Student Perceptions of Online Homework in Preparatory Year Pre-Calculus courses

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***Abstract*— The Internet is gradually becoming part and parcel of our lives. As a result, online educational technologies are gaining more acceptance in our educational system. This is more so in higher education. However, online assessment is one aspect of online technologies that has taken time to be accepted by educators. This is primarily due to concerns related to reliability, validity and security of online assessment. This paper presents the results of a study that investigates students' perceptions of online homework that was recently introduced in our precalculus courses, as compared to conventional paper and pencil homework. Furthermore, we share some qualitative data we observed that should be useful to all mathematics educators, especially those planning to implement online homework. Some important issues related specifically to MyMathLab, which is the platform we are currently using for online homework, together with the major problems students faced in getting accustomed to the online environment will be discussed.**

***Keywords*— online homework, learning management system, pre-calculus, Preparatory Year Mathematics, student perceptions.**

I. INTRODUCTION

Nowadays, online instructional technologies are complementing – in some cases even replacing --traditional instructional methods at a rapid pace. The underlying philosophy is that the students of today are already online, therefore, educators should engage them academically online as well. As a result, several higher education institutions have adopted a hybrid educational system that combines traditional and online teaching strategies. This has changed the whole concept of what teaching and learning is all about.

> "As a matter of fact, the concept of distance learning has been revolutionized to what is now known as e-learning, blended learning or Web-based learning programs. In what is now popularly known as distributed learning, people use a wide range of computing and communication technologies to provide learning opportunities beyond the time and place constraints of the traditional classroom" (Yushau et al., 2005).

This trend has brought forth a multitude of online learning management systems (LMS) such as Blackboard, WebCT, ILIAS and CCNet to name a few. Most of these systems offer online content delivery, interactive learning and the capability to assess the students online. Several textbook publishers have developed their own LMS environments to accompany their textbooks. Some examples are Pearson's My Labs and Mastering (formerly known as CourseCompass), John Wiley's WileyPlus and McGraw Hill's Connect.

In both traditional and modern classrooms, homework has been the preferred way for teachers to enhance students' learning, develop their skills, and make them demonstrate, hands-on, their understanding of what has been taught in the classroom (Trautwein, Köller, Schmitz, & Baumert, 2002). As a result, online homework has been a very important part of assessment in online classrooms. In fact online homework is one aspect of online assessment that has been widely blended in traditional classrooms as well. This is because it requires less security compared to online quizzes and exams, as students are given the opportunity to do it at home. Many other advantages of using online homework from both teachers' and students' perspectives have been discussed (Doorn, Janssen, & O'Brien, 2010).

Mathematics has generally been a fertile ground for implementing instructional technologies with computers being used in mathematics classroom for more than four decades. This is partly due to the intrinsic connection between computers and mathematics, and partly due to the increasing demand for undergraduate mathematics courses at universities. Furthermore, there is ever growing number of students that require remedial/preparatory mathematics courses to supplement their quantitative and analytical skills. Currently, the traditional classrooms are proving inadequate to deal with the growing influx of mathematics students, thus making the use of e-learning a necessity. Though there are a number of e-learning mathematics courses on offer at undergraduate and foundation levels, mathematics educators have taken a guarded approach to introducing online assessment

in traditional mathematics classrooms. Several reasons have been identified that lead to skepticism of the suitability of online assessment for mathematics courses (see Dermo, 2008).

Although many studies have been conducted on the issues related to the security, reliability, validity, effectiveness and students' attitude towards online homework, not much is known about how the bilingual Arab students perceive and react to online homework in mathematics or any other subject. The phenomenon of online assessment has only recently emerged in the Arab world. A large majority of these students encounter mathematics in English language for the first time in the university preparatory year. As a result, it is generally believed that language would be a formidable barrier for Arab students in online learning and assessment, leading to a negative perception of online assessment. This paper presents the results of a survey carried out at the Preparatory Year Mathematics Program of King Fahd University of Petroleum & Minerals in Saudi Arabia to understand students' perspective on online mathematics homework as compared to the traditional paper and pencil homework. The program adopted online homework for its two traditional classroom-based College Algebra and Trigonometry courses (MATH 001 and MATH 002), while also continuing with the paper-based homework. Therefore the students were in a position to compare the two styles of assessment. Furthermore, the paper also discusses our experience of implementing online homework via MyMathLab (one of Pearson's My Labs) and students' opinion of the platform. It is our goal that the study would prove useful for all mathematics educators in general.

II. Literature Review

Mathematics has generally been a fertile ground for implementing instructional technologies, with computers being used in mathematics classrooms for more than four decades. This is partly due to the intrinsic connection between computers and mathematics, and partly due to the increasing demand for undergraduate mathematics courses at universities. Furthermore, there is an ever growing number of students that require remedial/preparatory mathematics courses to supplement their quantitative and analytical skills. Currently, the traditional classrooms are proving inadequate to deal with the growing influx of mathematics students, thus making the use of e-learning a necessity. Though there are a number of e-learning mathematics courses that are offered at undergraduate and foundation levels, mathematics educators have taken a guarded approach to introducing online assessment in traditional mathematics classrooms. Several reasons have been identified that Have led to skepticism of the suitability of online assessment for mathematics courses (see Dermo, 2008).

> "As the pedagogical-effectiveness of information technology (IT) in mathematics education is carefully established, the topic of discourse among mathematicians and mathematics educators is no longer a dispute about whether or not to use IT in the teaching and learning of mathematics but a shift to some debate about the when and how of its usage" (Yushau, 2006).

Online assessment platforms provide teachers a unique opportunity to socially interact with students and keep track of their progress (Artino & Ioannou, 2008). No wonder the number of universities implementing online assessments is on the increase. However, there is still skepticism regarding the effectiveness of online assessment. Empirical studies conducted on the effectiveness of online homework have been inconclusive. However, the results point to the fact that online assessment is as effective as the traditional paper-based assessment (Hauk and Segalla, 2005). Other studies have found that "low-skilled students who used online homework exhibited significantly higher mathematical achievement than low-skilled students who used textbook homework" (Brewer and Becker, 2010). Furthermore, researchers have shown that the attitude of students towards online homework is generally positive (Dermo, 2008; Doorn, Janssen and O'Brien, 2010). It was also found that students were motivated to complete more homework assignments using the web-based tool than with the traditional paper-based methods, and that a good number of students indicated that online homework increased their mathematical understanding more than the traditional paper-based methods (Hodge, Richardson and York, 2009). Other studies reported that online homework can engage students outside the classroom since it has the capability of "mimicking the attempt-feedback-reattempt sequence of events which often occurs in a teacher's presence" (Melanie, Zerr and Ryan, 2005).

In a nutshell, studies have indicated that students like many features of online homework such as: the possibility of multiple attempts, receiving immediate feedback, working at their own pace, and having access to the correct answers after submitting their work (Sagarra and Zapata, 2008). Research has also shown that students have a highly positive perception of the pedagogical usefulness of online assessment (Hodge, Richardson and York, 2009). Similarly, students are of the opinion that online homework increases their performance and that it is an effective method of study (Demirci, 2007; Dermo, 2008; Dillard-Eggers, Wooten, Childs, & Coker, 2008). On the other hand, some studies have pointed out student difficulties regarding online assessment (Smart & Cappel, 2006), and issues such as plagiarism and academic dishonesty (Rowe, 2004, Khan & Yushau, 2011). It has also been pointed out that on average, students spend almost the same amount of time on online homework as on paper-pencil homework (Dillard-Eggers, Wooten, Childs, & Coker, 2008). Also, as online learning in general requires considerable self-motivation, some authors have given suggestions for successful implementation of this approach (Artino & Ioannou, 2008).

III. Theoretical Framework

The theoretical base of this work stems from the diffusion of innovations theory of Rogers (1995), which is a set of generalizations regarding the process in which innovations typically spread within a social system, where a social system is defined as a set of interrelated units that contributes to the problem solving process so as to accomplish a common goal (Orr, 2003). Since online assessment is completely new in our Prep-Year Program, we felt that Rogers' theory would help us account for the progress of using this method. The theory states that the diffusion of innovation is the "process through which an individual passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision" (Rogers, 1995, p. 20). According to Rogers (1995) the process consists of five stages. These are: knowledge: a person recognizes an innovation and has some opinion about its functions; persuasion: a person has a good or bad attitude toward the innovation; decision: a person manifests his own view on adoption or rejection of the innovation via activities in which he is involved; implementation: a person starts to use an innovation; and confirmation: a person finalizes his decision regarding the adoption or rejection of the innovation.

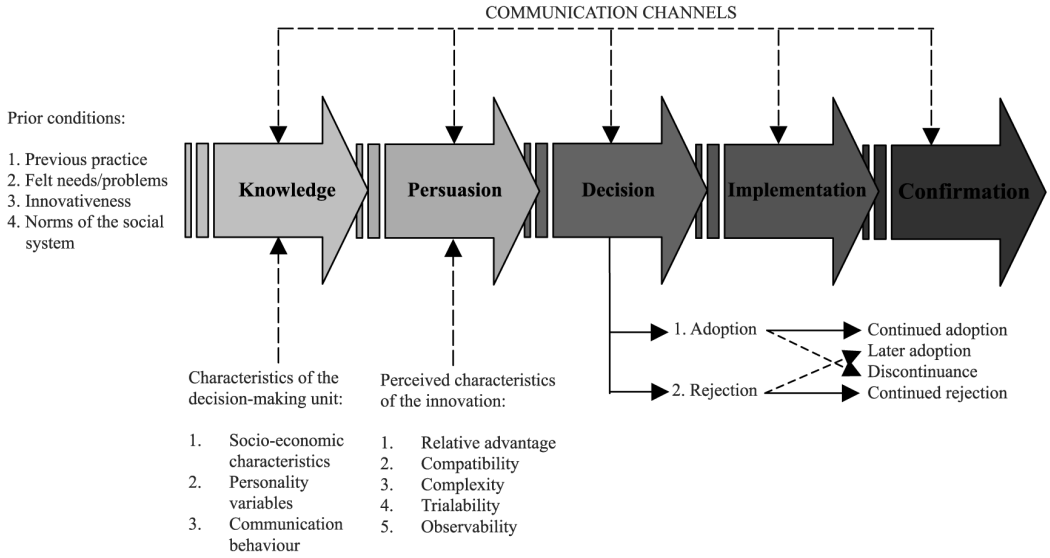

Figure 1. Rogers' Diffusion of Innovation as depicted in (Steele, & Murray, 2004)

When it comes to online assessment, our Prep-Year Program, like several other schools in the region, is currently somewhere between the implementation and the confirmation stages. Obviously, it is a result of the knowledge and positive attitude that the teachers and school administrators have regarding the online assessment that it is currently being used. However, since the purpose of the implementation is to improve the students' learning, it is important to investigate the students' perceptions towards online assessment before reaching the Confirmation stage. As noted by Karal, Cebi and Turgut (2011), the diffusion of an innovation depend on many factors. These include communication channels, time, and compatibility with social systems. The adoption of innovation is higher if it is less ambiguous for the potential adopters and does not conflict with the socio-cultural values, beliefs, and previous knowledge of the targeted group. Therefore, irrespective of the student perceptions of online assessment elsewhere, we felt the need to carry out a study to understand the attitude of our students.

We believe the findings of this study will go a long way in helping the school administration to finally reach the Confirmation stage, at least for adopting online homework as an additional means of assessing students' academic progress. The study also gives indication of the rate at which online assessments are likely to gain acceptance to complement/substitute traditional assessment in the Middle East.

IV. Methodology

Currently, our program is using MyMathlab for delivering course content and submission of online homework. Over an entire semester, students are required to submit their online homework assignments on a weekly basis. The system automatically grades the work submitted by the students and records their scores in the grade book. The students can view the correct solutions and see their grades after submitting their work. They are able to refer to the multimedia textbook, see an example, get a hint and ask the instructor while doing the homework. In addition to assessing students by algorithmically generated exercises, the platform comes with a number of other learning recourses such as multimedia course content, instructor resources and an opportunity for students to interact with each other and the instructor.

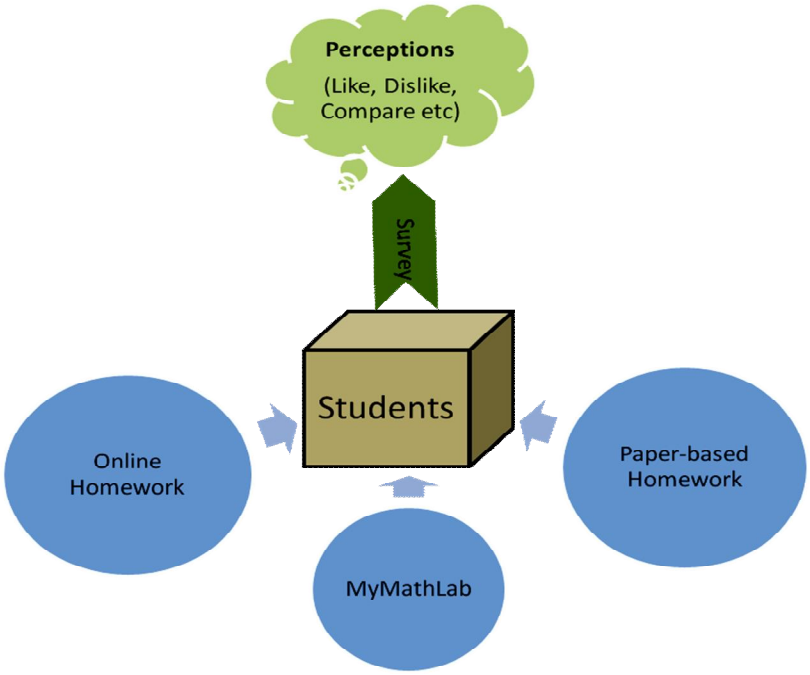

Figure 2. Methodology

Sample

In order to understand student perceptions, we surveyed 394 students from more than 10 sections of our college algebra courses. However, only the data from 337 questionnaires was used for the analysis. The sample includes first-time Math001 and Math002 students as well as those who were repeating these courses. Therefore, all student groups are well-represented in the survey. All the participants were male with average age ranges between 17 and 18. They were fully familiar with the use of computer at their home or school. In all instances, students submitted both types of homework (traditional and online) every week. Both types of homework aim at consolidating students' understanding of the material they have covered in the previous week. Students had access to online homework problems immediately after completing the material in class, and had one week to complete and submit. On the other hand, the written homework problems were chosen from the textbook and indicated in the syllabus that was handed over to the students at the beginning of the semester. The number and the level of both types of homework problems were almost identical, as MyMathLab questions are based on the textbook exercises.

Instrument

The survey was based on a 5-point traditional Likert scale with Strongly Agree = 1, Agree = 2, Neutral = 3, Disagree = 4 and Strongly Disagree = 5. The questionnaire consisted of 38 items, with students being asked questions regarding their possible likes and dislikes of online homework. Specific questions regarding the working platform (MyMathlab) and how the students compared online homework with paper-pencil homework were also included. The full questionnaire is attached as an appendix.

V. Results and Discussion

The student responses to the questionnaire were analyzed using SPSS. The reliability coefficients of the survey items, overall as well as subscales, were good. The alpha value for the total scale is 0.82.

Since the mid-point (3) of our adopted five point Likert scale can be seen as a neutral position, a mean value below 3 can be seen as positive and a mean rating above 3 is negative. In general, the students' responses are mostly positive in all the 38 items in the questionnaire (when the Likert scale is inverted for 'Do not like' questions). In particular, the subscale of 'Like' has an average response of 2.0, which is 'Agree', while the subscale of 'Do not like' has an average of 2.5, which is a score between 'Neutral' and 'Disagree'. Importantly, the correlation between the two subscales is statistically significant at $\alpha = 0.01$.

The item that received the highest rating on why the students like online homework is the fact that the online homework is *faster* than paper homework (mean = 1.7211). This goes to show the trend among youth of liking anything 'fast' (computers, cars, educational programs with short duration etc). This is followed by I receive *hints* if I get the answer wrong (1.9941). This is understandable as this option is not available in the traditional homework. However, what is surprising for us is how these

items got higher ratings than items such as: online homework *improved students understanding* of mathematics (mean = 2.0712) and whether the online homework *helped them prepare for exams* (mean = 2.2700).

Another reason with a high rating on why the participants in this study like online homework is that they are *used to working with computers* (mean = 2.0208). It is interesting to note that this rating is higher than the *immediate feedback* provided by the system on the mistakes made while doing the homework (mean = 2.1810) and I get my *grades immediately*, I do not have to wait for a day or two (mean = 2.2700).

The items that received the lowest positive ratings as to why the students like online homework include getting opportunity for *three attempts* for every question (mean = 2.2730), and that they like to *type instead of writing* (mean = 2.3145).

On the other hand, the main concern expressed by the students was lack of computer access (mean=1.6766). We feel this might not be the case as computer labs are very much available for students use. The second concern is regarding the amount of the homework students are expected to submit every week. It should be noted that the current practice at the Preparatory Year is for students to *submit both online and paper pencil homework* every week, and this is among the major concerns of the students (mean=1.8131). This calls for either reducing the number of problems in both online and paper-based assignments, or concentrate on one type of homework. However, it appears that the students mildly agree to having *both online and paper homework* in the prep year (mean=2.2344). The third concern is regarding the confusion on the *answer format* (for example 3.21435 or 3.2144) (mean=1.9139). This is a genuine problem as some students get confused and frustrated due to losing marks as a result of the answer format.

Other set of concerns with mild positive rating is that online homework *wastes a lot of students' time* (mean=2.2878). Obviously, students that are not conversant with typing mathematics on computers initially spend a lot of time to complete the assignments. This is followed by I like *using pencil and paper* while doing mathematics (mean=2.1513).

The responses to other items that are more or less neutral, but tilted toward agreement include:

time to submit the homework is too short (mean=2.3264).

the questions were not useful for exams (mean=2.3294).

Online homework can be very helpful if students have access to more computer labs (mean=2.3294).

Using a computer increases the difficulty of doing homework (mean=2.3947).

I experienced technical problems doing my online homework (mean=2.403).

online questions are not enough to cover all ideas in a textbook section (mean=2.4273).

the hints given when doing online home work were not helpful (mean=2.5786).

homework was too simple (mean=2.8368).

The general perceptions of the participants in this study regarding the accuracy and security of MyMathLab platform are mostly positive. They agreed that MyMathLab system always *grades their answers correctly* (mean=2.0297), and that they *are confident that their grades for online assessments are secure* (mean=2.3086). This is followed by the fact that the students are spending *more time* studying with MyMathlab than with their book (mean=2.4510). However, the participants are somewhat concerned that *the system is slow* (mean= 2.3145), and cannot completely *check students' mathematical ability* (mean=2.3917).

As of the general opinion regarding online homework as compared to the paper-pencil homework, the responses of the participants are as follows:

It is good to do all mathematics homework online (mean=2.1128)

All homework in the Prep-Year should be online only (mean=2.2374).

I find it hard to concentrate on questions when doing my homework online (mean=2.6261).

I have learnt more doing my homework on paper (mean=2.2938).

I would feel more comfortable if all my homework is by paper and pencil (mean=2.3056)

The online homework was more beneficial than the paper homework (2.4184).

Although the participants in this study have shown concern about the volume of homework, they seem to be comfortable with both types of homework. They do not seem to prefer one over the other.

Additionally, students were asked if they would like the online homework to be extended to quizzes and major exams. Surprisingly, they seem to agree more on having online *major exams* (mean=1.91) compared to online *quizzes* (mean=2.11).

In general, students have shown enthusiasm towards online homework. Now and then, they ask their teachers when the online homework is going to be posted. We have also noticed that online homework reduces collaborative cheating, since in the

paper-pencil homework, the same set of questions is allocated to each student while the online homework questions are algorithmically generated for each student with different parameters. However, students are generally smart and can devise different strategies for cheating the online platform. In fact, we did notice such an instance and how it was resolved. For further details one can see Khan & Yushau (2011).

VI. Conclusions

In this paper, we have looked into the students' responses to online homework in the Preparatory Year Mathematics courses. This is the first time such a study has been conducted in the Arab world as the whole concept of online homework is new in the region. As can be observed, the majority of students have a positive perception of online homework. Some of the factors that students appreciated the most include: the fact that online homework is faster than paper homework, the hints they received when they wrote the wrong answer, and the ease of use of the MyMathLab system. On the other hand, the participants have expressed concern regarding the lack of availability of computers to do the homework, which we do not think to be a genuine concern as computer labs are readily available for the students' use. This is followed by confusion regarding the answer format and the lack of time to do the homework; genuine concerns in our opinion. Some students expressed their reservations about the usefulness of online homework, especially for exam preparation, but mostly their problems were either technical in nature, for example slow Internet access or issues specific to the MyMathLab platform, for example the continual slowness of the system.

This is an initial study on the innovation of online homework. It is our hope to look deeper into the impact of online homework on students' learning and achievement in mathematics, how it compares with the impact of paper-pencil homework and how to make online homework an active learning process for students.

Acknowledgment

The authors acknowledge with thanks King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia for the research support.

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