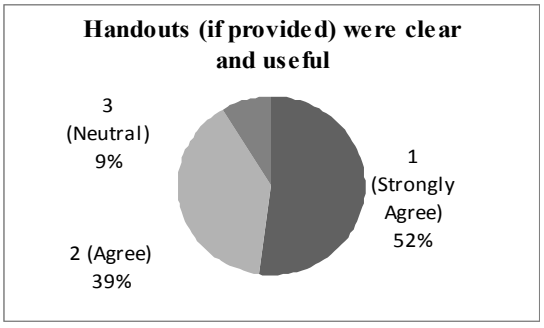
Lessons Learned

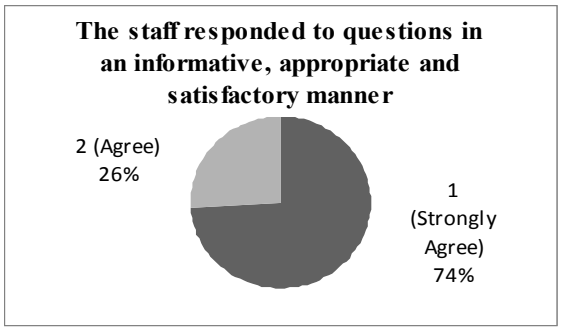
In order to determine the success of this workshop undertaking and the extent of the adjustments to be made for future workshops, a feedback form was distributed among the 23 participants to solicit their input and comments. The feedback forms were evaluated using the scale: 1 - strongly agree, 2 - agree, 3 - neutral, 4 - disagree, 5 - strongly disagree. A summary of the findings is summarized in Figure 4. One item requires a response of the types, yes or no.

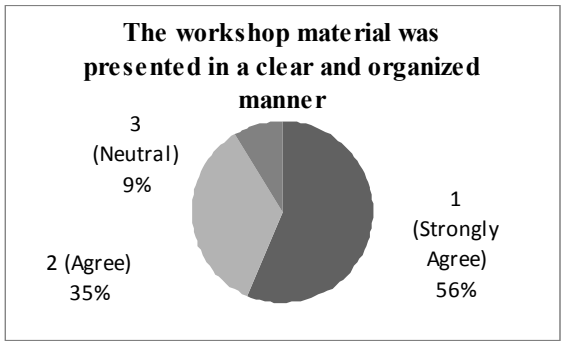

Information and Communication before the workshop was timely and accurate
3 (Neutral) 30%
1 (Strongly Agree) 44%
2 (Agree) 26%


The workshop was scheduled at a suitable time
2 (Agree) 30%
1 (Strongly Agree) 70%


The workshop facilities and location were appropriate and satisfactory
3 (Neutral) 9%
2 (Agree) 13%
1 (Strongly Agree) 78%


Handouts (if provided) were clear and useful
3 (Neutral) 9%
1 (Strongly Agree) 52%
2 (Agree) 39%


The staff responded to questions in an informative, appropriate and satisfactory manner
2 (Agree) 26%
1 (Strongly Agree) 74%


The workshop material was presented in a clear and organized manner
3 (Neutral) 9%
1 (Strongly Agree) 56%
2 (Agree) 35%

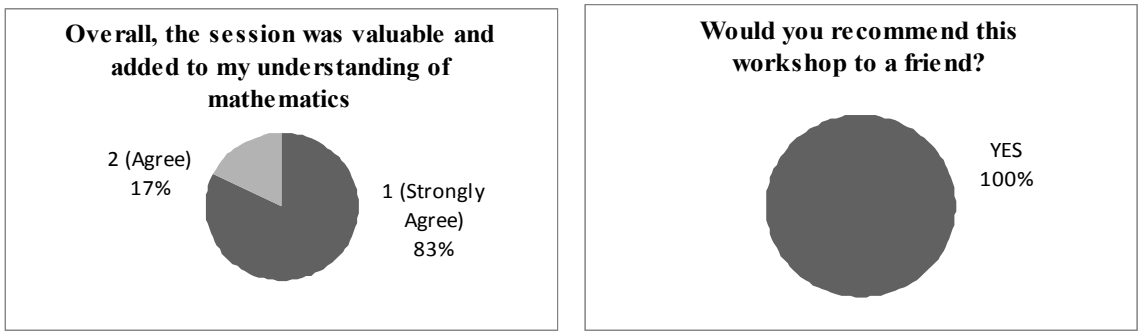


Figure 4: *A summary of feedback received from the workshop participants*

The workshop participants were highly appreciative about the way the workshop was conducted as is evident from Figure 4.

Conclusions

The organizers were quite impressed by the quality of the students that they had in this workshop. Students took a very long time to do the Initial Assessment in ALEKS (that is, they really did it consciously!), they participated enthusiastically in all sessions, and were eager to learn and see new points of view on matters they already knew. The organizers were very glad to have worked with them in this workshop. The initial assessment showed that they were very weak in handling expressions that involve radicals or exponents, or rational expressions, so they had to spend some time working with them in this type of problems. Students also worked in ALEKS on these topics, and they showed a clear improvement at the end of the workshop. Even though the final result was not that students completed the pie (a pie chart consists of various lesson plans), nor that they mastered the areas in which they were the weakest at (due to lack of time), it is felt by both the organizers and participants that the result was extremely positive, because it provided a venue for them to learn about their weaknesses, as well as it provided a way for them to overcome them. Students made substantial improvement in their weaknesses and we are confident that they will continue to do so. Overall, we are very satisfied with the workshop and the performance of the participants. The organizers also concluded that the number of participants in the workshop and the duration of the workshop are appropriate.

Among the comments made by students was the fact that the workshop allowed them to realize their weaknesses, and through ALEKS made a conscious effort to overcome them. Students acknowledged the value of the new points of view that had been presented during both morning sessions, as it helped them understand better material they already thought to have mastered.

Future Work

The authors plan to conduct the same set of analyses for the second workshop to be held in early August 2009. Plans are underway to recruit participants for the next workshop. The participants of this workshop are currently enrolled in Math 1314, College Algebra at Texas A&M International University. Their final semester grades will be compared with rest of the students in the class to see as to what extent they have been benefited from these types of intervention. Also, their standardized exam results will be collected to make a final determination of the effect of this workshop on them.

Acknowledgements

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