A study of students’ perceptions concerning two mathematical software systems used at Kirkwood Community College, Iowa City Campus. Should one of these systems be utilized in teaching remedial mathematics?

Hawkes Learning Systems (HLS) and MyMathLab (MML) are currently being used at the Iowa City campus of KCC. The two software programs are quite similar. However, HLS requires “mastery” of an assignment whereas MML does not. The purpose of this study was to gather information from students on their perceptions of the two different learning systems, which features they liked/disliked and whether they perceived the software as enhancing their learning experience.

**Important remedial teaching/learning issues in the U.S.**

Much of the education at U.S. two-year colleges is remedial. For the 2010 – 2011 academic year at Kirkwood, approximately 7000 student were enrolled in at least one of eight remedial courses compared to approximately 3500 students in at least one of sixteen college level math courses. Of those 3500 students in college level mathematics, approximately 1000 were enrolled into one of two terminal liberal arts math courses (Statistical Ideas or Math and Society). It should be noted that the prerequisite course for Statistical Ideas and Math and Society is Survey of Mathematics, not Intermediate Algebra. Thus the majority of math students at Kirkwood are either remedial or not pursuing mathematics coursework beyond what is required for a degree.

Remediation of community college students is considered one of the primary factors in poor graduation rates across the U.S. And the number of students in lower remedial mathematics courses is rising. Students who need remediation are more likely to drop out and those who don’t drop out often flunk out. At Kirkwood, 697, 1588 and 1577 students were enrolled in Pre-Algebra, Beginning Algebra and Intermediate Algebra respectively for the 2007 – 2008 academic year compared to 1055, 2558 and 1874 students for the 2010 – 2011 academic year. Passing rates for Elementary Algebra and Intermediate Algebra were 50% and 59% respectively at Kirkwood for the 2009- 2010 academic year.

Remedial math acts as a gatekeeper for many community college students to earning a degree. There are a number of explanations as to why this is so. Students who need limited remediation may be placed into a course where they may already know half of the material. These students become bored, stop attending class then finally show up when it’s too late. For other students the pace of the course may be too quick and they become discouraged and drop out. If a student didn’t understand algebra in high school why will they understand it in college when the material is presented at a faster pace? Students in larger lecture sections may not
receive individualized instruction tailored to their needs. Thus the question is how to help the masses efficiently and effectively using a learner-centered approach.

**Remedial mathematics teaching/learning issues at Kirkwood**

Kirkwood has decided to adopt the Emporium model in teaching developmental mathematics. Professors no longer lecture to a class. Instead, students work using the instructional software progressing at their own pace to “master” the material. Instructors act as “guides on the side” perhaps providing mini lectures to students struggling with a certain concept or providing one-on-one attention to a student in a lab setting. The advantages of using software to teach remedial mathematics include providing tailored instruction and immediate, specific feedback to a student as s/he learns the material, having professors available to provide coaching during class time to assist struggling students, and the ability of students to begin at an appropriate point in a course by having the option to test out of material they already know. There is also the time factor: some students may be able to complete their math remediation in a few of weeks instead of a semester.

The question is, what software should Kirkwood utilize in teaching remedial mathematics? The purpose of this study was to help answer that question by gathering information from students on their perceptions of the two different learning systems currently being used at the IC campus, which features they liked/disliked and whether they perceived the software as enhancing their learning experience.

**Helpful teaching/learning strategies**

Two learning systems are currently being used at the Iowa City Campus, Hawkes Learning Systems (HLS) and MyMathLab (MML). The two software programs have many similarities. The biggest difference is that HLS requires “mastery” of an assignment and MML does not (HLS also does not allow students to access problems out of a preset order). To achieve “mastery” in HLS a student must complete a homework assignment within the constraints set by the instructor. The instructor sets the percentage correct that must be achieved by the learner and the number of strikes that are allowed per assignment. S/he also selects the type of problems to be included on each assignment. If a student exceeds the set number of strikes s/he is kicked out of the assignment and must restart the assignment over from the beginning. (An algorithm is used to generate problems so the student receives the same questions again with the numbers changed. The order may be changed so the student receives a problem they did not encounter previously.) Students who achieve the assigned percentage necessary for mastery need not complete the rest of the homework assignment.
MML does not kick students out of assignments and allows students to reattempt the specific problems that they missed (if allowed by the instructor). Students may complete the problems in any order. Students earn the score achieved on each homework assignment and must not gain “mastery” in order to pass/receive credit on an assignment. So a student may earn a 60% or a 95% on an assignment using MML whereas in Hawkes it is all or nothing.

**Learning theories that support or inform these teaching/learning strategies**

With Mastery Learning subject matter is divided into units that have predetermined learning objectives. Students work through the units in an organized fashion and must demonstrate mastery of the material on a unit exam before moving on to new unit. Students who do not achieve mastery receive remediation. Students then continue this cycle of studying and testing until mastery is achieved. Thus all students are, in theory, able to learn and grow at their own rate and no one is left behind. Initially students may need more time to master material but amount of time should decrease as material becomes more challenging due to the students’ strong foundation in the fundamentals.

At the Iowa City campus using HLS, material is organized into sequential homework assignments requiring students to obtain a predetermined level of mastery before they can receive credit for having completed that assignment. If a student does not achieve mastery on an assignment then s/he may remediate (receive further instruction) and try again. There is no limit to the number of times a student may attempt a homework assignment. If a student does not achieve mastery on an assignment then s/he may remediate (receive further instruction) and try again. There is no limit to the number of times a student may attempt a homework assignment. But there are usually dates by which that assignment must be completed for credit. Students are given one attempt on tests and then move on to new material regardless of their test score. The thought is that students who certify in the homework should perform well on tests since they have supposedly mastered the material. And test questions are very similar to the homework problems for instructors who use HLS to create their tests.

MyMathLab utilizes constructivism theory. Students learn by solving problems. Supplementary instruction and hints are offered when a student is “stuck” during problem solving however it is up to the student to go through the instruction or to ponder the hint and figure things out for himself/herself. Instructors may facilitate students’ resolutions but do not tell them what to do when conflicted. Learning is the responsibility of the student.

MyMathLab does not require students to repeat an entire assignment if they miss a certain number of problems. Instead, a student can focus in on the problems that s/he missed and correct them. MML generates a personalized study plan for a student based on his/her performance on preset pre-chapter tests (taken before students even start the homework.
assignments for a chapter) and post-chapter tests (to be taken after students complete the homework assignments for the that chapter and before they take the instructor’s chapter or unit test). MyMathLab identifies areas where a student lacks knowledge and creates a study plan that links directly to interactive, tutorial exercises for topics the student hasn't yet mastered. The students can regenerate exercises with new values for unlimited practice, and these exercises include guided solutions and multimedia learning aids to provide extra help. Thua the student ends up spending more time on the areas where s/he needs practice instead of spending equal time on all areas. The learning is more focused, And, unlike Hawkes, MyMathLab includes a full eBook with a variety of multimedia resources available directly from selected examples and exercises on the page. Students can link out to learning aids such as video clips and animations to improve their understanding of key concepts.

Questions and/or hypothesis that might be further investigated in a classroom research project

The software to be adopted should work as a guide and not a gatekeeper to student success. Thus some of the questions to be addressed are: (1) Is there a difference in the ease of use and perceived effectiveness by students in these two systems? (2) Do students prefer the mastery system? Or do students feel as though any effort should earn partial credit? (3) Is there a perceived difference in how prepared students believe they are for their next math course (if any)?

To follow up on question (2), there is no doubt that most math students improve their skills with practice. But with Mastery Learning, will students with repeated failures give up on trying to learn the material? Will they come to believe they cannot learn mathematics? Or will they persevere until they learn the material and as a result come to believe that they can learn mathematics? Do they resent that they must, in the Hawkes system, repeat the material they know as well as the material that they have not mastered if repeating a homework assignment after being “kicked out”?

Data collection and summary

A survey was created and piloted to students in sections of intermediate algebra and college algebra with limits in the Fall, 2010. The survey was refined and the final version given to all instructors of intermediate algebra and to the instructor of the two sections of College Algebra with Limits that used MML. Data was collected from 41 intermediate algebra students and 33 College Algebra with Limits students. Nineteen of the 33 College Algebra with Limits students had also used HLS for Intermediate Algebra and answered survey questions pertaining to HLS and MML.
Survey Questions:

1. Do you use the instruct option in Hawkes before attempting a homework assignment?
2. Do you use the practice option in Hawkes before attempting a homework assignment?
3. Do you find the Hawkes System easy to use?
4. Did you find the software instruction (tutorials, video, etc) helpful when you used it?
5. Do you feel the homework provided the right amount of practice?
6. Do you feel that the Hawkes system helped develop mastery of the material?
7. Do you feel frustrated having to restart a homework assignment after "striking out"?
8. Did you fail to complete one or more homework assignments after "striking out" multiple times?
9. Do you think you should get partial credit for attempting an assignment even if you don't certify?
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**Conclusions**

Student perceptions of the two systems were quite similar. Students found both systems easy to use. Students felt for both systems the homework provided the right amount of practice about half of the time and that the learning systems helped develop mastery about half of the time. For both systems the students felt not fully prepared for the next math class and were less likely to take another math class if a learning system would be used for homework completion. However for both systems students felt for the most part completing homework enhanced their learning experience.
With HLS students felt frustrated having to restart an assignment after striking out about half of the time. And on occasion students reported failing to complete a homework assignment after striking out multiple times. Thus it was not surprising to find that students felt strongly that they should receive partial credit for a homework assignment even if they did not certify on that assignment. Given that Hawkes is a Mastery-based learning system it was surprising, however, that students’ did not perceive themselves as having mastered the material or as being prepared for the next math class.

With MML students tended not to use with any regularity the publisher touted “bells and whistles” of Help Me Solve This, View an Example, and Ask the Instructor. And some students reported relying too much on Help Me Solve This and View an Example to solve homework problems on occasion. Students felt that MML helped develop mastery of the material since students were not required to achieve a certain level of mastery on an assignment to receive credit nor did students have to repeat an entire assignment but only the questions they missed (if they even chose to do so).

When the results of students who had used both systems were analyzed it was found that the College Algebra with Limits students rated Hawkes higher for (1) homework providing right amount of practice, (2) developing mastery, and (3) feeling prepared for the next math course than the Intermediate Algebra students who had only used Hawkes (and not yet taken a college-level math class). When the results were examined by gender, College Algebra with Limits females who had used Hawkes previously used the Instruct option more and the Practice option less than their male counterparts. Females found the Hawkes system easier to use but felt that the homework provided the right amount of practice about half of the time as compared to males who found Hawkes easy to use about half of the time and who thought the homework usually provided the right amount of practice.

When the perceptions of Hawkes were compared between students in Intermediate Algebra and students in College Algebra with Limits who had used Hawkes previously, Intermediate Algebra students felt on occasion frustrated by striking out whereas College Algebra with Limits students felt frustrated about half the time. The Intermediate students felt less prepared for their next math class. Perhaps the College Algebra with Limits students realized they were prepared by Hawkes after taking completing the college level class, or maybe Intermediate Algebra weeds out the weaker students from taking College Algebra with Limits thus elevating the ratings in College Algebra with Limits.

Students were also given the option of writing in comments of what they liked and disliked about each system. The most common comments in Hawkes dealt with the frustration of
striking out and having to repeat an entire assignment. Students commented on the “pickiness” and unforgiving nature of the software. With MML students commented on how they could receive partial credit, couldn’t “strike out” and that they need only repeat the problems they missed.

Both systems have their advantages and disadvantages. Before a decision is made students using HLS should be tested outside of the software to determine if indeed the students are mastering the concepts and are able to generalize their knowledge. With HLS, the students often see the same problems on tests that they encountered in homework with the numbers changed. Multi-step homework problems tend to be broken down into individual steps for students. To show that the students understand the concepts and are not just learning to recognize a specific context and the algorithm to be used Intermediate Algebra students should be tested using questions other than those provided by the software. Also, MLS should be tested at the developmental level to see if students who have not used a learning system previously still feel it is easy to use and beneficial.

http://www.pressofatlanticcity.com/education/press/article_b443e028-609a-11df-a2ef-001cc4c002e0.html
http://teach.valdosta.edu/whuitt/files/mastlear.html
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