THE IMPACT OF COMPUTER-GENERATED INTERACTIVE MATHEMATICS PROGRAM ON STUDENT’S PERFORMANCE

Sofiane Grira
College of Arts and Sciences, Abu Dhabi University, Al Ain, United Arab Emirates

ABSTRACT

This paper describes the impact of using MyMathLab (MML) in math courses for engineering students. In this paper, we focused on the effect of proper use of one of the component of MML the Study Plan on student’s performance. We investigated the results of students in a calculus course after using MML and how it affects their grades. Finally, we concluded by student’s perception of using MML.

Keywords: MyMathLab, online assessment, learning management system. AMS Mathematics Subject Classification (2010): 97U50, 97U70


1. INTRODUCTION

For the last thirty years there has been considerable debate over teaching methods and approaches that might stimulate student-centered learning in undergraduate math courses. Many universities are still using no technology to deliver math courses. It may be due to a broad range of factors related to faculty preparation and training, the impact of technology in student learning and performance. One of the major challenge while teaching engineering students math courses was how can you make them motivated? Usually students do not feel comfortable asking questions in class, do not come often to office hours and go rarely to the learning support center to seek help especially the weak students. After years of teaching math, it was obvious to me that teaching math like the way we were taught when we were students will not help us to achieve our goals in this oriented technology life. Students use technology and digital tools in every part of their lives and very few for learning. They have never really been pushed or asked to use that same technology inside the classroom. As technology inseparably infiltrates into our day by day lives, it involves diverse openings and challenges for teaching and figuring out how to address students’ needs. In a traditional delivery classroom, an instructor gives lecture, uses blackboard and chalk and students listen and take notes. He monitors the activities of each student, identify their problems and gets solution to it. As for exams, it has always been conducted with the use of paper and pencil.
With the evolution of technology where everyone has technology devices as computers, tablets or smartphone, integrating technology was understandable and expectable. In nowadays, the use of technology is in every aspect of our life, we all de-pend on technology and we use various technologies to accomplish specific tasks in our lives. Unfortunately, instructional technologies have not been utilized to their full potential. The aim of this paper is to study the effect of introducing MyMathLab in math courses over student’s performance. It investigates the effectiveness of computer-assisted learning. A comparison between student’s performance in a paper and pencil exams with an online exams using MyMathLab will be given.

2. LITERATURE REVIEW
A number of studies have suggested that the computer provides an effective vehicle for improving student achievement [1], [3], [6]. Additional meta-analyses conducted during the 1990s found positive influences for some aspects of Computer Assisted Instruction (CAI), such as drill and practice of mathematical processes [7]. While some studies during the past 20 years have suggested positive results from CAI, other studies have raised questions about its efficacy. Rosenberg [15] issued a negative review of the influence of computers on instruction and achievement. He stated that the computer failed to deliver on the promises of increased efficiency and effectiveness.

Baker, Gersten, and Lee [2] conducted a synthesis of studies on the influence of CAI on mathematics achievement of low-achieving students. They found the low-achievers did not perform significantly better. Although some controversy exists about the effective use of CAI, particularly with respect to the drill and practice forms associated with simple knowledge development, the studies reviewed confirm a fairly positive effect for active learning. Technology integration in the classroom has steadily increased as more technologies have become available. Incorporating technological resources in instruction leads to higher levels of student engagement [12], student achievement [9], and student performance [16]. Loving [11] noticed that the modern cohort of students, who has been raised on the web and technology, are familiarized to the adapted and active way of learning. Capper and Copple [6] found that students who used CAI learned 40% faster than those students in traditional lectures. As indicated by Cotton [8], computer assisted instruction is more effective when used with traditional lecture. It gives the students the chance to benefit from what CAI offers in addition to see how instructor solve problems and ask questions in class. 3 MyMathLab

MyMathLab was used as a mean of communicating with students, administering and grading exams. E-books were used to teach instead of using slides. Students can access the study plan in MyMathLab using their laptops or smartphone. The study plan consists of sets of problems designed for students to improve their skills. After completing each assigned question, Study Plan will generate questions that focus on each learning objective that the students have struggled with. Students using MyMathLab could view stream-lined video lectures connected with any topic in the book and also do sample homework problems and sample tests on any topic with immediate feedback on their work to help them learn. Also from time to time and especially before exams online office hours are scheduled using live classroom chat where students and instructor use a real-time interactive whiteboard to interact. Moreover, a multimedia library is available which lets students access the multimedia resources related to your course. By linking to all multimedia from one place, the multimedia library makes it easy to identify and locate the resources needed by students.
3. DESIGN OF THE STUDY
After teaching for many years math courses without use of any technology except the use of the projector and slides and where the homework and exams were paper based, we implemented MyMathLab, a management learning system for the majority of the math courses (calculus 1, 2 and 3, linear algebra, and statistics) taken by engineering students. Over the period of six years, students were using MyMathLab for studying and doing their homeworks. All proctored exams were administrated online using MyMathLab. MyMathLab was used in conjunction with the conventional lecture method of instruction.

4. METHODOLOGY
The participants for this research were university Engineering students who enrolled in Calculus and linear algebra courses at Abu Dhabi University. 1148 students were selected. Half of them did use MyMathLab in their study as well as to do their homework. All exams taken by these students were online proctored exams using MyMathLab. The other half of students did not use MyMathLab and all their homework and exams were paper-based. All the courses had the same syllabus and were taught by different instructors. The grades used in the study are the final grades obtained by students in a math course.

5. RESULTS AND DISCUSSION
One of the most important features of MML is the study plan. Study Plan is designed for students to improve their skills by practicing problems and getting help to achieve the course objectives. Without the aid of technology, it is difficult, if not impossible, for faculty to ascertain how much time a student is actually spending on task. MML provides detailed tracking features, thereby enabling faculty to reliably and automatically monitor students time and intervene at the first sign of trouble. To study the effect of the study plan on student’s performance we did analyze for a calculus course some of the study plan’s components such as time spent by each student solving questions, number of questions solved and objectives mastered for each course. Figure 1 showed that there is no correlation between the number of questions students solved and their grades. Figure 2 also showed that there is no correlation between the time spent by students on the study plan solving problems and their grades. Figure 3 showed that there is a correlation between the objectives mastered by a student and his grade on a calculus course.
We can conclude that working on the study plan for many hours and solving many questions is not enough to get better grades unless students mastered the objectives for each section and chapter. The study plan has each objective for each section number itemized and questions for each objective. In this way, students can focus on reviewing questions under objectives that they are struggling with. It is obvious that working on the study plan and mastering the objectives had a positive impact on student’s grades. Study plan helps students monitor their own progress, letting them see at a glance exactly which topics they need to practice. Students are motivated by the guided solutions, by the ability to immediately see what they did wrong. After completing each assigned question, Study Plan will generate questions that focus on each learning objective that the students have struggled with. Students are taking responsibility for and ownership of their learning. Figure 4 compares the grades of students who used MML versus those who did not. We noticed that the number of students getting A has almost doubled.
Sofiane Grira

Table 1 Statistical Results (StatCrunch)

<table>
<thead>
<tr>
<th>Difference</th>
<th>Sample Diff.</th>
<th>Std. Err.</th>
<th>DF</th>
<th>T-Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_1 - \mu_2$</td>
<td>0.18</td>
<td>0.073000644</td>
<td>1133.5096</td>
<td>2.4657317</td>
<td>0.0069</td>
</tr>
</tbody>
</table>

Sample Statistics:

<table>
<thead>
<tr>
<th>Sample</th>
<th>n</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 1</td>
<td>574</td>
<td>2.23</td>
<td>1.3</td>
</tr>
<tr>
<td>Population 2</td>
<td>574</td>
<td>2.05</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Statistical results in Table 1 shows the result of a hypothesis testing comparing the average grades of students with and without using MML. P-value (0.0069) is small which implies that the average grades of students using MML is greater than the average grades of students who did not use MML. We can say that MML had helped many students to excel and become excellent students.

![Grade Distributions](image)

Figure 4

On the other hand, Figure 4 shows that the number of students who failed the course has almost remained the same. This can be due to many factors. One of them is the initial transition from a traditional lecture-based format to the student-centered Web format was a challenge for some students. Also some students are not familiar with the use of technology in their courses which requires some technology skills. Moreover, it is only in math courses where students were introduced to MML and were given online exams. This new way of learning and assessment was not of a great help for the weak and slower learning students.

6. STUDENT’S FEEDBACK

Table 2 A survey was conducted for students who used MML.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree</th>
<th>Disagree</th>
<th>Neither disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>MML provided adequate</td>
<td>58%</td>
<td>38%</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
The survey showed that 85% strongly agree/agree that MML increased the understanding of the course. 76% strongly agree/agree that MML helped them to get better grades. Also 83% of students preferred online exam using MML over paper and pencil exams. We can conclude from the above table that students agreed that MML helped them to learn and understand math. Re-grading grades 76% agreed that MML allowed them to have better grades. Moreover 88% will recommend this online system to other students too.

7. LIMITATION
This study was solely based on a survey where all the respondents were from one university. Thus, the results cannot be generalized to students in other universities. An additional weakness of this study is that is focused solely on students studying non-remedial mathematics courses and did not examine the impact of MML on remedial courses.

8. CONCLUSION
The study has shown that MML will have a positive impact on student’s performance if students know how to get benefit from the study plan’s features. Solving problems and spending much time on the study plan is not enough to have a good grade. Students need to master the objectives for each chapter. The study has shown that there is a strong positive correlation between the objectives mastered from the study plan in MML with the final grade. Consequently, mastering objectives in the Study Plan helped students to improve their mathematics skills as well as their grades. The study also has shown that the passing rate did not increase much by using MML. More study should be done focusing on weak and slower learning students. It should also include the effects of MML on students taking remedial courses. In overall, students were satisfied with the use of MML in their studies.

CONFLICTS OF INTEREST
The author declares no conflicts of interest regarding the publication of this paper.

ACKNOWLEDGMENTS
This work was supported by the Faculty Research Incentive Grant funded by the Office of Research and Sponsored Programs at Abu Dhabi University.

<table>
<thead>
<tr>
<th>Practice to understand the concepts</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MML adequately prepared me for exams</td>
<td>60%</td>
<td>28%</td>
<td>10%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>MML allowed me to get a better grade in the course</td>
<td>53%</td>
<td>23%</td>
<td>13%</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>My understanding of the course increased as a result of using MML</td>
<td>50%</td>
<td>35%</td>
<td>13%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I would recommend MML to another student taking this course</td>
<td>58%</td>
<td>30%</td>
<td>12%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I preferred online exam using MML over paper and pencil exams</td>
<td>68%</td>
<td>15%</td>
<td>5%</td>
<td>8%</td>
<td>4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table showing survey results</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice to understand the concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MML adequately prepared me for exams</td>
<td>60%</td>
<td>28%</td>
<td>10%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>MML allowed me to get a better grade in the course</td>
<td>53%</td>
<td>23%</td>
<td>13%</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>My understanding of the course increased as a result of using MML</td>
<td>50%</td>
<td>35%</td>
<td>13%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I would recommend MML to another student taking this course</td>
<td>58%</td>
<td>30%</td>
<td>12%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I preferred online exam using MML over paper and pencil exams</td>
<td>68%</td>
<td>15%</td>
<td>5%</td>
<td>8%</td>
<td>4%</td>
</tr>
</tbody>
</table>
REFERENCES


