

**STUDENT PERCEPTIONS ON USING MYMATHLAB
TO COMPLETE HOMEWORK ONLINE**

Joan Raines

Middle Tennessee State University

joan.raines@mtsu.edu

Abstract

The main aim of this study was to examine and better understand students' perceptions on the use of MyMathLab, an online interactive course management system, for completing homework online in a redesigned elementary algebra course. A survey was administered to 125 students after midterm and results indicated that from the students' perspective, completing homework online appeared to have a positive impact on their understanding of the mathematics concepts in the course. Additionally, students' perceptions that doing homework online prepared them for in-class tests appeared to have a positive impact on their learning the content in the course. The results of this study suggest that completing homework online played a prominent role in the attitudes of and outcomes for those students requiring some type of remediation before taking college-level mathematics courses.

Keywords: online homework, student perceptions of online homework, web-based mathematics instruction, MyMathLab

The number of high school students in the United States attending college after graduation is on the rise. However, thousands of these students discover they lack adequate preparation for college-level courses, especially in mathematics. In the fall of 2000, 56% of all mathematics classes at two-year colleges and 12% at four-year colleges were remedial; and in 2001, remediation was required for almost one-third of freshmen entering college (Bettinger & Long, 2009; McGowen, 2006). In their study using data from the U.S. Department of Education, Greene and Forster (2003) found that only 32% of all students that complete high school are ready to attend college. A 2010 report by the National Center for Public Policy and Higher Education and the Southern Regional Education Board found nearly 60% of incoming college students were not adequately prepared academically and required some remedial instruction. In 2012, only 25% of all high school graduates who took the ACT exam met the College Readiness Benchmarks in the four individual subjects tested and the number meeting all four benchmarks in 2013 and 2014 increased only 1% (ACT, 2013, 2014). Based on this information, the number of students entering college who require remediation, particularly in mathematics, is not decreasing.

With low retention and high DFW rates in many remedial courses, it is critical that educators find ways to turn these outcomes around. Brewer and Becker (2010) found that instead of trying to make drastic changes to entire programs and curriculum, “efforts to solve the problem of helping students succeed need to focus on interventions that can be implemented within the framework of existing programs” (p. 354). One such intervention

is a course management system allowing students to complete homework online, thereby increasing understanding of course content which leads to improved performance and student success in the course. This study analyzed students' perceptions of the use of one of these course management systems, MyMathLab, through the use of survey data.

Literature Review

There is no question that homework is necessary and there are multiple benefits for students when they complete homework, especially in mathematics. Numerous studies exist that have examined some of these benefits, and the relationship between homework completion and student achievement (e.g., Bruce & Singh, 1996; Cooper, 1989; Cooper, Robinson, & Patal, 2006). In addition to reviewing the benefits derived from homework completion, researchers have also found that when homework is completed online, the results include positive effects on achievement and learning (Burch & Kuo, 2010; Dillard-Eggers, Wooten, Childs, & Coker, 2008; Hodge, Richardson, & York, 2009; Kulik & Kulik, 1991). This is particularly true for those students who require remediation before taking college-level mathematics courses.

Course Management Systems and the Underprepared Student

Multiple studies have examined mathematics learning and subsequent achievement of underprepared students when they used online courseware or course management systems. For example, Testone (2005) compared the success rates of online students in beginning and intermediate algebra who used an online courseware system to complete homework with those in traditional on-campus classes at Onondaga Community College. Passing rates in beginning algebra for those students with access to online homework and

tutorials was approximately 65% and often higher, compared to a pass rate averaging between 40% and 48% for students taking the class on campus. Instructors of the developmental mathematics courses felt the success of the online students was due to their use of the online courseware system. Therefore, the online courseware system was made available to all developmental math students; however, they were not required to use it or complete their homework online. The instructors did find that those students who did use the interactive homework and tutorials had greater success rates in their courses and it appeared to improve student learning.

Additionally, Baker and Dias (2008) examined pass rates on the elementary algebra portion of the ACT/COMPASS exam which is required for students to exit from remediation at Hostos Community College. At the college, the pass rate for this segment of the exam was around 50% and remained relatively steady at this rate since the exam was implemented in 2004. The elementary algebra courses were taught using traditional lecture methods and the researchers introduced web-based software as a supplement for homework into those courses they were teaching. Baker and Dias then compared their students' results on the exit exam with the results of their students from previous years who did not use the software. Prior to using the course management software, the pass rate on the exit exam for Baker's classes (48.3%) was below the department average (54.7%) and after introducing the use of the software, the pass rate improved (76.3%). Dias also had an increase in students' pass rates on the exam after the introduction of the software and these increases were statistically significant for both researchers. From these results and from examining students' homework scores, Baker and Dias concluded the

web-based homework was a significant part of their students' success in passing the exit exam.

Due to large enrollment and low pass rates in elementary algebra at Delaware Technical and Community College, Vezmar (2011) examined the effects of an online courseware system, MyMathLab, on student achievement. The final sample for her study included 178 students, enrolled in elementary algebra in fall 2010, who completed all elements of the course. After examining the data, Vezmar found a statistically significant, moderate correlation between the amount of time students spent doing homework in MyMathLab and their homework grade. This result was not surprising since students do need to spend time in MyMathLab in order to complete homework. Additionally, the results of a t-test revealed a statistically significant increase in student achievement as measured by final exam scores for those students with homework grades of 75% or better; and, there was a statistically significant positive correlation between homework grades and final exam grades.

Students' Perceptions of Course Management Systems

The implementation and use of course management systems should be guided by the attitudes and perspectives of the students using them. Numerous studies have been conducted using survey data to better understand students' perceptions regarding the use of these systems to complete homework online.

Buzzetto-More and Ukoha (2009) reviewed survey data from 692 students enrolled in a remedial mathematics course, which had a high failure and attrition rate, at the University of Maryland Eastern Shore. MathXL, a web-based learning management

program, was introduced into the course in an effort to improve student success.

Responses on the survey revealed that 63% of the students felt MathXL was a valuable learning tool and 49% felt the program helped them succeed in the class. Additionally, 56.1% of those completing the survey felt the system helped them to better understand concepts in the course and 52.8% felt it helped them perform better on their assignments. Since the implementation of the learning management program, withdrawal data at the university indicated there was a significant decrease in student withdrawals (50%) in the mathematics course, while student pass rates increased.

Holt, Holt, and Lumadue (2012) employed a mixed method approach to explore the perceptions of students using MyMathLab for homework only in an intermediate algebra course at a regional state university in northeast Texas. Their qualitative study used a 28 question survey which was made available to 149 students enrolled in six on-campus sections of the course. Fifty-eight students completed the online questionnaire. The results of the survey revealed that the students who preferred using MyMathLab liked the immediate feedback received when working homework problems, along with the ability to rework problems and receive step by step instructions if needed. Additionally, 57% of the students felt they had a better understanding of math concepts after using MyMathLab to complete homework assignments, and 69% of students agreed that the time spent on the online assignments was beneficial. The researchers also asked respondents to rank which features of the program they found helpful. Sixty-seven percent and 66% stated "Help Me Solve This" and "View an Example", respectively, were among the most beneficial to them. Seventy-two percent found the ability to rework problems to be very helpful, while 55%

felt having immediate feedback on a problem's answer was useful. Overall, from the students' perspective, completing homework in MyMathLab seemed to have a positive impact on their mathematics understanding.

Law, Sek, Ng, Goh, and Tay (2012) also examined survey data to determine students' satisfaction and expectations after using MyMathLab in a pre-calculus course at Multimedia University. The researchers administered a 23-item survey to 450 pre-university students enrolled in the course during the first trimester at the school. Law et al. found that 62.7% of students felt the online system was easy to use and 68.2% said it increased their understanding of the course material. Half of the students (49.6%) felt that using MyMathLab helped them achieve a higher grade in the course; while 63.3% said regardless of their grade, they felt MyMathLab helped them to understand the subject matter better and the same percentage of students were satisfied using the system in the course.

Combined results of survey data covering two semesters, completed by 3,863 students at 674 individual institutions, revealed 81% of students strongly agreed or agreed that MyMathLab helped them better understand the subject matter and 80% felt the program helped them achieve a higher grade in the course they were taking (Speckler, 2012). Eighty-five percent of those surveyed were very satisfied or satisfied with the system. Speckler also noted that one of the most commonly used features of the system was "View an Example", and students felt this learning aid along with the other ancillaries helped them persevere and not become discouraged. Vezmar (2011) also noted that 66% of students responding to survey items reported the most beneficial aspect of MyMathLab was one of the learning aids, "Help Me Solve This" or "View an Example". Furthermore,

students surveyed stated that the immediate feedback in the MyMathLab program encouraged them to be engaged in and more accountable for their own learning (Speckler, 2012).

In order to understand students' perceptions of online homework, Yushau and Khan (2014) surveyed 394 students from more than ten sections of college algebra courses at King Fahd University of Petroleum and Minerals. Their final sample consisted of responses from 337 surveys, all participants were males with an average age between 17 and 18. The students in the course completed both online homework and traditional paper-pencil homework. Using a traditional Likert scale, the survey contained 38 items consisting of questions regarding how students liked online homework, how online homework compared to traditional homework, and how students liked using the MyMathLab program. One item that received a high rating on why the students liked online homework was receiving hints if they got the answer wrong (mean = 1.9941). Other items that did not receive as high of a rating with regards to the online homework were whether it improved students understanding of mathematics (mean = 2.0712) and whether it helped students prepare for exams (mean = 2.2700). The researchers were also surprised that students did not rate receiving immediate feedback on incorrect problems higher than they did (mean = 2.1810). Overall, student responses on the survey were positive and students were enthusiastic about completing homework online.

The study conducted by Leong and Alexander (2014) involved 78 students in developmental algebra classes at a community college located in the northeastern region of the United States. Students completed a 40 question survey examining their attitudes

regarding completing homework online using WebAssign. Students who liked the online homework system mentioned the easy accessibility, being able to work on homework anywhere at any time, the immediate feedback received on the correctness of solutions to homework problems, and the other ancillaries available to assist them in learning the content. Leong and Alexander also examined whether students' mathematics achievement had any relationship with their attitude toward using the online homework system and found that students with lower mathematics achievement had a more positive attitude toward using WebAssign than higher achieving students. The researchers' results suggested that online homework played an important role in students' attitudes because of the immediate feedback received leading to improved understanding, and it motivated lower performing students in learning algebra.

Course Management Systems and Immediate Feedback

One important component of these courseware systems is the immediate feedback they provide. It is often difficult if not impossible to provide timely feedback on graded assignments, which is essential for students to verify their understanding of mathematical concepts. Students, especially those struggling to begin with, need practice followed by instructor feedback in order to confirm they understand a concept. Once students receive this feedback, they can make corrections and work similar problems. This feedback process rarely occurs in the classroom due to various constraints (Zerr, 2007). Online homework provides a solution to this situation.

In his study of a first-semester calculus class at the University of North Dakota, Zerr (2007) created and used an online homework system to more thoroughly engage students

outside of the classroom. His online homework assignments consisted of multiple choice, matching, true/false, and fill in the blank type questions. Additionally, immediate feedback was provided for every question assigned and usually included a complete solution for the problem. Students also had the opportunity to redo any assignment as many times as they wanted before it was due, which provided the opportunity for them to learn from their mistakes. From survey data, Zerr found that students believed using online homework was beneficial and provided an effective method of study. When comparing student outcomes on quizzes and exams, Zerr found that students with more perfect homework scores performed better overall and thus concluded that online homework was helping students in the way it was designed to.

Bonham, Beichner, and Deardorff (2001) acknowledged that online homework programs allowed students to practice more and receive immediate feedback, which enabled students to master material by correcting their own mistakes. However, if a problem was missed, they felt students were given no explanation as to why it was not correct. Their research project, conducted with 220 students in an introductory calculus-based physics course and 120 students in an algebra-based course with experienced instructors teaching the courses back-to-back on the same days with everything similar except how the homework was completed, found students doing homework online consistently performed slightly better on the tests than students completing paper and pencil homework. This difference was not statistically significant; but, students responded positively to completing homework online and wanted to continue using the system.

Thus, the immediate feedback on all homework problems, the ability to get assistance through ancillaries included in the courseware systems, and the ability to get the assistance and receive feedback at any time are distinct advantages to completing homework online.

MyMathLab

MyMathLab is a customizable online textbook-based course management system developed by Pearson Education to correspond with their published textbooks. Once students purchase an access code and are given a course ID by their instructor, they register to use MyMathLab. The course management system can then be accessed 24 hours a day from any computer that has an internet connection. MyMathLab contains a multimedia e-textbook, video lectures, computational examples, animations, interactive tutorials, unlimited practice exercises, and sample quizzes and tests that coordinate with the students' textbook.

Homework assignments are created from an online exercise bank that correlates to textbook problems, and all of the problems are algorithmically generated. This allows for unlimited practice and mastery, and means that students will have mathematically similar problems, not identical, helping to ensure students do their own work. The correlation between online homework and textbook exercises is important for students due to the fact that it makes it easier for the students to use the textbook as a resource when completing their homework.

After working a problem, students receive immediate feedback - unlike traditional paper and pencil homework. Students are informed when they answer a problem correctly

along with encouraging remarks such as “Good job!” or they are informed that their solution is not correct and some type of instructional hint or guidance as to what they did wrong based on their answer is provided (see Figure 1).

In addition to the immediate feedback students receive, several learning aids are available to further assist them. Students can watch a video demonstrating a similar problem being worked out, go to the page(s) in the e-textbook where the type of problem they are trying to solve is explained, view an example of a similar problem worked out step-by-step, have the system help them solve the problem step-by-step, or email their instructor for assistance. If students choose the “Help Me Solve This” option, they are walked through the same problem they are trying to solve, answering questions along the way. Once students finish working through the problem using “Help Me Solve This” and return to the homework, they are given a similar problem to work on their own before they receive credit for the exercise. Using “View an Example”, students are shown a complete worked out example of a problem similar to the one they are attempting to solve. They can view this problem and follow the same steps while working on their problem.

A student has three attempts to correctly work a problem unless the instructor changes the limit on the number of attempts for each question, which has both advantages and disadvantages. If a student gets a problem incorrect after the third attempt, the correct solution is shown and the student then has the option of working a similar problem. This allows students to continue working a problem until they completely understand and master the concept. It also allows them to improve their grades by working the problem until it is correct. However, it may also enable students to simply keep guessing until they

get a correct solution for the problem. If the problem is worked again, the student would get the same type of question, difficulty level, and scope as the original problem worked.

Factor the trinomial.

$$r^2 + 5r - 36$$

Select the correct choice below and, if necessary, fill in the answer box within your choice.

- A. $r^2 + 5r - 36 = (r - 9)(r + 4)$ (Factor completely.)
- B. The polynomial is prime.

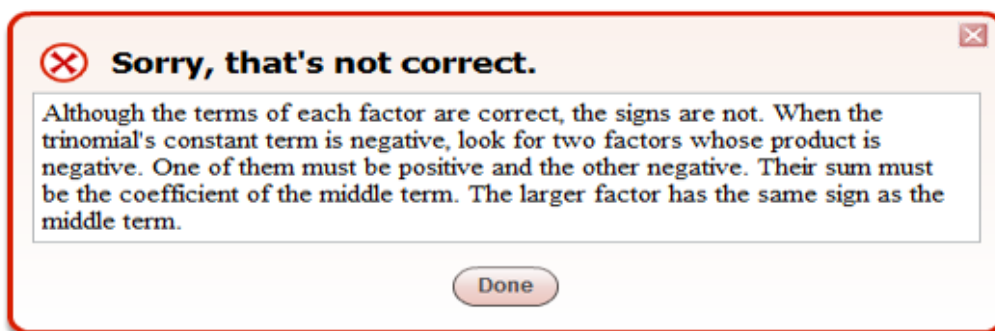


Figure 1. Screenshot of hint given for an incorrect solution from Pearson Education's MyMathLab. Problem from *Elementary and Intermediate Algebra: Graphs and Models*, 4th ed., by M.L. Bittinger, D.J. Ellenbogen, and B.L. Johnson. Copyright 2012 by Pearson Education, Inc. Reprinted with permission.

Methodology

The main aim of this research was to examine and better understand students' perceptions on the use of MyMathLab, an online interactive course management system, when completing homework online. Questions that guided the study were as follows:

1. What were students' perceptions of online homework in Essentials of Mathematics?

In particular,

- a. did students believe that completing online homework was helpful in learning the mathematics content and
 - b. did students believe that completing the online homework prepared them for tests?
2. Did online homework completion improve student performance on in-class tests?
 3. Did students complete online homework and did they prefer online homework versus traditional homework?

Course Details

Essentials of Mathematics, which is a redesigned elementary algebra course, was the mathematics course used in the study. Students enrolled in this course have not met requirements for enrollment in college-level credit mathematics courses that satisfy university degree requirements. Thus, students were required to take this course if they had an ACT mathematics test score of 15 or 16, if they had a high school deficiency in math, or if additional placement testing scores required they take the course.

Essentials of Mathematics serves as an introduction to learning mathematics and helping students acquire the foundations and skills necessary to succeed at the next level. Topics covered included exponential notation, solving linear equations and inequalities, graphing equations, writing equations of lines, functions, polynomials, and factoring. After completion of the course, students received a three credit-hour elective credit and moved on to take a college-level math course. All sections of the course for this study were face-to-face lecture-based classes meeting either two days a week or three days a week. The number of students in each section averaged between 22 and 23.

Setting

Demographic data for the institution during the fall 2012 and 2013 semesters when the study was conducted is shown in Table 1. The majority of students who took Essentials of Mathematics were freshmen with ACT math subscores of 15 and 16. Approximately 46% of the population was male and 54% female for both fall semesters.

Table 1
Institution Demographics

	Fall 2012	Fall 2013
Total enrollment	25,394	23,881
Freshmen enrolled	5,486	5,167
Average ACT Composite	21.8	21.9
Average ACT Math subscore	20.3	20.6
Freshmen with ACT Math subscores 11-15	240	187
Freshmen with ACT Math subscores 16-20	1,401	1,373

Participants

The participants in this study were students enrolled in seven sections of Essentials of Mathematics (N = 157) taught by the same instructor during fall 2012 and fall 2013 semesters at a four year public university in the southeastern United States. Survey results from both semesters were combined to obtain an overview of students' perceptions regarding online homework. Students who did not complete the course were excluded from the study (n = 8) and only those that completed the course and the survey were included. Of the 149 students who completed the course, 125 filled out the survey (representing a response rate of approximately 84%). With this rate of return, it is assumed that a representative sample of student responses was attained.

The students taking this course consist of individuals that are considered traditional students, those between the ages of 18 and 22 who are attending college right after graduating from high school, and non-traditional students, those over the age of 23 and attending college either full or part time. All of the students in the study used MyMathLab to complete the same homework problems online, received the same instruction through traditional lecture in the classroom, and took the same chapter tests and final exam.

Instrumentation

After reviewing similar surveys, an attitudinal survey instrument was designed by the researcher and a colleague in order to examine students' perceptions regarding the use of MyMathLab. The survey consisted of 19 Likert-type statements, two free-response questions and one question asking about previous use of MyMathLab. The free-response questions were structured so that students could provide detailed comments on the beneficial features of MyMathLab and using it to complete homework online. The other survey items consisted of statements regarding attitudes about math and doing homework in general to more specific statements concerning the use of MyMathLab and how students felt about completing homework online versus traditional textbook homework. A five-point Likert scale was used where (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 survey was administered after midterm to students in seven different sections of the redesigned elementary algebra course, three sections during fall 2012 and four sections during fall 2013. The paper survey instrument was distributed to students during

class time near the end of the period, and only students who attended class the day the survey was administered had the opportunity to complete it. Prior to administration of the survey, students completed an informed consent form in compliance with the institution's IRB. Consequently, participation was voluntary and students choosing not to participate could leave. In order to link responses with various grades, students provided their institution id number on the survey which was deleted once the data were linked.

Approximately 61% of the respondents were female and 39% male. The majority of respondents were between the ages of 18 and 19 (74%), 10% were between the ages of 20 and 22, 10% were between the ages of 23 and 30, and the remainder of the respondents were over 30 (6%).

Results and Discussion

The results of the survey were examined to try to better understand students' perceptions regarding the use of MyMathLab to complete homework online. Percentages were calculated for each response category for survey items along with response means for the appropriate items. In some cases, medians along with interquartile ranges were reported. Since there is a wide range of viewpoints on how to report Likert data, both response means and medians with interquartile ranges were reported.

Students were asked several questions designed to look into their attitudes and opinions regarding mathematics in general. Of the 125 respondents, 34.4% stated they like math while 37.6% stated they did not, and the remaining 28% were neutral. When asked whether they thought they were good in mathematics, approximately 37.9% felt they did not do well when it came to math, 26.6% thought they did well, and 35.5% had no strong

opinion either way. Of those students who felt they were “not good at math”, 72.3% had A or B homework averages, 12.8% had a C average, 4.3% had a D average, and the remainder had failing homework averages. For those students who had no strong opinion, 81.8% had an A or B homework average, 6.8% had a C average, 4.5% had a D average, and the rest had failing averages. Reviewing grades at the end of the semester, 97 students (77.6%) had an A or B homework average, 14 had C averages (11.2%), 5 had a D average (4.0%) and 9 students had failing homework averages (7.2%). End of course grades revealed 69 students received an A or B in the course (55.2%), 28 students received a C (22.4%), and 28 students failed (22.4%). Students had to earn a final grade of a C or better to pass Essentials of Mathematics, thus no final grade of D was given.

Students were also asked about using MyMathLab prior to taking the course. Of the students surveyed, 102 stated they had never used the courseware before and 23 indicated they had previous experience with the program. Most respondents indicated agreement with the idea that MyMathLab was easy to use (Mdn=5, IQR=1). This was also reflected in some of the comments on the free-response questions, such as “love using this online program”, “I enjoy MyMathLab and hopefully will use it all through college”, “I like it”, “really love it”, and “MyMathLab is the BEST!”

Table 2 reveals the results of statements relating to students’ perceptions of how online homework facilitated their learning in Essentials of Mathematics. These results indicated that 97.6% of the students believed that completing the online homework helped in their learning the mathematics content in the course. The responses reflected strong agreement with that statement (Mdn=5, IQR=1), with a response mean of 4.6.

Furthermore, the majority of students (92.8%) felt that doing homework in mathematics was important. The results also revealed 84% of respondents believed completing online homework helped them prepare for tests and the majority agreed with that statement (Mdn=5, IQR=1). The response mean of 4.33 also echoes this agreement. Additionally, there was a positive correlation ($r = 0.483$, $p < 0.0001$) between homework averages ($M = 87.586$, $SD=14.896$) and test averages ($M = 72.089$, $SD=13.980$) indicating homework performance may have some effect on test grades. In general, those students with higher homework grades tended to also have higher test grades.

Table 2

Response rate (in %) to statements involving students' perceptions of how online homework facilitated learning

Statement	SA	A	N	D	SD	Mean
Homework helps me understand what I learned in class.	63.2	34.4	1.6	0.8	0	4.60
I think doing math homework is important	50.4	42.4	4.8	1.6	0.8	4.40
Doing the homework assignments in MyMathLab helps me prepare for tests.	56.0	28.0	10.4	4.0	1.6	4.33
I do the practice tests in MyMathLab.	8.8	26.4	24.0	31.2	9.6	2.94
The practice tests help me prepare for the in class tests.	19.4	29.8	34.7	11.3	4.8	3.49

Although students felt the homework prepared them for tests, according to responses very few took advantage of taking practice tests. Only 35.2% stated they did the online practice tests while 40.8% did not. The results from this statement conflict with

responses given on the statement that the practice tests helped prepare students for in class tests (49.2% were in agreement and 16.1% disagreed). The difference in responses could have come from students misinterpreting the statement. In addition to online practice tests, students also had a test review available online that could be printed out and worked with paper and pencil. Some students might have assumed the statement was referring to the test review. Additionally, 34.7% of the students had no opinion as to whether the practice tests helped prepare them for in class tests. This large percentage could have included students who did not do the practice tests, students who did the practice tests but were not sure if it helped, and students who may have done several things to prepare for the in class tests but were not exactly sure what helped.

Students were asked to express any additional thoughts with respect to using MyMathLab. Some of these comments included:

- “MyMathLab is very easy and helps me with my math skills.”
- “It helped me prepare for tests.”
- “The practice tests are very helpful.”
- “helping me better understand”
- “It can help students a lot in their tests.”
- “You can do a lot of practice from the homework that is in MyMathLab.”

As shown in Table 3, students’ attitudes towards MyMathLab and online homework were favorable overall. Out of the 125 students surveyed, 88% liked being able to complete their homework online and 90.4% agreed that using MyMathLab to do homework was better than working problems in the textbook. The response means of 4.42 and 4.48,

respectively, suggest relatively strong agreement with these statements. Additionally, 81.6% of the students felt using MyMathLab motivated them to complete more homework than having to do the usual paper and pencil homework (Mdn=5, IQR=1). An overwhelming majority (98.4%) believed graded homework was important. This finding tends to re-enforce the belief that if homework is going to be assigned and is to be meaningful for students, then it must have merit. Doorn, Janssen, and O'Brien (2010) also noted that over 52% of the students they surveyed admitted they would not do homework unless required and graded. Students feel that if they are going to put the effort in to complete homework, then they should receive a grade.

Table 3

Response rate (in %) to statements involving students' perceptions of online homework and MyMathLab

Statement	SA	A	N	D	SD	Mean
I like being able to do my homework online.	60.8	27.2	7.2	3.2	1.6	4.42
I would rather do problems in MyMathLab than problems from the textbook.	66.4	24.0	3.2	4.0	2.4	4.48
I was motivated to complete more homework when using MyMathLab than traditional paper/pencil methods.	57.6	24.0	14.4	0.8	3.2	4.32

In general, students had positive attitudes and opinions towards using the program and completing homework online. Most students preferred using the program and felt it was beneficial. Some representative responses to a free-response question regarding MyMathLab and online homework included:

- “Doing homework online is more convenient.”

- “The most beneficial feature was being able to do my homework online.”
- “MyMathLab gives us more options than if we were using pen/paper.”
- “This is way better than pen/pencil and paper.”
- “I like doing homework online, it more fun and easier [sic].”
- “Being able to do homework at my own pace.”
- “It keeps track of due dates and its online.”
- “Love using this online program.”
- “It lets you do problems over.”
- “I enjoy it.”

In an earlier study, Raines (2012) examined the effect that homework due dates had on student achievement in a redesigned elementary algebra course and found that students performed about the same regardless of when homework was due. Therefore, in this study, homework for each chapter was set to be due the night before the in-class chapter test. The intent was to give students the opportunity to review the material and rework problems while studying for the test. When students were asked when they completed the homework, 80% indicated they did the homework as soon as possible and did not wait until the last minute, while 31% stated they waited to do the homework until right before it was due. This did not appear to effect homework completion rates. Out of 125 students, only 8 students did not do some of the assignments by the due date (approximately five assignments each out of a total of 25).

MyMathLab contains several tutorial learning aids (e.g., “View an Example” and “Help Me Solve This”) to assist students when they are working homework problems.

Table 3 reveals that when students were asked if when they needed help they used these learning aids, 72% indicated they did. Depending on which aids were used, this could be beneficial to students to help them learn from their mistakes. Yet, it is somewhat disconcerting to think that some students may be using particular aids just to get the homework completed without gaining an understanding of the concepts. One of the drawbacks to MyMathLab is that there is no way to determine whether students are using the learning aids and if so, which ones. Peng (2009) found that some students were using shortcuts just to get their homework completed, not to learn and gain understanding.

However, it was encouraging to note that 84.0% of the students did go back and work similar exercises if they got help solving a problem (last statement in Table 4). This would appear to indicate that these students were interested in learning from their mistakes (Mdn=4, IQR=2). Students also revealed that when they did not understand the homework, they asked for help from friends and family and their instructor more than visiting a mathematics tutoring lab to get assistance from the tutors.

Table 4

Response rate (in %) to statements involving online homework understanding

Statement	SA	A	N	D	SD
When I do not understand my homework, I ask for help from my friends/family.	33.6	40.0	8.0	12.0	6.4
When I do not understand my homework, I ask for help from my teacher.	13.6	34.4	28.0	20.8	3.2
When I do not understand my homework, I ask for help from tutors in the lab.	6.4	16.8	20.8	38.4	17.6
When I do not understand my homework, I use tutorial learning aids in MyMathLab.	34.4	37.6	10.4	11.2	6.4
When I get help solving a problem, I go back and ask for a similar exercise to see if I can do it by myself.	40.0	44.0	7.2	5.6	3.2

A free-response question asked students what they thought was the most beneficial feature of MyMathLab. From their comments, it appears many of the students did use the tutorial learning aids when completing homework. Thirty-eight specifically mentioned using the similar exercise feature which allows a student to work a similar problem, 23 mentioned using “Help Me Solve This”, and 20 mentioned using “View an Example”. Some of the representative comments included:

- “When I do get an answer wrong I can click similar and try again. That help me get a better understanding [sic].”

- “It gives you that extra help if you don’t understand a problem – gives you good examples and directions.”
- “I like that you can get help if you need it. Then you can do a similar exercise to see if you understand it.”
- “It helps you see what you are doing wrong.”
- “That it helps you understand when you don’t.”
- “When you miss a problem, it shows you the correct answer and then you can see what you did wrong and you can do a similar problem.”
- “The help aids to walk me through the problem step by step. Along with being able to do similar problems to better understand it.”
- “Similar exercise feature and how it explained how to do the problem.”
- “Being able to get help with a problem and getting a chance to re-do the problem I got wrong.”

There were very few students who expressed frustrations with MyMathLab and how it worked. The homework was set up to automatically grade every problem in the assignment, but no partial credit was given and only the final answer was graded. One student did not like the fact that for problems containing several parts, credit was given only if all parts were worked correctly. This was not a MyMathLab issue, but was how the instructor set up the way homework was to be graded. Since students had unlimited attempts to work a problem, it was felt that working all parts of a problem correctly would not be detrimental to a student’s grade and would be beneficial to their learning and understanding. Two students commented on how the system required answers to be

entered. One complained that the “program glitches frequently and marks correct answers as incorrect. When showing correct answer, it completely matches my answer” and the other stated that “sometimes it doesn’t ask for a particular answer form” such as fractions or decimals. MyMathLab is particular about the format for expressing an answer. If a comma or parentheses is omitted or a different letter for a variable is used, the program will consider the response to be incorrect. Furthermore, most problems do have instructions for what form to express the final solution in – fraction or decimal, if necessary. However, there have been a few problems that do not, which is understandably frustrating for students. Another student felt “the error messages when first getting a problem wrong are sometimes confusing” and one other student felt “it is not great or perfect, however it is better than the textbook”.

Limitations

There were some limitations within this study. The findings may have limited generalizability since survey results were self-reported will all respondents from the same institution and the focus was solely on students in one course, Essentials of Mathematics. The study did not examine the impact of using MyMathLab for homework in higher level mathematics courses or with students having ACT math scores greater than 16.

Conclusions

This study examined students’ perceptions regarding the use of MyMathLab to complete homework online. From the students’ perspectives, completing online homework using MyMathLab appeared to have a positive impact on their understanding of the concepts in Essentials of Mathematics. Additionally, students’ perceptions that doing

online homework prepared them for the tests they took in class appeared to have a positive impact on their learning the content in the course. The final grades for the course revealed that the majority of students did pass the class, reinforcing the idea that using MyMathLab and completing homework online did have some influence on this outcome.

The results of this study suggest that completing homework online played a prominent role in the attitudes of those students requiring some type of remediation before taking college-level mathematics courses. The flexibility allowed for creating and setting up the assignments (possibility of multiple attempts and students working at their own pace), the immediate feedback provided to students, and the availability of tutorial learning aids are important and exceedingly beneficial for students struggling with course content. The ability to work similar problems helped students learn from their mistakes and improve their mathematical understanding.

After the students completed the course, it would have been interesting, if possible, to re-survey the participants to see if their responses pertaining to their attitudes towards mathematics had changed since final grades revealed that most of the students did successfully complete the course. The results of this study are promising; however, further research needs to be done to examine if similar results would be obtained with different groups of students such as those taking higher level mathematics courses. Additional research might also examine any correlations between student perceptions of online homework and various demographics such as age, gender, high school gpa, and/or economic situation.

References

- ACT. (2013). *The condition of college and career readiness 2013*. Retrieved from <http://act.org/research/policymakers/cccr13/pdf/CCCR13-NationalReadinessRpt.pdf>
- ACT. (2014). *The condition of college and career readiness 2014*. Retrieved from <http://act.org/research/policymakers/cccr14/pdf/CCCR14-NationalReadinessRpt.pdf>
- Baker, W., & Dias, O. (2008). The effect of supplemental web-assisted exercises on student performance in remedial algebra. *Mathematics Teaching Research Journal Online*, 2(3), 27-40.
- Bettinger, E. P., & Long, B. T. (2009). Addressing the needs of underprepared students in higher education: Does college remediation work? *Journal of Human Resources*, 44(3), 736-771.
- Bonham, S., Beichner, R., & Deardorff, D. (2001). Online homework: Does it make a difference? *The Physics Teacher*, 39, 293-296.
- Brewer, D. S., & Becker, K. (2010). Online homework effectiveness for underprepared and repeating college algebra students. *Journal of Computers in Mathematics and Science Teaching*, 29(4), 353-371.
- Bruce, F. A., & Singh, K. (1996). Academic achievement: A model of school learning for eighth grade students. *Research in Middle Level Education Quarterly*, 19(3), 95-111.
- Burch, K. J., & Kuo, Y. (2010). Traditional vs. online homework in college algebra. *Mathematics and Computer Education*, 44(1), 53-63.

- Buzzetto-More, N., & Ukoha, O. (2009). The efficacy of a web-based instruction and remediation program on student learning. *Issues in Informing Science and Information Technology*, 6, 285-298.
- Cooper, H. (1989). Synthesis of research on homework. *Educational Leadership*, 47(3), 85-91.
- Cooper, H., Robinson, J. C., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research, 1987-2003. *Review of Educational Research*, 76, 1-62.
- Dillard-Eggers, J., Wooten, T., Childs, B., & Coker, J. (2008). Evidence on the effectiveness of on-line homework. *College Teaching Methods and Styles Journal*, 4(5), 9-16.
- Doorn, D., Janssen, S., & O'Brien, M. (2010). Student attitudes and approaches to online homework. *International Journal for the Scholarship of Teaching and Learning*, 4(1), 1-20.
- Greene, J. P., & Forster, G. (2003). *Public high school graduation and college readiness rates in the United States*. (Education Working Paper No. 3). Retrieved from <http://files.eric.ed.gov/fulltext/ED498138.pdf>
- Hodge, A., Richardson, J. C., & York, C. S. (2009). The impact of a web-based homework tool in university algebra courses on student learning and strategies. *MERLOT Journal of Online Learning and Teaching*, 5, 618-629.
- Holt, D., Holt, W., & Lumadue, R. (2012). At cross-purposes with a developmental mathematics course: Perceptions of students on the use of MyMathLab. *Focus on Colleges, Universities, and Schools*, 6(1), 1-26.

- Kulik, C. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior*, 7, 75-94.
- Law, C.Y., Sek, Y.W., Ng, L.N., Goh, W.W. & Tay, C.L. (2012). Students' perceptions of MyMathLab as an online learning tool. *International Journal of e-Education, e-Business, e-Management and e-Learning*, 2(1), 22-27.
- Leong, K.E., & Alexander, N. (2014). College students attitude and mathematics achievement using web based homework. *Eurasia Journal of Mathematics, Science and Technology Education*, 10(6), 609-615.
- McGowen, M.A. (2006). Who are the students who take precalculus? *MAA NOTES*, 69, 15.
- National Center for Public Policy and Higher Education and the Southern Regional Education Board. (2010). *Beyond the rhetoric: Improving college readiness through coherent state policy*. (policy brief). Retrieved from http://highereducation.org/reports/college_readiness/CollegeReadiness.pdf
- Peng, J.C. (2009). Using an online homework system to submit accounting homework: Role of cognitive need, computer efficacy, and perception. *Journal of Education for Business*, 84(5), 263-268.
- Raines, J.M. (2012). The effect of online homework due dates on college student achievement in elementary algebra. *Journal of Studies in Education*, 2(3), 1-18.
- Speckler, M.D. (2012). *Making the Grade, V.5: Data-driven Case Studies Illustrating How the MyMathLab Family of Products Supports Student Achievement*. Boston, MA: Pearson.
- Testone, S. (2005). Using publisher resources to assist developmental mathematics students. *Research and Teaching in Developmental Education*, 21(2), 1-4.

- Vežmar, K.A. (2011). *Analyzing the effects of MyMathLab on student achievement in elementary algebra* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3465766)
- Yushau, B., & Khan, M.A. (2014). Student perceptions of online homework in preparatory year pre-calculus courses. *International Journal of Mathematics Trends and Technology*, 8(1), 12-17.
- Zerr, R. (2007). A quantitative and qualitative analysis of the effectiveness of online homework in first-semester calculus. *Journal of Computers in Mathematics and Science Teaching*, 26(1), 55-73.