

## EXPLORING ATTITUDES AND ACHIEVEMENT OF WEB-BASED HOMEWORK IN DEVELOPMENTAL ALGEBRA

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### ABSTRACT

The purpose of this study was to understand how students' attitudes were connected to their mathematics learning. This investigation was specific to web-based homework in developmental courses in the community college environment. The mixed-methods approach was used to analyze the relationship between students' attitudes and mathematical achievement. The findings from the survey questionnaire showed mixed responses from the students on the benefits and disadvantages of the web-based homework. Cluster analysis results indicated the relationship between the three groups of students and their differences in mathematics attitude. The results suggest that students with lower and average mathematics achievement had a more positive attitude towards using the web-based homework system compared to the high achieving students. Based on the results, it can be noted that web-based homework plays an important role in students' attitude possibly because of the immediate feedback that improves understanding

**Keywords:** Web-based homework; Mathematics attitude; Mathematics achievement; Developmental algebra

### 1. INTRODUCTION

Students who enrolled in college level mathematics courses seem unprepared to complete the courses especially college algebra (Hodges & Kennedy, 2004). This is based on their high school grades and college placement examination scores. Colleges help these underprepared students with the developmental or remedial mathematics courses. After completing these compulsory developmental courses with satisfactory grades, students are then allowed to enroll in their college mathematics classes.

A study done by Hoyt and Sorensen (2001), reported that between 30- 90% of in-coming college students require developmental mathematics classes before they begin college level mathematics classes. Even with extensive developmental mathematical courses, a large number of students were unable to succeed in college algebra by getting the D, W or F grades known as the DWF rate (Brewer, 2009). The average passing rate for college algebra in the United States is between 40- 50 % (Herriott, 2006).

To address this issue, reforms in college algebra should be given priority. Nonetheless, large scale reforms in these mathematics courses face difficulty as colleges and universities structure these programs based on certain theoretical and practical considerations (Baxter Hastings et. al., 2006). In most college algebra classes, the pedagogical framework are lectures given by instructors and homework assigned to students. If these effective pedagogical strategies can fit within the traditional lecture based classes, the college mathematics community would support this change (Brewer, 2009). This study intends to blend the intervention called web based homework within the traditional framework and explore students' attitudes and achievement in developmental algebra.

### 2. WEB-BASED HOMEWORK

Homework is assigned to students by instructors to be completed at home. This is particularly relevant in mathematics classes. Students require the opportunity to practice the skills they have just learned. Observing examples provided by instructors in mathematics classes are insufficient to help students acquire the necessary procedures in solving a mathematical question. Students require feedback from instructors after completing their homework. This step is important in knowing whether the students' understanding is correct when solving problems. Students are then able to adjust their approach after realizing their errors from the feedback obtained. This is known in the mathematics education field as the attempt-feedback-reattempt cycle (Zerr, 2007).

However, at the college level some students do not attempt the homework problems given by their instructors. This causes the students to miss the opportunity to solve the homework questions on their own. Without this important component, students would not know the correctness of their solutions and obtain the necessary feedback from their instructors. In addition, some instructors might not be able to collect their students' homework and grade them due to time constraint (Brewer, 2009). Finally, even though the first attempt has been graded, students might not receive the feedback in a timely fashion and students fail to re-adjust their

understanding of the concept (Jacobson, 2006). In short, the students do not obtain the maximum benefits of completing the homework in an algebra class.

One way to improve the attempt-feedback-reattempt cycle in a traditional homework is by using the web-based homework. The web-based homework or online homework, in general refers to a system of computerized homework problems that is available online with the capability to automatically grade answers and provide immediate feedback on the correctness of the solutions (Jacobson, 2006; Kinney, 2001). In this study, the web-based homework used follows closely the aspect of this definition. The homework system contains similar questions that are available in an algebra textbook and also questions with different degree of difficulty. Questions vary in different forms of true or false, open ended questions, regular exercises and challenging questions. Completed solutions would be automatically graded by the homework system once the answers are submitted. Students have the option to save the answers and complete one whole section of an exercise before submitting them. To assist students having problems solving the homework, a few examples similar to the question asked are shown. This helps the student understand the steps involved in answering the questions. Short video lectures are also provided for students to revise the algebra concepts. The online homework system is able to generate similar questions of a particular concept from the large database of questions.

### 3. OBJECTIVES

The aim of this study was grounded in our goal to understand how students' attitudes are connected to their mathematics learning and performance. This investigation was specific to web-based homework in developmental courses (i.e. remedial) in the community college environment. Some of our initial questions, answered using mixed-methods, centred on gaining a better understanding of how mathematics attitudes of community college students impeded their progress in developmental mathematics courses (Author & Author, 2011). Findings from this study suggest that attitudes about web-based homework have significant implications on how students engage with and use web-based homework in online learning environments, thus the re-development of positive attitudes about mathematics at this late stage is essential.

Empirical and critical perspectives are applied in this research study based on factors surrounding lower income, immigrant, and racial/ethnic minority student success in community colleges. In general, students' difficult and often ill-equipped transition from high school to community college (Conley, 2007, 2010), especially lower-income students and urban students of colour (Roderick, Nagaoka, and Coca, 2009), positions them on a track for failure. With the advent of advanced web-based technology to track and aid students in mathematics, we are required to persistently investigate the usefulness of such platforms in developmental mathematics contexts. The present investigation was situated along three primary areas: (1) examining associations between attitudes and achievement, (2) understanding students' attitudes about web-based homework, and (3) increasing student outcomes. In a larger context, this study also seeks to add to discourses about developmental education in community colleges (Bailey, 2009).

The purpose of this study was to understand how students' attitudes are connected to their mathematics achievement. The study focuses specifically on the web-based homework in developmental algebra courses at the community college level. This study sought to answer the following research questions:

1. What are the benefits and disadvantages of web-based homework programs in developmental algebra, specifically as they relate to student learning?
2. What associations exist between students' attitudes and beliefs about web-based homework and their achievement in developmental algebra?

### 4. THEORETICAL PERSPECTIVES

The perspectives and ideas presented here allowed us to utilize former research as a means to contextualize and outline the modes of inquiry applied in this study. One additional goal of this study focused on continually challenging notions of "what works" in diverse mathematics classrooms and generating more active discussions about student experiences, their attitudes, behaviours, and their resulting achievement in developmental mathematics courses. Cooper (2007) noted that opinions about homework, not necessarily web-based homework, and the positive effects on their achievement were varied. Brewer & Becker (2010) conducted a quasi-experimental, post-test design study to examine the effectiveness of online homework (OHW) versus traditional-textbook based homework (THW). The results showed that low-skilled students who utilized OHW exhibited higher mathematical achievement than the low-skilled students who utilized THW.

Within the mission to advance the mathematics learning and increase mathematics achievement of lower income students and students of colour enrolled in community colleges (Zimmerman et al, 2011), more research focused on supporting beneficial and positive experiences is needed. Given that the use of web-based homework

platforms is becoming a standard practice in developmental algebra courses in community colleges, the research described in this study is both important and appropriate.

## 5. METHODOLOGY

This study used the mixed-methods research; phase 1 focused on quantitative component, phase 2 focused on qualitative component. A survey questionnaire was utilized to inform the researchers about the attitudes and beliefs of students on the web-based homework in the developmental algebra classes. The survey instrument consist of a 40 items questionnaire using a five point Likert scale. Items 1 to 15 focuses on mathematics beliefs, items 16 to 30 concentrates on attitudes towards web-based honework and items 31 to 40 courses on the usefulness of the web-based homework. Qualitative component (phase 2) asks for individual student thoughts about web-based platform from the open ended responses in the survey instrument.

To ensure the reliability of the survey questionnaire, a pilot test was conducted to obtain the reliability coefficient. The reliability coefficient method used was Cronbach's alpha. The Cronbach's alpha coefficient value of the survey items was 0.76. To answer the first reseach question, data from the open-ended responses in the survey instrument were analyzed. Students shared the benefits they obtained while using this web based homework system. The disadvantages of the homework system was also obtained from the students in the developmenal algebra classes.

For the second research question, quantitative methods such as cluster analysis and analysis of variance (ANOVA) were used to analyze the data. Cluster analysis identifies groups of samples that behave similarly or show similar characteristics. In this study, cluster analysis was used to explore the number of student groups from the sample. The ANOVA technique was used to determine whether there were any significant differences among the clusters. ANOVA investigated the relationship between students' mathematics attitudes and beliefs and mathematical achievements (as measured by a standardized examination). If the ANOVA analysis was significant among the clusters, the researcher also conducted a Tukey post-hoc test to determine where the differences existed.

Participants of this study are from a community college in an eastern state in the United States. Students are mostly Black and Latin. In this study, data was collected from 78 participants. The majority of the students are taking this mathematics course as a requirement for their graduation and usually as a pre-requisite for other courses. Most of the students are full time students but some of them work outside class time to pay for their college fees. Data collected from students in a developmental algebra course.

## 6. RESULTS

The first research question in this study states: What are the benefits and disadvantages of web-based homework programs in developmental algebra, specifically as they relate to student learning? The results from the survey questionnaire indicated mixed responses from the students on the benefits and disadvantages of the web-based homework. Students who liked the web-based homework generally mentioned the easy accessibility. In addition, the convenient of accessing the homework online and they could attempt the questions wherever they are. Some students preferred to attempt the questions late in the night or early in the morning depending on the available time. Many students mentioned that the instant feedback received from the homework system on the correctness of the answer was beneficial. The step by step solution provided for certain questions was very helpful in students finding their mistakes. This helps students who get frustrated easily when they are unable to spot the errors they made while attempting the question. One student even said that "This online homework system gave me a great study guide for questions and a way to work on them to perfection." A few students also praised the tab buttons in the homework system that was useful such as the "Practice It" and "Master It". Furthermore, what the students liked was the many features in the program that includes some video lectures and the how the program helped them in learning.

Some of the disadvantages mentioned by the respondents included the emphasis not on the working but just the final answer and how to get the right solution after trying a few times. The homework system only gives a feedback of right or wrong for most of the questions attempted. One common feature of this program that frustrate students especially when the error exists in their solution or when inputting mathematical symbols in the answer column. One student even mentioned about the difficulty of inserting the answers in the fraction form. Furthermore, the program does not provide sufficient feedback on what parts of the answer were incorrect in a specific problem. Citing one very specific example in the graphing of points, one student mentioned that the program is very rigid and does not let you plot the points easily.

Now we move on to the second research question: What associations exist between students' attitudes and beliefs about web-based homework and their achievement in developmental algebra? To answer this research question, quantitative methods that include cluster analysis and ANOVA was utilized. Cluster analysis results showed the relationship between the group of students and their mathematics attitude. From the analysis, there were 3 groups of students. Students in Cluster 1 rate survey items on attitudes and beliefs on the web based homework highly. Students in Cluster 2 and Cluster 3 had rated more items on attitudes and usefulness of web based homework system highly. Cluster 1 consists of 12 students. Cluster 2 had 29 students while Cluster 3 had 37 participants. The ANOVA analysis utilized the Tukey post-hoc test to compare the mean differences between the clusters. Using the Tukey post hoc test, the result showed that Cluster 1 students had high mathematics score, Cluster 2 students had average mathematics score while Cluster 3 students had a low mathematics score.

## 7. DISCUSSION AND CONCLUSION

This study investigates how students' attitudes are connected to their mathematics learning. Specifically, it examined learners' attitudes and beliefs on web-based homework in one developmental algebra course at the community college setting. It probed certain student demographics and whether the mathematics achievement had any relationship with the attitude towards the web-based homework tool. This study also explored the benefits and disadvantages of using the web based homework platform from the students' perspective in learning algebra.

The first research question comprised of the usefulness of the web based homework system. Results from the survey questionnaire showed mixed responses from the students on the benefits and disadvantages of the web-based homework. Students who liked the web-based homework generally mentioned the convenience, the many features in the program that includes some video lectures and the how the program helped them in learning. Some of the disadvantages mentioned including the emphasis not on the working but just the final answer, how to get the right solution after trying a few times and just getting a feedback of right or wrong.

The results suggest that students with lower and average mathematics achievement had a more positive in attitude towards using the web-based homework system compared to the high achieving students. These findings are similar with the notion that low-skilled students who obtains more benefits than high-performing students from the usage of web based homework (Wooten, 2013). Based on the results, it can be noted that web-based homework plays an important role in students' attitude possibly because of the immediate feedback that improves understanding.

This study provided some evidence that web-based homework such as Web Assign used in developmental algebra class maybe more beneficial to the students to receive immediate feedback through the automatic grading system. Furthermore, this study indicated that the use of the web-based homework provides more opportunities and motivates lower performing students in learning algebra. This is consistent with the findings of the study of the usage of the web-based homework in the first semester calculus class (Zeer, 2007).

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