

Web-Based Homework Systems: Students' Perceptions of Course Interaction and Learning in Mathematics

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Abstract: The use of web-based homework management systems has been on the rise for the past few years. These systems provide digital alternatives to the traditional paper-and-pencil assignments. The current study aimed at investigating student perceptions of the impact of the use of web-based homework systems on students' active learning in mathematics. The study also investigated the effects of specific features of these systems such as immediate feedback and multiple attempts on student motivation and practice. Ninety-seven college students enrolled in a mathematics course participated in this study. Data were collected using a 5-point Likert-type questionnaire. The results indicated that students had a positive attitude toward the use of web-based homework systems and they also felt motivated to do more practice using the different features of these systems. Students perceived the web-based homework systems to have a positive influence on their learning experience in the classroom.

Keywords: Web-based systems, Class interaction, Perceptions, Mathematics

Introduction

The National Council of Teachers of Mathematics (NCTM) emphasized the use of technology in the mathematics classroom. In 2008, NCTM stated the following:

Technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that all their students have access to technology. Effective teachers maximize the potential of technology to develop students' understanding, stimulate their interest and increase their proficiency in mathematics. When technology is used strategically, it can provide access to mathematics for all students.

One of the ways to effectively include technology in the classroom is the integration of a web-based homework system. Web-based homework has been used as an alternative to paper-and-pencil homework in many fields of study including chemistry, mathematics, physics and statistics courses (Babaali & Gonzalez, 2015; Bliwise, 2005; Bonham, Beichner, & Deardorff, 2001; Cole & Todd, 2003; Dufresne, Mestre, Hart, & Rath, 2002; Freasier, Collins, & Newitt, 2003; Fynewever, 2008; Hauk, & Segalla, 2005; Lenz, 2010; Lin, 2009; Pascarella, 2004; Penn, Nedeff, & Gozdzik, 2000; Pennington, 2013; Toback, Mershin, & Nazimova, 2005; York, Hodge & Richardson, 2008; Zerr, 2007).

Some of the studies that investigated the use of web-based homework systems focused on students' perceptions of their learning using these systems (Butler & Zerr, 2005; Demirci, 2007; Hauk & Segalla, 2005; Picciano, 2002; Smolira, 2008), while other studies compared between the use of web-based homework systems and the use of paper-and-pencil homework (Burch & Kuo, 2010; Dufresne, Mestre, Hart, & Rath, 2002; Mendicino, Razzaq & Heffernan, 2009; Thoennesen & Harrison, 1996).

Tang and Titus (2002) surveyed students who used WebAssign in their physics and calculus courses on a weekly basis. They found that using WebAssign increased student-instructor as well as student-student interactions. Its use was beneficial for both students and instructors; the students put more time and effort into doing homework outside the classroom while instructors were able to create learning activities based on student feedback.

Smolira (2008) investigated students' perceptions of online homework assignments in an introductory finance class. Eighty students participated in the study. Fifty students were enrolled in two undergraduate introductory corporate finance classes required of all business majors. Thirty students were enrolled in a Master of Business Administration prerequisite corporate finance class. To elicit students' perceptions of the effectiveness of online homework as part of the learning process, students completed a questionnaire at the end of the semester. In their

responses to whether the online homework assignments were helpful in improving their understanding of finance, most students reported that the homework improved their understanding; 84% of undergraduates and 87% of graduate students reported that it was extremely helpful or somewhat helpful. In addition, students (64% undergraduate and 70% graduate students) reported that online homework was more valuable and beneficial to them than traditional homework. Furthermore, 32 undergraduates (64%) and 21 graduate students (70%) reported that the online homework was more valuable than traditional homework. The majority of students (80% of undergraduate students) and all graduate students reported that it was easy to use. The researcher concluded that students perceived the online homework as valuable in contributing to their learning. Students preferred online homework to traditional homework assignments.

Gok (2011) compared the effects of web-based vs paper-and-pencil homework on the achievement of 287 students using conceptual tests, exams, and homework assignments. The participants were enrolled in two sections of an introductory calculus-based semester course at a public university in the middle region of the US. Students in the experimental section used a web-based homework system, while students in the other section completed homework in a traditional fashion using paper and pencil. Gok found that there was no significant difference between the exam scores for the two sections. However, he found that students in the experimental section performed better on their homework.

Pennington (2013) investigated the use of ALEKS as a web-based homework system on student achievement in a college algebra course. The research data consisted of a pretest, posttest, pre- and post-surveys. The pre-test was used to measure students' prior knowledge of the material before taking the course. The pre-survey was used to gather demographic information including gender while the post-survey was used to gain information on students' work ethic and their perceptions of the use of ALEKS in the course. The researcher found that using ALEKS improved students' online quiz grades.

Babaali & Gonzalez (2015) investigated the effects of the use of a computer software program to supplement instruction on student performance in pre-calculus. Participants in this study were divided into two groups; a control group and a treatment group. The treatment group consisted of four sections of pre-calculus. A total of 123 students enrolled in the course and 99 students completed it. This group used the Hawkes Learning Systems for homework assignments. The control group consisted of four sections of a total of 122 students who completed the course in which the software was not used. This group completed the semester with paper and pencil homework and in-class exams. Data were collected in the form of final exam grades and also data was collected for each question on the final exam. The researchers found that students in the treatment group had a higher average on the final exam than the students in the control group as well as students enrolled in traditional courses from past years. Based on the results of this study, the researchers support the inclusion of online homework software in introductory-level mathematics courses.

York, Hodge & Richardson (2008) examined students' perceptions of the effects of the use of web-based homework on their learning and motivation. Participants in study were 376 students enrolled in a college algebra course at the university level. Participants completed the majority of their homework online. The researchers evaluated students' perceptions of the web-based homework through a survey containing both Likert-scale items and open-ended questions. The researchers found that few students appreciated the immediate feedback, but that most of them felt more accountable for completing the assigned work.

In a study that investigated the use of online homework, Wooten & Dillard-Eggers (2013) surveyed 453 students in 16 accounting principles classes, six of the classes were financial accounting principles while ten of the classes were managerial accounting principles. Students had access to the "Personal Trainer" (Thompson-Southwestern Publishing) online software through an access code. The assigned homework problems were from the textbook and were answered via the online software. Students were able to work on the problems through unlimited attempts until they answered correctly. Online homework was a requirement for students in seven classes (225 students). For the other nine classes (228 students), use of the online software was recommended. The researchers found that users of online homework, compared to nonusers, earned a higher grade in class. In addition, they found that, on average, both required and not-required users rated the online homework experience positively. They concluded that the use of online homework is an effective way to motivate students and may be particularly beneficial for less motivated or poorer performing students.

Lin (2009) investigated the comparative efficiency of Web-based instruction and traditional teaching methods on preservice teachers' fraction knowledge. Forty-two preservice teachers who were enrolled in two classes (21 students each) participated in this study. The experimental class used Web-based Instruction, the other class was given traditional instruction. The researcher collected the data using pre- and posttest. The test consisted of 32

items that aimed at assessing students' knowledge of fractions. The results revealed a statistically significant difference between the experimental and the control groups' posttest mean scores in favor of the experimental group.

Raines (2016) examined students' perceptions of the use of MyMathLab to complete homework online in a redesigned elementary algebra "Essentials of Mathematics" course. The researcher designed an attitudinal survey instrument based on her review of similar surveys in other research studies. The survey consisted of 19 five-point Likert scale items, two free-response questions and one question asking about previous use of MyMathLab. The scale was used as follows: (1) equaled strongly disagree, (2) equaled disagree, (3) equaled neither agree nor disagree (or neutral/no opinion), (4) equaled agree, and (5) equaled strongly agree. The responses of 125 students who filled in the survey and completed the course were used. The results indicated that completing homework online appeared to have a positive impact on students' understanding of the mathematics concepts in the course. In addition, students felt that the use of MyMathLab prepared them for the tests.

The focus of this paper is on students' perceptions of the impact of using web-based homework systems on their course interaction and learning in mathematics. In addition, the study investigated the effect of the web-based homework system features such as immediate feedback, multiple attempts and other resources on students' motivation to do more practice.

Research Questions

The aim of this study was to answer the following five questions:

Did using a web-based homework system increase students' interaction with the professor, classmates and tutors in and outside of class?

What is the impact of the web-based homework system features such as immediate feedback, multiple attempts and other resources on students' motivation to do more practice?

What are students' perceptions of the influence of online homework on their learning?

Do students prefer web-based homework over paper-based homework?

What are students' perceptions of technical issues with their computers and the web-based homework system on their course performance and attitudes?

Method

The participants in this study were 97 university students who were enrolled in a mathematics course. To provide an answer to the research questions, data were collected using a 5-point Likert-type questionnaire about the use of Web based homework systems in the classroom. The scale ranged from Strongly Agree (5) to Strongly Disagree (1). The questionnaire consisted of 13 items that were developed by the researcher based on the aim of the study as well as the review of the literature.

Findings

In the following analysis, the designation of "agree" includes all "agree" and "strongly agree" responses while the "disagree" designation includes all "disagree" or "strongly disagree" survey responses. To answer the first research question about students' interaction with the professor, classmates and tutors in and outside of class, 17.5% of students agreed that that the use of the web-based homework system increased their interaction with the professor, while 40.2 % disagreed. This indicates that students did not feel that the use of web-based homework systems influenced their interaction with their professor positively. In addition, only 27.8% indicated that the use of web-based homework systems increased their interaction with their classmates, while 41.2% disagreed with that. On the other hand, 37.1% of the students indicated that the use of web-based homework system motivated them to seek help from tutors, instructors and classmates while 30.9% disagreed with that. This indicates that the students' degree of interaction with the computer did not have an effect on their interaction with their instructors and classmates. Table 1 provides the mean the standard deviation for these items.

Table 1. Students' Perceptions of Interaction

Item	Mean	SD
The use of the web -based homework system increased my interaction with the professor in and/or outside of class	2.7	1.04
The use of the web-based homework system increased my interaction with my classmates in and/or outside of class.	2.8	1.11
The use of the web-based homework system motivated me to seek help from tutors, classmates and the instructor.	3.1	1.16

In regards to the second question about the impact of the available features of the web-based homework system such as immediate feedback, multiple attempts and other resources on students' motivation to do more practice, 70.1% of students indicated that immediate feedback improved their practice, 94.8% indicated that the multiple attempts feature motivated them to do more practice, and 79.4% indicated that the available resources also motivated them to do more practice. The results indicated that students had a positive attitude toward the positive value of the available resources within the web-based homework system; students found that these resources motivated them to do more practice. Table 2 provides the mean the standard deviation for these items.

Table 2. Students' Perceptions of System Features

Item	Mean	SD
The Immediate Feedback feature motivated me to do more practice with the course material.	3.8	1.10
The Multiple Attempts feature motivated me to do more practice with the course material.	4.6	0.63
The resources within the web-based homework system helped me understand and solve the questions correctly.	4.1	0.99

In regards to the third question about students' perceptions of the Influence of online homework on their learning, more than 50 percent (51.1%) of students indicated that using the web-based homework system enhanced their learning of the mathematical concepts covered in the class. Only 11.3% disagreed (mean=3.6). In addition, 66% of the students reported that the system prepared them for the paper-based in class exams (mean=3.7). In addition, 58.8% of students indicated that the system helped them develop confidence in their understanding of mathematical concepts (mean=3.6). Results indicated that Students found that web-based homework systems had a positive influence on their learning experience in the classroom.

Table 3. Students' Perceptions of the Influence of online homework on their learning

Item	Mean	SD
Doing homework using the web-based homework system enhanced my learning.	3.6	1.01
Solving questions using the web-based homework system prepared me for the paper-based class exams.	3.7	1.06
The use of the web-based homework system helped me develop confidence in the subject.	3.6	1.06

In regards to the fourth question regarding students' preference of web-based homework over paper-based homework, the majority (92.8%) indicated that it was easy for them to access the internet (mean=4.7). In addition, 61.9% indicated that they preferred submitting the homework online rather than on paper.

Table 4. Accessing and Using Online homework

Item	Mean	SD
It is easy for me to use the internet.	4.7	0.67
I spend less time studying when there is no homework assigned for class.	3.6	1.08
I prefer submitting homework online using a web-based homework system more than submitting it on paper.	3.8	1.25

In regards to the fourth question about the effect of technical issues on students' class performance. Most students (54.6%) indicated that technical difficulties did not affect their course performance, with 24.7% indicating that technical issues with their computers and the web-based homework system affected their class performance and attitude toward homework in this class.

Table 5. Technical Issues

Item	Mean	SD
Technical issues with my computer and the web-based homework system affected my class performance and attitude toward homework in this class.	2.6	1.22

Conclusion

The use of technology was emphasized as an essential tool for learning mathematics in the 21st century by The National Council of Teachers of Mathematics. Web-based homework management systems are instructional tools that provide flexibility, offer students immediate feedback and facilitate a student-centered environment where students are able to rework the questions multiple times thus enhancing the learning process. The goal of using these systems is to enhance students' understanding and engagement in classroom discussions. The focus of this study was on students' perceptions of the impact of using web-based homework systems on their course interaction and learning in mathematics.

In addition, the study investigated the effect of the web-based homework system features such as immediate feedback, multiple attempts and other resources on students' motivation to do more practice. The results of this study indicated that students had a positive attitude toward the available resources within the web-based homework system and that they perceived these systems as having a positive effect on their motivation to do more practice. The results revealed that students found the web-based homework system to have a positive influence on their learning experience in the classroom. In general, students had a positive experience using web-based homework systems as indicated by their responses. More studies are needed to examine the correlation between gender, age, and grade differences and students' attitudes toward the use of these systems.

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