Is computer-generated interactive mathematics homework more effective than traditional instructor-graded homework?

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Introduction

The purpose of this study was to determine if online homework using MyMathLab (MML) would lead to an increase in academic performance compared with traditional paper-based, instructor-graded homework. Seventy-two students enrolled in a required college algebra course participated in this study. Results from this study indicate that there is not enough evidence to claim that the students in the group with interactive, computer-generated homework performed better than the students in the traditional paper-based, instructor-graded homework group at the usual significance level $\alpha = 0.05$. However, the students’ success rate, the 'final grade of A, B or C', is 70% in the MyMathLab group, while the success rate is 49% in the traditional homework group. This difference in students success rate calls for further research with larger sample sizes.

It is a widely held view that homework contributes to the enhancement of school learning and academic achievement (Cooper, 1989; Walberg, 1985). As a result, numerous literatures consisting of books and articles devoted to various aspects of homework have been developed (Hong & Milgram, 1999; Doyle & Barber, 1990). In particular, the effectiveness of homework assignments in facilitating student learning in mathematics is well documented. However, most of these studies are limited to the investigation of the effect of homework on academic achievement at the elementary, middle and high school level.

‘Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students’ learning’ (National Council of Teachers of Mathematics, 2000). Indeed, there is sufficient optimism in the potential of technology to have a positive impact on learning and achievement that colleges have established committees and task forces dedicated to identify and promote ways to deliver instructions with the use of technology. At the same time, researchers have discussed many dimensions of integrating technology in education (Brosnan, 1998; Marcy,
Also, there are numerous articles reporting varying degrees of success of integrating technology into mathematics teaching and learning (Malanie, Diana, Bronwen, Kenneth & John, 2004; Qing, 2005).

At Fayetteville State University, most of the textbooks adopted for lower level mathematics courses have supplementary online teaching tools. We have been using textbooks from Pearson Education for one of the large enrollment courses, MATH 123-College Algebra, for the last few years. Pearson Addition-Wesley and Pearson Prentice Hall mathematics and statistics textbooks contain a text-specific online course design, MML. As a result, some of the instructors assign homework using MML, while others use traditional paper-based homework assignments. Although only 10% of the final grade is allocated for homework in determining final grade for the course, we believe that students who do their mathematics homework score significantly better in chapter tests and the final examination, which has 60% and 20% contribution to the final grade respectively. Therefore, a need for research in determining the effect of homework based on MML over traditional paper-based homework assignments was established.

Background of the course
The course ‘College Algebra’ is a required undergraduate course for the students majoring in nonmathematics and science. The course content covers topics such as linear equations and inequalities, quadratic equations and inequalities, logarithmic and exponential equations and inequalities, and polynomial functions and their graphs. The cognitive domains; knowing facts and procedures, using concepts, solving routine problems and reasoning, define the set of behaviors expected of students as they engage in college algebra content. The students’ final grade is determined in terms of performance in homework (10%), chapter tests (60%) and a final examination (20%), and a research project (10%).

About MyMathLab
MML is an online interactive course design. MML provides multimedia instructions, practice exercises, homework and tests, all correlated to the accompanied textbook. Figure 1 shows a screenshot of a question and a student answer for the question. Figure 2 shows the screenshot for how MML reacts to the given answer with some suggestions to solve the problem. MML allows three attempts to solve any open-ended question. If one could not answer a question in one attempt, then MML guide you with some helpful suggestions such as formulas, explanations, etc, to solve the problem. MML reports the correct answer if one could not solve a problem in three attempts. However, one can always request a similar problem until he or she solves it correctly.

Method analysis and results
To test our hypothesis, we selected two instructors who are assigned to teach two sections of MATH 123 and have already used MML as a teaching tool. Then each of these instructors randomly selected one section of MATH 123 and assigned traditional paper-based homework, while the other section assigned homework using MML.
Table 1 contains the descriptive statistics of the final scores for the two groups. A $t$-test was used to answer the research question 'Is interactive computer generated homework more effective than traditional paper-based instructor graded homework?' The hypothesis test is set up as follows:

<table>
<thead>
<tr>
<th>Homework type</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MyMathLab</td>
<td>73.7</td>
<td>17.4</td>
<td>34</td>
<td>30</td>
<td>98</td>
</tr>
<tr>
<td>Traditional</td>
<td>67.4</td>
<td>17.6</td>
<td>38</td>
<td>22</td>
<td>100</td>
</tr>
</tbody>
</table>

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\textbf{Conclusion}

Since \( p \)-value is 0.0638 (see Table 2), there is not enough evidence to conclude that the students’ achievement in college algebra is significantly better if they have done homework using MML instead of traditional paper-based, instructor-graded ones. However, students success rate as measured by percentage of ‘A, B, C’ grades is significantly higher in the MML students group (70%), compare with the traditional paper-based group (49%).

In addition to significant differences in success rates between students who do and do not use MML as a media for homework, both students and faculty benefit from MML. For examples: MML enables faculty to spend more time with students; as homework grading is transferred to MML, students can learn according to the style and pace that best suit them.

Although this study has some interesting finding, one should consider the following shortcomings when drawing inferences.

1. Lack of complete random assignment of participants.
2. Small sample size.
3. Failure to control for extraneous influences such as ‘students receiving tutorial support from the University college’.
4. The effect of intervening variables such as gender, age, etc.

\textbf{References}


