

IMPLEMENTATION OF MYMATHLAB IN A FOUNDATION COURSE: AN EXPLORATORY STUDY

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Abstract. Recent years have witnessed academic institution throughout the world rapidly adopting technology into their teaching and learning curriculums. Such technology is thought to enhance student learning. Pearson's MyMathLab tool is one example of technology widely in use at various academic institutions worldwide. In this study, we investigated the effectiveness of the MyMathLab tool in enhancing the teaching and learning at a private college in Kuwait which recently implemented the tool. Our findings show that the students' grades improved significantly after MyMathLab tool was implemented. Thus giving some support to the view that MyMathLab tool can enhance student learning. Our results also support findings from previous related studies that there is little, if any, correlation that exists between times spent using MyMathLab tool and students' assessment grades.

Keywords: Blended Learning, hybrid Learning, eLearning, MyMathLab, Gradebook, mathematics, Foundation Mathematics

Introduction

In a traditional delivery classroom, students attend lecture-based instructions and take notes, while assessments are conducted in class, on a paper-based format. With the adoption of technology worldwide, this approach to teaching and learning is rapidly changing (Hayfa & Othman, 2014). The application of technology in teaching and learning in curriculums is known variably as “eLearning”, “online learning”, “internet-based learning” (Law, Ng, Goh, Tay, & Sek, 2012c) among other names. In some academic institutions, eLearning is now the only mode of teaching and learning, while in others it has been partially incorporated into curriculums. Terms such as “blended learning” or “hybrid learning” are frequently used to describe the latter strategy of partially incorporating technology in teaching and learning curriculums (Law et al., 2012a). Scida and Saury (2006) define hybrid learning as “classes in which instruction takes place in a traditional classroom setting augmented by computer-based or online activities which can replace classroom seat time” (p. 518, para. 2). An often cited advantage of adopting technology in teaching and learning curriculums relates to accessibility. Lectures delivered online can be accessed anytime and replayed as frequently as the user wishes (Dennis, 2003). This is particularly important for Foundation Mathematics where frequent practice is considered a must for one to acquire the necessary skills to grasp key concepts in arithmetic.

One web-based tool which is widely used in the teaching of mathematics is MyMathLab (MML) designed by Pearson Publisher Company (Hayfa & Othman, 2014). When properly employed, the MML tool can enhance the students’ learning especially through providing them with an alternative platform for practicing mathematics (Hayfa & Othman, 2014). In the spring semester of 2014, a private college in Kuwait introduced the MML tool for the first time as part of a hybrid learning strategy to teaching Foundation Mathematics. Briefly, Foundation Mathematics is a pre-University unit which students take as a pre-requisite to more advanced mathematics courses. At the college we conducted our study; Foundation Mathematics is taken by students from both the Business and Engineering majors. Since the MML tool was introduced at the private college, no study has yet been conducted to establish its effectiveness. Therefore; the aim of this study was to explore the effectiveness of the MML tool in the teaching of Foundation Mathematics at a private college in Kuwait. The objectives to achieve this aim were to

1. Ascertain whether or not there is relationship between the ‘Average Time Students Spent using the MML Tool’ and the ‘Letter Grade’ they obtained for the unit.
2. Find out whether or not there is a relationship between the ‘Average Time Students Spent using the MML Tool’ and the ‘Grades Students Achieved in the Various Assessments’, namely, quizzes, homework, mid and final examinations and overall grades for the unit.
3. Investigate the effect, if any, the MML tool had on the students’ overall grades for Foundation Mathematics unit.
4. Establish whether or not there were any differences between female and male students’ grades that could be attributed to the MML tool.

5. Identify in which major, whether Engineering or Business, the use of the MML tool was more effective.

Literature Review

The advancement of computer technologies and its adoption in educational institutions has brought a paradigm shift in the way students learn and instructors teach (Glass & Sue, 2008). Implementing technology in the curriculum has proved to be beneficial to the teaching and learning. It has been shown to be favorable as it enhances communication, efficiency, problem solving, research, and decision-making (Niess, 2005). Technology provides students with new forms of communication to enable them to take control of their own learning (Reba & Biggers, 2008). Moreover, students in eLearning develop technology skills and knowledge that they can incorporate in their daily and working lives (Kazmer, 2005). Educational technologists state that technology makes fit for the different learning styles of learners and offers flexibility for access (Peck & Jobe, 2008). In addition, the online resources in a blended environment could enhance and enrich the learning experiences of students and help learners to finish their online work and projects (Lin, 2009).

One of the most frequently adopted teaching and learning tool is MyMathLab. It is an online educational system developed by Pearson Education to assist in the teaching and learning of a number of subjects, including mathematics. The MyMathLab tool is tightly integrated with the published textbooks which makes it user friendly. It offers an eBook, a range of practice exercises that can be assigned as homework, quizzes, or tests, an adaptive Study Plan, a Gradebook, Discussion Forums, and Instructor Resources (worksheets, solution and resource manuals, test bank, to name a few). In addition, for each section, a multimedia Library is available and offers learners a range of features such as animations, videos, and power points, among others which are designed to aid student learning.

Research over the years has shown that the MML tool has a potential to enhance student learning of mathematics. For example, Speckler (2012) analyzed 77 data-driven case studies in which the MML tool was implemented and established that in the majority of these cases, the tool greatly supported student achievement in a number of subjects including mathematics. There are many benefits of using the MML tool that has been cited by Speckler (2012). One of the key benefits is that it helps in improving student retention and success (Speckler, 2012). Also, it helps in changing the culture of the math department, from students who are afraid and weak in math to students majoring in mathematics. Furthermore, it also increases the completion and pass rates (Speckler, 2012).

The MML tool satisfies at least four of Chickering and Ehrmann's (1996) seven principles of the most effective ways to use computers and telecommunication technologies in education. The four principles are (i) using the prompt feedback, (ii) emphasizing time on task, (iii) respecting the diverse ways of learning, and (iv) implementing the active learning techniques (Chickering & Ehrmann 1996). Briefly, a

key advantage of the MML tool is its ability to offer prompt feedback. Providing students with feedback is a very crucial aspect to the learning process. Chickering and Ehrmann (1996) argued that, feedback is very important because students must know what they know in order to focus their learning. Students need to be assessed on their competence and knowledge, and receiving instant feedback can help them reflect on their learning and what they still need to work on to succeed (Chickering & Ehrmann, 1996). Furthermore, having immediate feedback on correct and incorrect answers to problems increase the students' performance and motivation to get answers right (Kendrick, 2002). In addition, this feature individualizes instruction, which is similar to an instructor providing feedback to a student during office hours (Reba & Biggers, 2008). The Pearson report (Speckler, 2012) showed that, the immediate feedback feature in the tool has proven to reinforce the learning process and increase student success.

The MML tool promotes emphasizing time on task. Chickering and Ehrmann (1996) quoted that "Time plus energy equals learning" (p. 4, para. 3). The authors stated that technology can allocate a considerable amount of time and increase time spent on learning tasks hence it can make studying more efficient for students and more effective for teachers. Dennis (2003) confirmed that one of the benefits of the MML interface is that it saves time in the classroom and increase time spent on the learning tasks. In addition, the use of the MML tool provides benefits to diverse ways of learning. Chickering and Ehrmann (1996) mentioned that "students need opportunities to show their talents and learn in ways that work for them" (p. 4, para. 9). The authors stated that technological resources can offer students different learning methods (powerful visuals, direct experiences, and tasks that promote analysis, synthesis, and evaluation) that can broaden their learning repertoires and supply a structure for students, which best fit their learning styles. Hayfa and Hiba (2014) confirmed the fact that MML provides an opportunity for students to work at their own pace and creates a learning environment that best suits their different learning styles and needs.

Last but not least, the MML tool promotes the practice of active learning techniques. Chickering and Ehrmann (1996) stated that "learning is not a spectator sport" (p. 3, para. 3). The authors attested that students learn by doing and teachers facilitate that by making students responsible for their own learning. According to Reba and Biggers (2008), mathematics instructors, in order to promote active learning, would move their classrooms away from statics homework and long lecturing. Speckler (2012) affirmed that the use of MML provides a new form of communication that promotes active learning and encourages students to take control of their learning.

However, there are drawbacks to using web-based educational system (Niess, 2005). The MML interface requires more time initially for the instructor to design and to use it (Dennis, 2003). In addition, Dennis (2003) stated that students as well as teachers may encounter technical difficulties in accessing some features of the interface. They may not be able to install the plug-ins and players required to use those features. Another important point is that, students may lack the time management skills that make them successful in the eLearning environment (Davidson-Shivers & Rasmussen, 2006). It is

worth noting that, ineffective use of technology is not necessarily associated with the technology but to inappropriate strategies in its use (Chickering & Ehrmann, 1996).

Methodology

In this section, we present the methodology we used to explore the effectiveness of MyMathLab (MML) tool at a private college in Kuwait. We employed an exploratory research design (Creswell, 1994). An exploratory design is adopted where little is known about the phenomena of interest to the researcher (Miles and Huberman, 1994). In this, an exploratory design can help a researcher gain useful insights about a phenomena of interest, particularly in the early phases of a research, as was in our case. Miles and Huberman (1994), note that exploratory designs can take either a qualitative or quantitative approach. In our study the exploratory design was mainly quantitative.

The population for the study comprised 200 students who registered for Foundation Mathematics at the college. Given the relatively small size of the population, we decided to include all 200 students who enrolled for the unit in the study. Foundation Mathematics course consisted of 4- credit hour, where three hours were lecture-based classes and a one hour computer laboratory session. During the 3-hour of lectures, instructions were delivered using the traditional way of teaching, but resources from the interface website were used, like power point presentations, eBook, videos, animations, and worksheets. The one hour computer laboratory session was used to administer online quizzes and for students to carry out some assigned task on MML tool. Two sets of data were collected for the study.

The first comprised weekly online data from quizzes, homework results and the time each student spent using the MML tool. We obtained this data from the 'Gradebook' function housed in the MML tool. The second set of data was made up of results from paper-based mid and final semester examinations. The Gradebook function in the MML tool contains information about the total time spent on MML on each of the assignments, grades of homework and quizzes, the number of attempts to get right results, the features used by each student (videos, help, and eBook), the progress and skills acquired of each student, and descriptive statistics on each assignment.

We exported the quizzes, homework results, and the time each student spent using the MML tool data sets from the Gradebook into Microsoft Excel program using a procedure in the MML tool. We then manually entered data from the paper-based mid and final semester examinations. After screening and checking the data for errors, we used various statistical techniques (e.g. mean, standard deviation, correlation) in Excel program to analyze the data.

Results and Discussion

The data provided by the online Gradebook revealed a lot of information about the students' work on MML throughout the semester which can be used to answer the research objectives mentioned earlier. In this section we present our findings for each of the research objectives. Data for the study was collected over one academic semester,

comprising 14 weeks, at a private college in Kuwait. We sampled all 200 undergraduate students who registered for Foundation Mathematics in the spring semester of 2014. While vetting the data, we found out that 19 (9.5%) students had neither used MML nor took the final examination for the unit and hence these students were excluded from the analysis. In addition, data from a further 13 (6.5%) students was also excluded from the analysis for incompleteness reasons since these students did not take the final examination. Consequently, only data from 168 (84%) of the 200 students who enrolled for the unit was used (see Table 1).

In terms of sample composition, the gender distribution of the respondents was quite even; 57% male and 43% female (see Table 1). However, the majority of respondents were from Engineering (77%) and the remainder (23%) from Business School (see Table 1).

Table 1
Respondents' Profile for the Pilot Study (n=168)

Characteristics	Respondents (%)	Characteristics	Respondents (%)
Gender		Major	
Male	96 (57)	Engineering	130 (77)
Female	72 (43)	Business	38 (23)
Total	168 (100)	Total	168 (100)

In the first objective, we investigated whether or not there was a relationship between the 'Average Time Students Spent using the MML Tool' and the 'Letter Grade' they obtained for the unit. The 'Letter Grade' is derived from combining the students' grades for the various assessments which make up the unit. For example, 'Letter Grade' H for Honor represents a grade of 90% and above, P for Pass denotes a grade of 65% and above and lastly F means Fail which denotes a grade below 65%. The results of the analysis conducted to achieve the first objective are presented in Table 2 below.

Table 2
Association between 'Letter Grade' and 'Average Time Students Spent on MML'

Letter Grade	Average Time Spent using the MML tool (hours)	Number (%)
*H	18.96	19 (11)
**P	15.69	133 (79)
#F	9.93	16 (10)

*H = Honor (90% and above), **P = Pass (65% and above), #F = Fail (below 65%)

As Table 2 indicates, 19 (11%) students achieved the overall Letter Grade Honor (H) for the unit. H grade is the highest possible letter grade. Students who achieved the H grade on average spent at least 18 hours using the MML tool. This represents on average the most time students spent using the MML tool (see Table 2). Based on the various tasks we assigned the students throughout the semester, we expected that students would spend on average of 14 hours using the MML tool. The majority of the students (79%) spent on average 15.69 hours using the MML tool and these achieved the Pass (P) grade for the unit. The least (10%) number of students spent on average 9.93 hours using the MML and obtained a Fail (F) grade for the unit (see Table 2). On the overall, the results in Table 2 appear to suggest a positive correlation between the time students spent using the MML tool and the overall 'Letter Grade' they achieved for the unit. Thus, implying that the more time a student spent using the MML tool the likelihood that s/he would receive a higher grade for the unit. We explored this idea in objective two.

In the second objective, we wanted to ascertain whether or not there was a relationship between the 'Average Time Students Spent using the MML Tool' and the 'Grades Students Achieved in the Various Assessments', namely, quizzes, homework, mid and final examinations and the overall grade for the unit. The results of the correlation analysis we conducted to achieve the second objective are presented in Table 3 below.

Table 3
Correlation between 'Total Time Students Spent on MML tool' and 'Assessment Grades'

	Quizzes	Homework	Mid	Final	Overall Grades
Pearson Correlation	0.25	0.33	0.04	0.27	0.23
n	168	168	168	168	168

Table 3 indicates a positive correlation between the total hours students spent using the MML tool and quizzes grades $r = 0.25$, $n = 168$. Based on Cohen's (1988) interpretation $r = 0.25$ indicates a modest positive correlation between the total time students spent using the MML tool and their quizzes grades. Similarly the correlation between the two variables can be considered as modest for mid examinations scores $r = 0.04$, $n = 168$, final examinations scores $r = 0.27$, $n = 168$ and overall unit grade scores $r = 0.23$, $n = 168$. Only the correlation between the total hours students spent using the MML tool and the homework grades $r = 0.33$, $n = 168$, is within the moderate range, albeit, very low end (Cohen, 1988).

As indicated in the above section, we expected higher correlations between the variables than we obtained. Similar results were reported by Law et al., (2012b) in their study on the use of MML tool by students in Malaysia. The authors argue that the modest correlation could be a result of the fact that students spent a lengthy time on the interface getting familiar with it, since it was their first experience using the system. Another reason might be that, students would leave their account open while doing the homework outside the campus, hence this would add time spent on the interface without actual work

on it (Law et al., 2012b). While we agree that, further research is necessary to explain the modest correlations between the variables we obtained in our study, Law et al.,(2012)'s latter proposition sounds plausible in our study.

In the third objective, we intended to establish the effect, if any, the MML tool had on the students' overall grades of the Foundation Mathematics unit. In this we compared the students' 'Letter Grade' from our study where the MML tool was used, with those from the previous semester in which the MML tool was not used. Table 4 presents the results of analysis of means conducted to achieve objective three.

Table 4
Comparison of 'Letter Grade' With and Without the MML tool Implementation

Letter Grade	% 'Without MML' tool	% 'With MML' tool
*H	30	11
**P	52	79
#F	18	10

*H = Honor (90% and above), **P = Pass (65% and above), #F = Fail (below 65%)

The sample size for the 'Without MML' tool results was 254 students while in our 'With MML' tool was 168 students. We observed mixed results for this objective. First, the percentage of students who achieved an H grade for the 'Without MML' tool (30%) was almost treble the number of those who achieved the same grade in the 'With MML' tool. However, the percentage of students who achieved P grade was higher for 'With MML' tool group (79%) than for 'Without MML' tool (52%).

More importantly, on the overall, the percentage of students who passed the unit is higher for the 'With MML' tool (90%) group than for 'Without MML' tool (82%) group. In addition, fewer students from the 'With MML' tool (9%) group failed the unit than compared to the for 'Without MML' tool (18%) group. Consequently, the results appear to suggest that the MML tool had a positive effect in increasing the number of students passing the unit and to some extent reducing the number of students achieving the highest grade H. However, it must be noted that tests for statistical significant differences would be required before such a conclusion can be made with certainty.

In the fourth objective, we wanted to establish whether or not there were any differences between female and male students' grades that could be attributed to the MML tool. To achieve this objective, we compared and contrasted male and female scores in a number of assessments and also the times each gender group spent using the MML tool, see Table 5 below for results.

Table 5
Mean Differences Between Gender Assessments and Time Spent using the MML Tool

Assessments	Female (n=72) Mean	Male (n=96) Mean
MML Homework (in percentage)	62	79
MML Quiz (in percentage)	79	78
Total Time (in hours)	18.28	13.44
Midterm (in percentage)	79	77
Final (in percentage)	73	72
Overall Average Grade	78	76

The result in Table 5 indicates that female and male scores were mostly similar in the various assessments. Thus, suggesting that the MML tool had a similar effect on both female and male students. However, there appears to be some gender difference in the means for the 'Homework' grades. Male students with an average grade (79%) for 'Homework' appears to have significantly done better than their female (62%) counterparts.

On the other hand, the results appear to suggest that female students (18.28 hours) spent significantly more time using the MML tool than their male (13.44 hours) counterparts (see Table 5). However, in the absence of results from appropriate statistical tests, it is not possible at this stage to conclude whether or not these gender differences in 'Homework' and 'Time spent using the MML tool' are statistically significant. We planned to conduct tests for statistical significant differences in preceding stages of our research.

In the fifth and final objective, we wanted to establish in which major, whether Engineering or Business, was the use of the MML tool more effective. To achieve this, we compared and contrasted various assessment scores and the time students spent using the MML tool between the two majors, see Table 6.

Table 6
Mean Differences Between Students from Different Majors

Assessments	Engineering (n=130) Mean	Business (n=38) Mean
MML Homework (in percentage)	73	67
MML Quiz (in percentage)	75	72
Total Time (in hours)	12.87	14.89

Midterm (in percentage)	80	70
Final (in percentage)	74	67
Average Grade	78	72

Engineering students' scores for all assessments were marginally higher than those for Business students (see Table 6). To some extent we expected this result given that, at the college where we conducted our study, proven prior mathematics background is more of an entry requirement for Engineering students than for Business students. What we did not expect, however, is the fact that, Business students' grades would be nearly as high as those of Engineering students. The fact that Business students (14.89 hour) on average spent more time using the MML tool than Engineering students (12.87hours) may account for their improved grades (see Table 6). It must be noted that, further tests will need to be conducted to establish if any of these differences are actually statistically significant.

Limitation

There are some limitations with the study which related to the research design and the techniques of data analysis we employed. Because of the exploratory design we adopted for the study, we cannot generalize our findings to the wide pollution. Also another shortcoming of our study is that, it is mostly depended on data from only one semester in which the MML tool was introduced. Perhaps the results would have been different if data from a number of semesters rather than one had been used. With regards to statistical techniques we employed in our study, there are to some extent limitations here too. For example, we mostly relied on statistical tests which do not investigate statistical significant differences. Consequently, this placed some constraints in the way we interpreted our findings and ultimately the conclusions we could draw from them. Having said this, it must be stated that the use of statistical tests for significant differences were in most cases beyond the scope of this study. We planned that the current study would be for the purpose of gaining insight into the effect of the MML tool in the teaching and learning of Foundation Mathematics. We believe that this goal was attained in this study.

Conclusion

There are a number of conclusions we can draw from the study. The results of this study appear to indicate that the overall pass rate improved with the introduction of the MML tool. This finding is encouraging as it implies that adopting the MML tool in teaching and learning the curriculum of Foundation Mathematics could enhance the students' results. Students who obtained the H grade on average spent at least 4 hours above the expected time. While those who failed (F-grade) the unit spent just about half of the expected time. These results suggest that the more time you spent on MML the higher the likelihood you could achieve an H grade which is the highest possible grade. Conversely, the less time you spent on MML the higher the likelihood that you will fail the unit. If this interpretation of the results is true, then the time spent on the MML tool could be used to predict the student's grade for Foundation Mathematics.

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