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THE IMPACT OF USING MASTERINGPHYSICS ON STUDENTS' LEARNING

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ABSTRACT: *In this work we investigate the use of MasteringPhysics in teaching an introductory physics course at United Arab Emirates University. The subject of the course is classical mechanics offered for science students. Online homework assignments are managed to assess the course learning outcomes. During the assignment 92 students see their grades and have the choice to receive computer feedback on each outcome, and they have the chance to correct their answers until the assignment is completed. The final score is based on the number of trails and hints they obtained by the computer. The main objective from this method is to improve students' learning. Therefore, the average grade for all homework assignments for each student was calculated, and correlated to the students' achievements in the final exam. A relatively good correlation was observed, and most of the course outcomes are achieved.*

KEYWORDS: Online Education, Mastering Physics.

INTRODUCTION

The perennial problem of poor performance of students in introductory physics courses has remained a matter of great concern to all, and the retrogressive of students' performance is known to be a global issue (William, 1990). Improving students learning attracted the attention of physics educators for many years. One part of a solution involves helping students to improve their learning through the use of effective learning techniques. The history of computer-based instruction in physics is almost as old as the electronic computer itself, and as computers have evolved so has educational software. The learning environment using main-frame computers was initiated at the University of Illinois in 1961 (Hans Laue 2005). The arrival of personal computers in 1977 brought about wide- spread development of computer-assisted instruction in physics.

(Hestenes, Wells, and Swackhamer 1992) have used the Force Concept Inventory instrument that provides a clear detailed picture of the problem of commonsense misconceptions in introductory physic. (Mazur (1997), and Benkraouda, Madi, Abada, and Qamhieh 2013) showed that a collaborative teaching and peer instruction method of teaching (PIMT), increases the level of understanding of the course material substantially. (Ausserhofer 1999) showed that the industrial revolution and the advances in computer technology allow transforming the method of instruction to a web-based one. The effectiveness of a Web-based teaching method on students' learning provides a new pattern of research, and it is widely used in higher education for delivering the material and assessing students' learning what so called e-learning.

In United Arab Emirates University (UAEU), the use of new technologies such as laptop projects and blackboard course managing system has an impact on learning. (Benkraouda 2006) showed that combining a method of teaching with technology helps students retain their interest and attention, which stimulate students for more participation, and emphasizes different learning styles. The students' homework performance using a web-based testing system and paper-based in introductory physics courses have been assessed. The result showed that

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students' perceptions about the use of web-based homework system (Blackboard) were positive, and it suggests that students were motivated to complete more homework using the web-based method (Qamhieh, Amrane, and Benkraouda 2013).

(Angie, Jennifer, and Cindy 2009, and Hodge and Demirci 2010) have studied the effect of web-based assessment on student achievements in conceptual tests, exams, and homework assignments. It is found that the web-based homework scores were higher than that of the paper homework. Experiments carried out to evaluate the trustworthiness of the web-based computer homework showed a relatively strong correlation with student's scores in the final exams and the traditional written tests (Qamhieh, Mahmoud, and Ayesh 2013).

Recently a new medium (MasteringPhysics) of learning is evolving which has been demonstrated to have a positive impact on teaching and learning. MasteringPhysics facilitates the transfer of problem-solving skills through tutorial problems. It is supported by a student's helping system in the form of requestable hints, descriptive text, and feedback. Many studies quantify Mastering's impact on teaching, learning, and retention (Michelle and Speckler 2014). The studies illustrate the variety of ways instructors have used Mastering and the results they have achieved..

In this paper, we investigated the impact of using MasteringPhysics as a tool for managing the homework assignments on students' learning. The scores of students were analysed and compared with their scores in other traditional tests. This study share with the community and educators our experience in using MasteringPhysics and its significances on improving students learning and achieving the course learning outcomes.

The Study

To test the feasibility of using MasteringPhysics as a tool for online homework we conducted a pilot study in Fall 2014. An introductory physics course (Newtonian's Mechanics) has been selected for this study. The total number of students involved in the study is 92 distributed over three different sections, and it includes the two genders, two female and one male sections. To enhance students understanding and learning, students are required to complete weekly MasteringPhysics homework assignments comprising of end-of-chapter discussion questions, exercises, and problems. Assignments are due several days after lecture. The assignment allows students to practice conceptual, problem solving and critical thinking questions related to the basic physics concepts covered during the lectures. The homework are selected to tackle specific ideas and concepts help students to improve their understanding and their math skills. Because of time limitation of classes it is difficult to provide students with all ideas correlated to material covered. Therefore, assignments are conducted online outside the classroom using a web-based tutorial system called MasteringPhysics provided by Pearson publisher. When a student login to the assignment site, he/she will find several questions from the MasteringPhysics tutoring system that were carefully selected by the course instructor. Questions were selected from the end of each chapter problems that covers the outcomes of the course. The students are asked to complete the homework assignments outside the classroom and they can use the textbook or any other reference, since this activity is assessment for learning that based on understanding rather than memorizing. While doing an assignment students may interact with each other; hence, peer teaching plays an important role in improvising their physics understanding. After students submit their answers and see the score, the computer prompts students with a feedback on the submitted answers. In addition, MasteringPhysics allows students to hints that lead students to the correct answer. Also,

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students may discuss their mistakes with other classmates or even with the instructor whenever they need more help to understand a specific concept. This will improve students learning. To encourage students to learn from their mistakes, they are given the opportunity to resubmit their answer and improve their performance and score.

It is reported that plagiarisms is a very serious problem and it is the form of academic dishonesty. Therefore, assignment options and features in MasteringPhysics allow restrictions in order to minimize students' plagiarism. In this work several restrictions were implemented:

1) Limit the due date for submitting their assignments; about 5-6 days' were given for students to complete an online homework.

2) Allow questions to appear for students one at a time.

3) Randomize the variables of a question.

4) Limit the time of the assignment to the global average time required by students to complete the selected problems.

To measure the effect of online assignment by using MasteringPhysics on students learning and outcomes assessment, other traditional tests were scheduled to assess students' performance. Throughout the semester, two written tests were scheduled; each covers the material of three chapters from the course material. The tests were graded uniformly by teaching assistants in the department. Since all students registered to the introductory physics course in the university have to sit for a final examination, which can be considered a suitable gage for students learning. The final exam in this study consists of forty multiple-choice questions that covers the whole material and selected carefully to fulfil the course outcomes. Moreover, the final examination is designed such that questions are distributed over different levels of difficulties, so that to reflect clearly the level of students. It is worth noting that Multiple-choice questions are most widely used for measuring knowledge, comprehension, and application of learning outcomes (IAR, 2007). However, there is a debate on the effectiveness of this type of questions among physics educators locally as well as globally (Sevenair et al. 1997).

RESULTS AND DISCUSSION

The 92 students distributed over the three sections completed the tests. Each student submitted eight online assignments, and sat for two written tests and the final exam. The average score of students' performance in the online assignments and the traditional tests were calculated and plotted in figure 1.

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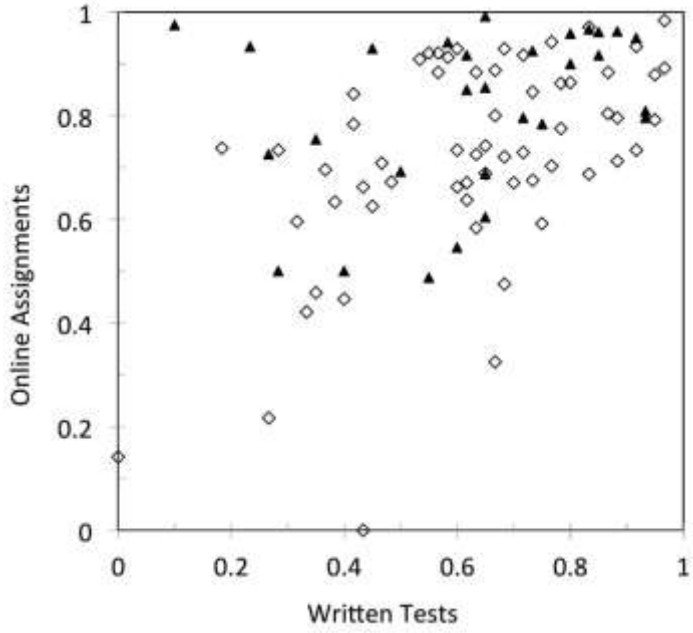

Figure 1. The average scores for students in online assignments versus traditional written tests. The full symbol and the empty symbols represent the scores for male and female students, respectively. The dashed line is the linear trend of the data.

Each point in the figure represents the average score of one student normalized to a value of one. The linear trend of the data has a slope of 1.1, which is a good indication that the online assignments correctly reflect the level of students where the performance of students in online assignments is very close to that of the written tests. A better factor that reflects the trustworthiness of the online assignments outside the class is the correlation factor. The online assignments versus traditional tests are strongly related for female students with a correlation factor of 0.54, and la weaker correlation factor for male students of 0.35. The data in the figure is more concentrated around the dashed line and some are scattered away from it on both sides towards high performance either in traditional or online assignments. Scores deviated from the line towards the upper part of the graph represent students who completed the assignments with the help of others, hence they did not benefit from the assignments in improving their learning as observed from their low score in the tests. This pattern is more prominent in the male sections as shown full symbol in figure and the week correlation factor. On the other hand, few points are deviated from the line towards the lower part of the graph represent students who did not show interest in completing the assignments. Generally, a good student achieves a high score in both online and written tests.

Since students did the MasteringPhysics assignments outside the class and there is no time limitation for the each question, we looked at the amount of time students spent on each assignment compared to the global amount students spent to complete it. The average time our students spent on each assignment versus the global time, provided by MasteringPhysics, is plotted in figure 2. The data in the figure is strongly related with a correlation factor of 0.82. Also the figure shows that, generally, our students spent less time in completing the assignment, which can be related to different factors: Elucidation on the concepts and ideas of the problems during the lectures, and some students may work on the assignments independently. Noteworthy, the two data points at average assignment time of 21.7 are belonging to chapter 5

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(Application of Newtons Laws) and 9 (Rotational Motion). Our students spent less average time on these two specific assignments might be related to the traditional written tests scheduled directly before the assignments of the chapter 5 and 9 that students are well prepared to do them.

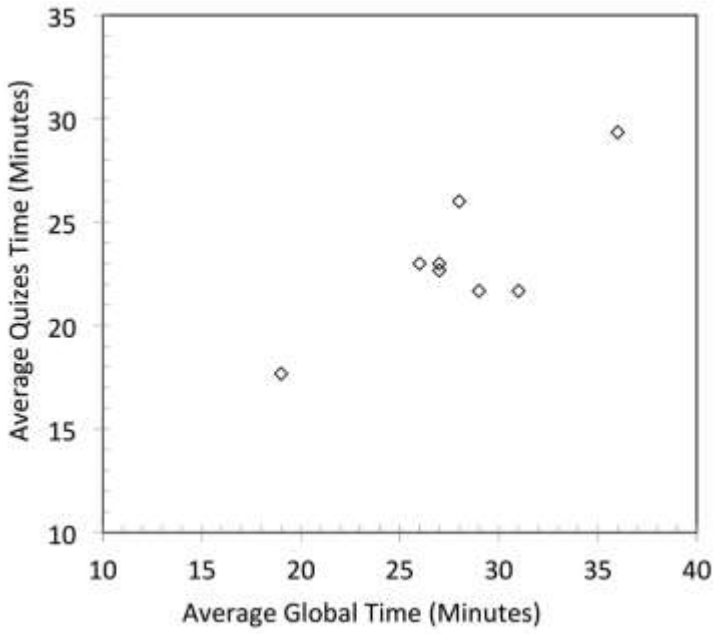

Figure 2. The average time students spent in doing each assignment versus the average time spent globally.

The essence of teaching and learning is to plan teaching events (contents, strategies, etc) and to ascertain to what extent learners have acquired the intended competences, and the learning outcomes of the course have been achieved. The homework manager "MasteringPhysics" tolerates assigning suitable learning outcomes for each question. Herein, we chose three questions to assess three different learning outcomes: 1) Rewrite the kinematic equations for one-dimensional motion in two dimensions (2-Dim. Motion), 2) Reduce a two-dimensional problem into two coupled one-dimensional problems by resolving the components of velocity and acceleration into components along two perpendicular axes (projectile motion), and 3) Calculate the velocity of an object in different reference frames (relative velocity). The three concepts selected to do our study are covered in the same chapter. The percentage of students completed the assigned problems correctly was measured and plotted in figure 3. The figure shows that 75% and 85% achieved the learning outcomes 2-dimensional and projectile motion, respectively. On the other hand, students performance in relative velocity is low, as observed by 45% of the students achieved the learning outcome. Most people find relative velocity to be a relatively difficult concept. In one dimension, however, it's reasonably straightforward. In two dimensions the relative velocity equations look identical to the way they look in one dimension, but it harder to add and subtract the vectors, because students have to use components.

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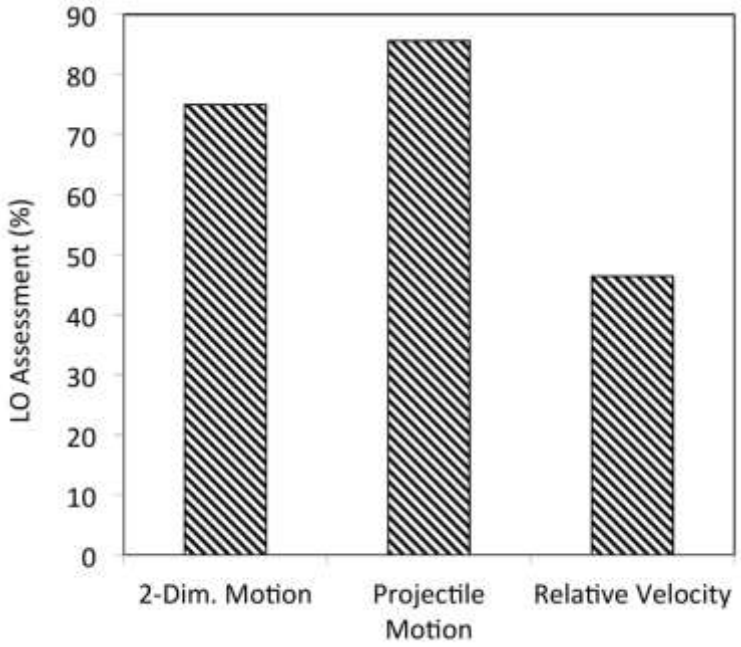

Figure 3. Assessment for three different learning outcomes (LO) to measure students' ability to solve two-dimensional motion, projectile motion, and relative velocity physics problems.

The main objective of using new methods of teaching is to improve students learning. The use of MasteringPhysics assignments makes students more engaged with the material. The increased amount of engagement results in better performance in the course. Figure 4 shows the analysis of the students' performance in the final exam of Fall 2014 compared with similar analysis taken in previous semesters when traditional homework and blackboard homework manager were used. The use of MasteringPhysics online assignments gives a better students performance than using the traditional homework assignments, where 58% of students completed successfully the two dimensional motion problems in fall 2014. In addition, the figure shows a comparable result with the previous study by using Blackboard where 61% of the students achieved the learning outcome, two-dimensional motion. Worth noting that the material used for online homework on blackboard was prepared by the course instructors, which requires a huge amounts of efforts and time. On the other hand, MasteringPhysics provides the instructor with a full access to lists of discussion and tutorial questions, end-of chapters' exercise and problems to be selected for the online assignment. A better students performance in the use of Blackboard, appears in Figure 4, could be related to the fact that the homework was prepared to fulfill the needs of our students from physics principles, and math skills.

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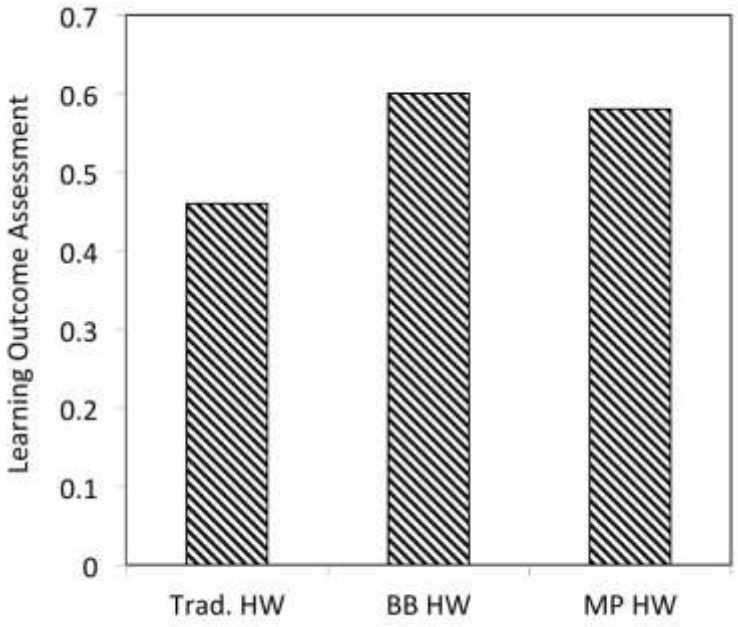

Figure 4. learning outcomes (LO) assessment to measure students' ability to solve two-dimensional motion problems in the final exam by using MasteringPhysics (MP). The result is compared with previous semesters analysis where different homework methods were used [ref].

CONCLUSION

MasteringPhysics has enhanced the performance of our. The weekly MasteringPhysics assignments help and ensure that students keep up with course material as it is delivered, rather than leaving their learning until just before the final examination. Using MasetringPhysics as a homework tool is trustworthiness where students' performance reflects students level. Although there is no time limit for the assignments our students spent an average time similar to that observed globally. In addition to the improvement in exams performance, the learning outcomes are better achieved. Finally MasteringPhysics is like any online packages that provides students with resources and feedback they need to practice and learn outside the classroom.

REFERENCES

Angie, H., Jennifer, C. R., & Cindy, S. Y. (2009). The impact of a Web-based homework tool university algebra courses on student learning and strategies, Journal of Online Learning and Teaching, 5(4), 618-629.

Ausserhofer, A. (1999). Web based teaching and learning, Communications Magazine, 37(3), 92-96.

Benkraouda, M. (2006). Using the peer instruction method in teaching general physics with Blackboard as a tool. Annual Conference for Middle East Teachers of Science, Mathematics and Computing (METSMaC). Abu Dhabi, UAE, 17-19.

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Benkraouda, M., Madi, M., Abada, A., & Qamhieh A. (2013). A systematic study of the efficacy of the peer-instruction method in teaching introductory courses using Blackboard, Education 3(6), 344-347.

Demirci, N., (2010), Web-based vs. paper-based homework to evaluate students' performance in introductory physics courses and students' perceptions: Two years' experience. International Journal on E-Learning, 9(1), 27-49.

Hans Laue (2005), What About Software to Tutor Physics Students in Canada?, La Physique au Canada, Vol. 61, No. 2.

Hestenes, D., Wells, M., and Swackhamer, G. (1992). Force concept inventory. Phys. Teach. 30, 141.

IAR, (2007). Instructional Assessment Resources, University of Texas at Austin.

Mazur, E., (1997), Peer instruction: A user's manual, Prentice Hall Series in Educational Innovation, Upper Saddle River, NJ 07458),

Michelle, D., & Speckler, (2014), MyLab & mastering science and engineering: Data supported evidence of mastering's positive impact on teaching and learning, 2976-2983.

Qamhieh, N. , Ayesh, A. I., and Mahmoud, S. T. (2013). Web-based homework assignments for introductory physics courses. British Journal of Education, Society & Behavioural Science 3(2), 132-143.

Qamhieh, N., Benkraouda M., Amrane, N. (2013), The Use of Backboard in Teaching General Physics Courses, Educational Research (ISSN: 2141-5161) Vol. 4(8) pp. 569-573.

Sevenair JP, Burkett AR (1997). Overview of the multiple-choice format, Retrieved July 21, 2006 from the Xaviar University of Louisiana Web site: http://webusers.xula.edu/jsevenai/objective/overview.ht

William, C. R. (1990), Detection of cognitive structure with protocol data: Predicting performance on physics transfer problems, Cognitive Science 14(2), 253-280.

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