Technological Tools to Learn and Teach Mathematics and Statistics

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Abstract:

The blended learning method of teaching could be applied within the learning of mathematics and statistics. There are many different ways to obtain such learning, however one of the beneficial ways is to use MyLab and Mastering. MyLab and Mastering is blackboard website managed by the Pearson Publication Company which is used to enhance student learning in mathematics and statistics embedded within the current technological world. This paper describes the use of the MyLab and Mastering website from three points of view: instructor, students and administrative. This paper portrays the results of a recent study, where 120 students were enrolled in mathematics and statistics classes and used MyLab to improve their learning outcomes. Result of the case study are reported and analyzed. In addition suggestions are provided how to establish almost cost-free distance learning environments for mathematics and statistics.

Key words: Blended learning, MyLab and Mastering, Pearson Publishing Company, Distance learning.

Introduction

The case study for this paper is based on the analysis of data obtained over three consecutive semesters from the pilot program of introducing technology in the teaching and learning of mathematics and statistics at the American University of Sharjah.

The author of the paper is a faculty member in the Mathematics and Statistics Department and was actively involved in the pilot project where he taught three courses using the particular technology.

The technology used in the pilot program was the Pearson Publishing webpage designed for mathematics and statistics classes. The website formerly called MyMathLab has been renamed to MyLab and Mastering, however the content on the website stayed the same. What the website is about can be seen from its definition:

MyLab and Mastering are online learning products, deliver customizable content and highly personalized study paths, responsive learning tools, and real-time evaluation and diagnostics. MyLab and Mastering products give educators the ability to move each student toward the moment that matters most—the moment of true understanding and learning.[1]

Basically the MyLab and Mastering was used as a pilot project to introduce technology in teaching and learning and at the same time to establish *blended learning* method of teaching [2] in mathematics and statistics as a possible future development of the online class setting.

It is important to mention, that there are others similar companies which provide almost exact or similar services as Pearson does and some may have additional tools. McGraw Hill offers a product called

'Connect' which is similar to that offered by the Pearson Publishing website, however study in this paper concentrate only on Pearson website.

MyLab and Mastering website

As mentioned earlier MyLab and Mastering is an online learning product developed by Pearson Publishing Company. In other words MyLab is an enhanced blackboard used for particular subjects, which in our case is mathematics and statistics. In addition to the traditional blackboard used by most universities and colleges in the world, MyLab has additional features such as ebook, videos, animation, power points, and many more already preinstalled features ready for use. In order to explain some of the MyLab characteristics it would be more suitable to present it from three different viewpoints, the students view, the instructor's view and the administrative point of view.

Instructor view:

An instructor, who is willing to use MyLab should contact the Pearson Publishing Company and obtain access to the website as an instructor. The process requires confirmation by the department chair, or contacting a person who is responsible with dealing with the publishing companies. Once access is obtained, the instructor can go and create a user name and password, which will be used in future logins to the webpage. On the webpage there are tutorials available for instructors, where the instructor could learn how to navigate through the website. Pearson Publishing costumer technical service representatives are available for live chat and they are willing to come in person and train the faculty how to navigate through the website.

Through tutorials, or training, instructors will learn about all teaching and learning mechanisms included in the MyLab. The most important thing that they would learn is that they do not have to create anything within the particular course and that everything is already created for them. They just need to select appropriate material that they think is necessary to be included in the course setting. For example, if an instructor wants to assign homework from a particular section to the students, the instructor just needs to review the questions and select them for students. Obviously instructors are given option to add your own questions if needed, however the question bank is very large and there is no need to create your own problems. Another very useful tool is that through MyLab, an assignment could be assigned in such way that the every student has the same topic but different questions. For example, on the topic *solving linear equations,* an instructor could assign assignments to the students so that every student would have a problem on solving a linear equation. However, none of the problems would be the same. The program uses algorithms to create random linear equations for every student as a different problem. One student would have a problem such as $3x - 5 = 7$, and a second would have a problem such as $4x - 3 = 9$ and so on. In this way, students cannot copy from one to another. Also, the instructor could select a number of trials, which allows students repetition of the same problem. It could allow the student to do the same problem multiple times until the correct answer is obtained. In such a case, for every trial the algorithm would again randomly create a new problem in the same manner discussed above.

The other useful feature in MyLab for the instructor is the grading. MyLab automatically grades assignments for the instructor in a way the instructor pre-determines. There are multiple options on the grading scale for particular problems and for the assignment as a whole. Partial credit could be allowed for particular parts of the problem. It is left to the instructor to determine, which part of the particular problem partial credit would be granted. So, MyLab is reducing the workload for an instructor, which allows the instructor to invest the extra time into research or teaching other classes.

The instructor is in full control of the web-site and can determine which features can be seen by students. For example, an instructor may request a prerequisite for an assignment. It could be studying particular topics from the multimedia features. In such a case, a student would not be able to access the assignment if he/she does not complete a prerequisite such as listening to the video lecture or completing previous assignments. An instructor is able to monitor students' progress such as time spent on a particular problem or on a particular assignment and the students' ability to complete the assignments. An instructor controls the timing within minutes of every announcement, assignment, or any other relevant matters for the students view. For example, an instructor sets the time of the assignment for a particular day and particular hour and such assignment could not be viewed by the students before the time the instructor had assigned. Basically the instructor could set the whole system before the semester starts and just monitor through the semester reducing the workload even more.

There are many others features that are not discussed in this paper that an instructor could benefit from. All features are usually self explanatory, or as said earlier, Pearson Publishing Company could provide training for the faculty willing to use MyLab.

Student view:

In order to be able to access and use MyLab website, as a student, there are three requirements: Access Key, Plug-ins installation, and the course name created by the instructor.

Access Key is a code provided by Pearson Publisher Company which is included in the book package. There is no extra cost for students because the book price already includes the Access Key. The Access Key is used for students' registration which is done only once. Through the registration process, a student sets their own username and password, which would be used to log into the website in the subsequent visits.

Plug-ins installation is a technical component of the MyLab, which is required to be installed on the student's computer. The plug-ins allows the user to obtain all MyLab components, such as videos, power points, animations, and other tools with good quality. Installing plugs-ins is a self-explanatory, simple procedure and must be done only once during registration.

Course Name (or Course ID) is the last component for which the student needs to access the website. The Course ID is obtained from the instructor who is creating the course. As for the other two components, Course ID needs to be entered only once during registration.

After the registration process, a student is able to see all the components which are made available by a course instructor. Students could access the e-book which is one of many benefits that students receive by using MyLab. For example, if the student is assigned homework in the traditional class setting and experiences a problem, usually the student seeks examples from the book. That requires time to spend looking for particular topics and particular chapters. Then it requires finding appropriate sections in the chapters and in the end students look through the section to find a particular problem which would be relevant for the assigned homework, and that is if the student understands the nature of the problem. If the student happened to not know the nature of the problem then the search could take a very long time. With MyLab if the student is doing homework and has some difficulties solving the particular problem, MyLab has a feature by which with just one click would bring the student to the e-book at a particular page and particular problem, where the student would look at the example related to the homework problem. That feature alone could save a great deal of the time for students, time which could be invested in studying.

Another feature that student have access to are the video lectures. The video lectures are presented in the same way as the e-book, chapter by chapter and section by section. A student can select and view any section of interest. In a case where a student does not need to listen to the whole lecture and just needs an explanation for one particular problem, there exists navigation similar to that of the e-book that could directly bring the students to the part of the video lecture for the particular problem. So, again a student would save a lot of time which could be invested in some other learning.

One of the most important features that MyLab offers to the student is the immediate feedback. In the regular class setting if a student does an assignment and submits it to the instructor, the feedback from instructor to student would come at a later period of time. Sometimes an instructor needs a few days or a whole week in order to grade a particular assignment and the student gets the feedback after receiving the graded assignment. The period of the time from when the student submits the assignments until they get it back is *learning empty*. In that learning empty period student is doing nothing about that particular homework, because the student doesn't know if the homework is correct or wrong. In most cases, a student does not know what to do until the assignment is returned back. When the assignment is returned, a student could determine whether the earlier studying was successful and that the particular material is mastered or the opposite that there is a need to study more. With MyLab, a student receives immediate feedback. Depending on the instructor's MyLab setting, a student could obtain immediate feedback for every completed problem or for every completed assignment. For example, if the instructor assigns homework the student would have immediate feedback after every completed problem. If an instructor assigns a quiz or test, then a student can get feedback after the whole quiz or whole test is completed. In each case, a student gets the feedback immediately and the *learning empty* period does not exist.

The next feature that MyLab offers to a student is called *Help Me Solve This* [3]. This feature is usually set by an instructor to help a student to complete homework. It could be also set to help a student on the quizzes and tests; however, it is usually used for help on homework. If a student is working on homework and experiences difficulties in a particular problem, the feature *Help Me Solve This* helps students to solve the particular problem step by step. It will lead students step by step through the problem asking for some input on crucial steps in the problem. If the student's input is wrong the feature *Help Me Solve This* would correct it and explain why it is corrected. After the problem is completed with the guidance of *Help Me Solve This* the problem is not counted in the assignment. The program's algorithm would create a new problem which is similar in nature however it is different problem, and student will still have to complete it on his/her own. So no matter how many times *Help Me Solve This* is used every time after its use student have to do a similar problem again. This feature makes sure that the student has actually learned the material and that the student knows how to find the particular solution to the problem.

MyLab offers many other features for students that are learned as students get more familiar the website. Features such as the grade book, study plans, discussion board, announcement, and posts to classmates, are just some of many features that student could have access to, if selected by an instructor. It is important to mention that all assignments and all study tools are located in one place, and if students need to review them at any later time, they are all available and they are one click away.

Administration view:

Administrating MyLab is a very simple task. In other words, one may say it is no task at all. Institutional administrating of MyLab is basically minimized to do nothing. The whole administration of the program is run by the Pearson Publishing Company. Students are required to purchase the book for a

particular mathematics or statistics class and the book package contains the Access Key requested for website registration. The institution has nothing to do with the special orders or anything that is requested for students' MyLab registration. One factor that could concern an institutional administration is computer and internet availability. If a student has no computer and internet access then MyLab would not be available, however in today's technological world it is unthinkable that a university student does not have their own computer and access to the internet. In such a rare case where a student does not have computer and access to internet, the institutional administration should provide students with the computer and internet access. Again, even in rare cases where students have no access to the computer and internet on their own, every educational institution has available computers and internet for the student use.

Universities don't need to provide technical support for MyLab as well as training for instructors, because again it is available from the Pearson Publishing Company.

Some institutions may have an instructor assistant, who is paid to grade assignments, and MyLab would minimize or eliminate the need of assistant help. The Mathematics and Statistics Department at the American University of Sharjah has about 30 graders per semester who are paid from the Mathematics and Statistics budget. The institution could reduce the cost of paying instructor assistants to grade, because MyLab grades the assignments automatically.

MyLab and Mastering Pilot Project in Mathematics and Statistics

Introduction of the MyLab as a pilot project was established by a Pearson Publishing representative and some faculty members from the Department of Mathematics and Statistics at the American University of Sharjah. The MyLab was introduced to students for four different reasons. The main goal was to determine if the students' learning is impacted in positive ways by using the MyLab. The other reasons were introducing technology in teaching and learning, and introducing blended learning. If those three component resulted in success then the forth reason would be establishing the base for possible future distance learning.

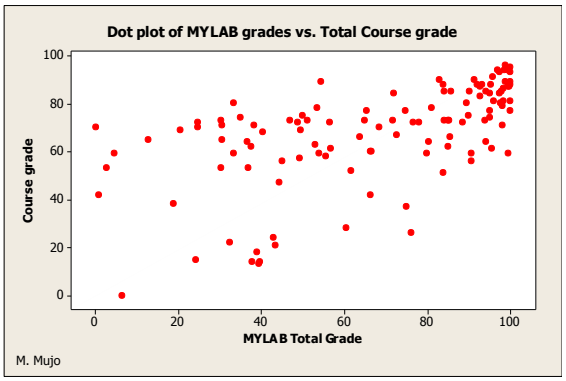
Some of the faculty members have already experienced navigating through MyLab and some others faculty members needed to attended workshops organized by Pearson Publishing representatives where faculty learned the navigation procedures.

There was a coordinated monitoring of the project in the form of obtaining feedback from instructors (interviews) and students as user satisfaction. Students were surveyed and there was a positive outcome of satisfaction obtained. The interview was conducted with all instructors involved in the pilot project and resulted in a positive outcome as well. Each instructor was satisfied with the MyLab. All of the instructors believed that students benefit from MyLab and they conclude that students learning was positively impacted. The outcome was based on surveys and interviews and a conclusion was given in opinion matters without any statistical analysis. Such outcomes triggered the need to provide evidence of the belief and to support the conclusion made in the pilot project. The author of this paper decided to conduct his own pilot project study. The study was conducted in a one year period, precisely in three semesters Summer 2010, Fall 2010 and Spring of 2011 where 120 students were introduced to MyLab and the students' progress was observed through the three semesters while the students were using the MyLab.

In the Fall 2010 there were two classes monitored and observed, while in Summer 2010 and Spring 2011 there was only one class. In the Summer 2010 semester, a class of pre-calculus (Introductory Mathematics for Engineers) was observed; Fall 2010 semester class of Statistics (Introductory Statistics for Social Sciences,) and a pre-calculus class (Introductory Mathematics for Architects) was observed; Spring 2011 semester, a class of Statistics (Introductory Statistics for Social Science) was observed. Each class had approximately 30 students who were attending class on a regularly basis. Every student in each class was requested to register for MyLab and to complete an assignments assigned by an instructor. Two out of 120 students were not registered in MyLab and the same students withdrew from the classes. They were not included in the study. The remaining 118 students were assigned homework and quizzes within MyLab. One class had four long assignments (about 50 questions per assignment) while the other have up to 10 assignments which were shorter (about 25 problems per assignment). The grade for the assignment was five percent of the total course grade. Basically the assigned grade for MyLab impacted the total score in a minimal way. For example, if a student chose not to complete the MyLab assignments at all, the total course grade could still be in the highest range.

In order to find out if the MyLab impacted learning outcome, the author decided to examine grades obtained in MyLab and compare them with the final course grade. The grades were seen as percentages out of possible hundred percent in both MyLab and total course. By observing individual scores on MyLab and comparing those to the total grades of all students there was recognized some positive linear correlation as seen in the picture below.

Correlation observation



Picture 1

The next step was to test the hypothesis:

H_o: *There is no positive linear corelation in between MYLAB Total Scores and the Total Course Grade*

H_A: *There is positive linear corelation in between MYLAB Total Scores and the Total Course Grade*

Running the statistical test the following results were obtained:

Correlations: MYLAB TOTAL GRADE, Course grade

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Pearson correlation of MYLAB TOTAL GRADE and Course grade = 0.586
P-Value = 0.000
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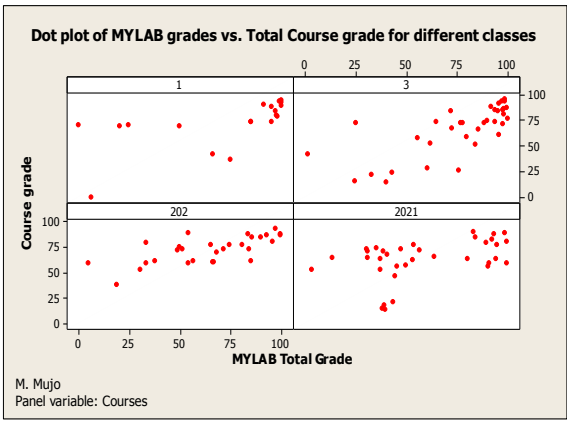
Therefore, at 1% level of significance there is enough evidence to reject the null hypothesis and conclude that there is significant positive linear correlation between MYLAB Total grade and Course Total Grade. Obviously here is considered a *cause-and-effect relationship* [4] between MYLAB Total

grade and Course Total Grade. It is not said that the MYLAB is only cause toward the Total course grade, however there is significant evidence showing that higher MYLAB grade show higher Total course grades. Therefore one may argue that having higher score in MyLab relates to having better understanding of the material and obtaining higher grade in the course in general.

Furthermore author decided to investigate the correlation in each individual class and to see if the correlation is significant in each class. The graphs below showed that three out of four have clear positive linear correlation:

Correlation within individual classes

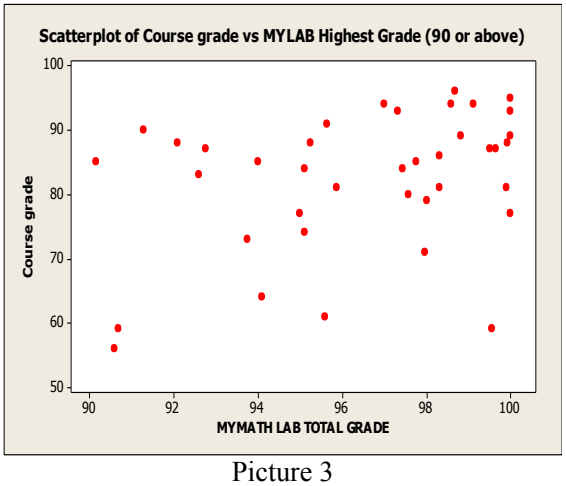


Picture 2

The same type of hypothesis testing was conducted and the 1% level of significance, there was enough evidence to conclude that there is positive linear correlation between MYLAB scores and Course Total grades for each individual class.

In addition to above test, the author wanted to examine the highest achieved grade on MYLAB and compare them with the course total grade. The Students score of ninety percent or above on MYLAB were placed next to the course total grade and the following graph is obtained:

Correlation of the best MyLab Scores



Picture 3

Thirty three percent of all students achieved 90 or above on MyLab. The seventy percent of those students obtained grade B or higher (80 or above) in the course. From these results one may again conclude that the MyLab is impacting students' learning and students' course outcome.

Author of this paper strongly believes that the MyLab is a great tool of blended learning and from the evidence concludes that the MyLab (if implemented correctly) is improving students' leaning outcome.

Distance Learning Possibility Using MyLab and Mastering

MyLab and Mastering are one of the possibilities to have fully distance learning environment. The majority of academic officers believe that the learning outcomes in online settings would exceed regular face-to-face setting [5], therefore institutions should create online environment and MyLab is the perfect tool for implementation of such setting. By adjusting institution from regular face to face education into online education one must consider pros and cons and they could be different from institution to institution.

There are *five factors* [5] in general that need to be considered if an institution is looking into the possibility of implementation of distance learning environment. Those five factors are:

1. Institutional readiness to move to online educational setting
2. Accreditation issues.
3. Reasonable market.
4. Quality control
5. Financial analysis

The first factor is institutional readiness which includes technological structure and experienced staff who would provide online classes [6]. With MyLab the technological structure is already in place. Regarding the experienced staff, institution doesn't need to make any training or any adjustments. Pearson Publishing Company is willing to provide training to all faculty who are using MyLab and Mastering. After agreement is made with Pearson Publish Company about the training, an institution would be ready to implement online classes. There may be *some obstacles* [6] concerning online environment. One of them could be a faculty tradition that resists change. Many faculty would oppose to any change in current teaching setting. One should examine why it is happening and how could it be overcome. The question stated in Shelton and Saltsman (2003) asking: "What causes these barriers to remain in place at some institution while similar barrier at other institution were removed?", should be considered and ask in the process of making institution ready for the online environment.

The second factor that needs to be considered by institutions is that the course objectives in online classes should be in accordance with the accreditation factors. At same time course outcomes have to satisfy the accreditation factors. Now with the MyLab the course objective and course outcomes are not different than the one in face-to-face class. The issue could arise about plagiarism or violation of academic integrity in general. For example, a student may hire someone to complete the online assignment for them and that would be an issue. However, the problem could be easily solved by making the weight of the final exam to be sixty percent or even higher. Students would do online assignments trough semester and the final exam could be administrated in the regular classroom where students would be required to attend university for one day. The final exam will determine students' grade, if for example

student doesn't pass the final the student need to repeat the class. In this way violation of integrity code could be eliminated.

The third factor is establishing a reasonable market. There should be investigations made if the students are willing to take the online classes instead of face to face. It should be explained to student that the online classes provide the same learning outcome as the face to face classes. White (2000) notes that "a positive emotional climate can serve as a frame of reference for online students activities and will therefore shape individual expectancies, attitudes, feelings, and behaviors throughout a program" [7] Also one more problem may occur and that is availability of computers and internet to students who are willing to take the online classes. Assuming that in today's technological world, every student has access to a computer and internet that barrier shouldn't exist, however one should consider some other possibilities. For example, institution could bring some company that is willing to rent the computers to the student or the institution could do it by itself.

The fourth factor is the quality control where some investigation should take place. Institution should investigate if the quality in online setting is the same as the quality in face-to-face setting. This should be viewed or revised from many different prospective: students, faculty, administrators, and accreditation personal prospective. Such investigation could be accomplished by running some pilot projects of online classes were the quality is monitored and observed. With the authors pilot project the MyLab showed that the students who obtained high scores on MyLab tended to have higher grades in the course, however that is not the only measurement of the quality. There should be future investigation applied especially if MyLab is used in a complete online setting. Bischoff (2000) says "The key to online education's effectiveness lies in large part with the facilitator" [8]. Author of this paper believes that the quality of online class setting depends on facilitators and that they should produce the same quality in online setting as they produced in face-to-face setting. The facilitators should use their experience from regular teaching and implement into online class setting. Also, in the article by Anonymous (2009), states "the keys to a quality distance-learning program are faculty involvement and compensation. Faculty members must be incentivized to both develop and teach online courses and faculty members must also have access to seasoned instructional designers able to offer technical and instructional support."[9]. Using MyLab and Mastering faculty doesn't need to develop online course and doesn't need to have additional designers because it is already in place. Here an institution doesn't need to compensate and spend additional resources on development and design of the online mathematics or statistics course.

The fifth factor has to deal with the financial costs of implementing such a program, where institution should conduct financial analysis. The analysis should consider tuition for the online classes, cost of technological equipment if needed to run online classes, cost of faculty and staff needed to run the online classes and the students ability to purchase necessary tools required for the online class [5]. With MyLab the cost is minimized and in some cases it could be turned into profit. As mentioned earlier there are no additional costs for MyLab. Access to it is already provided by purchase of the text book. Faculty members running the online classes do not need to be paid extra. The faculty assistants such as graders, tutors or other kind of teaching aids are not necessary, because MyLab grades all assignments by itself. The number of students in the online class could be higher than in the regular class setting, because the interaction with the teacher is minimized. In such cases institution could save on the resources.

In general, the complete online mathematics or statistics class setting using MyLab and Mastering would be more achievable than creating the online class without it. If institution already has initiative to offer online classes in mathematics and statistics the MyLab and Mastering would be the perfect tool. The

online pilot project could start immediately with no delay, and if there are no obstacles observed it could be implemented as the distance learning. If there are any obstacles they should be fixed or eliminated so the MyLab and Mastering for mathematics and statistics could be used for a distance learning setting.

Conclusion:

MyLab and Mastering was used for Mathematics and Statistics classes as blended learning in a pilot project at American University of Sharjah in the United Arab Emirates. Results were positive and it was shown that students' course learning outcome was correlated to the MyLab use, and possibly the MyLab was a direct cause for students' learning improvement. Faculty members who were using MyLab and Mastering were satisfied with results, and students were satisfied with benefits provided by MyLab and Mastering.

There exist the possibility of turning blended learning into distance learning using MyLab and Mastering. The distance learning may need some minor preparation and it could be achieved with minimal cost. The MyLab and Mastering could be the perfect settings for online teaching and learning. A pilot project should be established where the implementation of the distance learning using MyLab and Mastering in Mathematics and Statistics would take place. If a pilot project results in positive outcome, then the MyLab and Mastering should be used for distance learning in Mathematics and Statistics classes.

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