Grading Homework: Is It Really Worth the Instructor’s Time

James H. Gifford

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Abstract
Initially four classes of introductory chemistry students were assigned daily homework but never had that homework checked by the instructor. After the first exam, two of the classes had their homework checked for completeness at the beginning over every lesson, while two other classes continued to never have their homework checked. Grades were then monitored throughout the semester to see if having their homework checked had any noticeable benefit to the students’ performance. The results of this study show that there is no significant difference between the two groups performance throughout the remainder of the course.

Introduction
In most high school science courses, the students are given daily homework to complete after the lesson has been presented. The goal of this homework is to have them practice or review what they have learned that day in class and get an understanding of the material (Becker & Epstein, 1982). The average high school science class in the United States is 24.3 students (OECD, 2009). This relatively small class size makes it possible for high school teachers to check homework daily without too much time required. Once graded and returned, these daily homework assignments afford the student feedback about their work and what they are doing incorrectly. The practice of previously presented material through homework seems to have a positive influence on achievement in elementary and high school students (Cooper, et.al, 1998). In a later review of research, Cooper points out that the “impact homework might have on achievement varies from student to student, depending on how much each student is assigned or completes.” (Cooper, et.al, 2006). It has also been shown that the amount of time a student devotes to homework assignments increases their achievement, regardless of the student’s ability (Keith & Cool, 1992). These studies do agree that the practice a student gets by completing homework assignments in primary and secondary school does increase their performance. But once students transition to a college or university they are exposed to a science class typically much larger than what they experienced in high school. Most commonly, college students experience large lecture-based classes (Wyss, et. al., 2007). These much larger class sizes, as well as the college professors’ outside of class time commitments, make grading homework every lesson difficult. Most introductory science courses in colleges either provide problem sets that span multiple lessons or just don’t have any graded homework. If problem sets are assigned they may or may not have much feedback. As such, there is no research on the effect of daily homework in a college environment. Students might only get a red “X” on an answer and a number of points cut without any instruction on where they went wrong. The student has to then check the solutions of the problem set to get any feedback about their work.

At the United States Military Academy (USMA) the class size is normally 20 or less students. This class size much more closely resembles that of a typical high school science class. This smaller class size affords for instructor to assign daily homework assignments that can be checked every lesson. However, USMA utilizes a unique teaching method known as the Thayer Method. In this learning
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paradigm, students are assigned a section of reading from the textbook and corresponding homework problems prior to the lesson being covered in class. Students are expected to read the textbook and attempt the problems on their own prior to ever learning about the material in the classroom from their instructor. This allows the student to identify what they do not understand and then allows the instructor to focus the lesson only on the material that the students had trouble with. Instead of spending the entire class period lecturing, the instructor spends the first portion of the class going over the material the students did not understand or had difficulty completing. The remainder of the class period the students are sent to the chalkboards to work problems presented in the lesson. This board-work allows for the students to get immediate practice and feedback from their instructor on their work and what they are doing incorrectly. This is the same practice and review of presented material that research has shown (Cooper, et.al, 1998 & Cooper, et.al, 2006) high school science students get through homework, which leads to an improvement in performance. It is this practice of presented material that has been shown to increase performance. Since the homework at USMA is more preemptive instead of practice, the influence of homework on performance should not be as significant.

In an effort to see if students’ performance on the assigned daily homework truly helped their overall performance in the course, students from four second semester introductory chemistry courses were divided into two groups. Initially both groups did not have any of their daily homework checked or even looked at by their instructor. This continued for the first 11 lessons until the first Written Partial Review (WPR) or graded exam. After this exam, students in two classes were designated as the control group and continued not to have their homework checked. The students in the other two classes had their homework checked every lesson for the remainder of the semester. At the end of the semester, students’ performance in the course was compared between the two groups to see if emphasizing the daily homework assignments had any effect on their performance. The hypothesis tested here is that enforcing the daily homework assignments through grading does not have a significant benefit, because the students practice the presented material at the end of every lesson during the board problems portion of the lesson, not in the homework.

Method

Participants

Four classes of general chemistry students at the United States Military Academy were chosen for this research, all from the same instructor during the spring semester of 2011. 18 students in the A hour class, 18 students in the C hour class, 19 students in the G hour class, and 17 students in the I hour class. Students were not informed about the research as to not bias the results. Student abilities were fairly uniform across the four classes.

Procedure

Students were assigned to the two groups based on their class. The students in the A hour and the C hour classes (taught on the same day) were assigned as the control group, while the students in the G hour and I hour classes (taught on the same day) were assigned as the experiment group. The A and G hour classes met at the same time (7:30am – 8:50am) on opposite days and the C and I hour classes met at
the same time (9:50am – 11:20am) on opposite days. By selecting these classes from the same instructor, the effects of the time of day could be minimized by comparing A hour versus G hour and then C hour versus I hour.

For the first 11 lessons of the course I did not check any homework for any of the 4 different classes. Students came to class, I answered their questions about the lesson’s reading and/or homework assignment, and the students worked board problems for at least 20 minutes. This allowed the establishment of a baseline for each class and each student based on their individual aptitude. The first exam occurred during lesson 12, after which I began checking the homework every lesson for the experiment group (G and I hour classes). Each lesson timeline remained the same for all four classes, I just spent a few minutes at the start of class checking everyone’s homework in the experiment group.

Students are given 25 instructor points per major block in the course. During the second semester there are 4 major blocks that correspond to the three exams and the final capstone project. This experiment ran through the first three blocks, but I did not include the capstone block of instruction as this was a group work assignment and there was not individual homework. For the control group, each students’ instructor grade was based on their in class participation (asking questions, answering questions from the instructor, staying awake, etc.) only. This was a very objective grade based on my daily observations of the students. For the experiment group, I assigned the instructor points based on the students’ homework completion. I divided the 25 instructor points by the number of homework assignments in that block (10 homework assignments in block 2 and 6 homework assignments in block 3). Students then received full points for completing the homework, half of the points for only partially completing the homework, and zero points for not attempting the homework. These instructor grades for the experiment group allowed me to easily track and tally student homework performance during the second and third block of the course. Appendix A shows the breakdown of the instructor points for the experiment group. Appendices B-E are a listing of the grades for the students after each block in each of the four classes, A, C, G, and I hours, respectively.

In an effort to reduce the effects of inherent student ability on the experiment, I further divided each class into three class-standing categories based on their performance after the first exam. The highest ranking third of students were designated as “top”; the middle ranking third of students were designated as “middle”; and the lowest ranking third of students were designated as “bottom”. This further designation allowed for an improved comparison between the control and experiment groups.

At the end of the semester I examined the overall grades for each class and compared their scores through the first exam (block 1) to their overall grade at the end of the course to find the improvement/decline of their grade during the experiment portion of the course. A significant improvement at the end of the course for the experiment group compared to the control group would refute the hypothesis, while a lack of significant improvement would support the hypothesis.
Overall

All four classes had an average decline from the first block to the end of the course. Only 10 students out of the 73 participants from all four classes had an improvement from the first block through the end of the course. The remaining 63 had a decline in their grade during this research, ranging from -0.10% to -11.73%. The average change from grades after the first block (WPR 1) to the end of the course for each of the four classes can be seen in Figure 1. The error bars in Figure 1 are one standard deviation above and below the average change for that class.

![Figure 1](image)

Figure 1. Average decline in grades for all students in each class hour

Figure 1 shows that there was no significant change between the control group, A and C hours, and the experiment group, G and I hours. All four courses showed a decline in their average grades during the research period. Since all of the averages are very close there is no significant change between the control group and the experiment group. Including the standard deviations makes the differences between the averages negligible, because the standard deviations are so large for each class. This data indicates that checking homework did not have a significant effect on the experiment group.

The data does imply a correlation between the time of day of the class and their average change in grades. A and G hours begin at 7:30am on opposite days, and both courses showed an average decline of -4.08% and -4.07%, respectively. There seems to be no effect of checking homework in the G hour class compared to not checking homework in the A hour class. Likewise, C and I hours begin at 9:50am on opposite days, and both courses showed an average decline of -3.25% and -2.85%, respectively. At first glance it seems that there was a slight advantage to checking homework for the I hour class, but the standard deviation for the C hour class is larger than its average, making the 0.4% difference between the
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averages of the C and I hours statistically insignificant. It seems that the later morning classes performed better in the course than the early morning classes, regardless of if homework was checked or not.

Top Third

Those students that were in the top third of their class after the first exam seemed to perform the same regardless of whether their homework was checked or not. Figure 2 shows the averages and standard deviations for each class’s top third. The average change from the first grade to the end of the course was -4.34%, -4.84%, and -4.32% for A, C, and G hour classes respectively. They all performed nearly the same. Only the I hour class has a smaller decrease in grades, with a -2.48% change at the end of the course. Much like each entire class, the top third of each section had a wide spread of grade changes and thus large standard deviations. In fact, the standard deviation for the top third of I hour class is larger than the average. This data shows that there was no significant effect on checking homework for the better performing students in each class.

Middle Third

Much like the top third, there seems to be no correlation between checking homework and student performance for the middle third of students. The averages for the four classes are -5.46% (A), -3.80% (C), -4.55% (G), and -4.49% (I), respectively. Figure 3 shows the averages and standard deviations for each class’s middle third. Again, the standard deviation of each class is very large and close to the average itself, which illustrates that there is no real trend to be discerned from the data. The data does,
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however; still support the idea that the later morning classes perform slightly better than the first morning classes.

![Figure 3. Average decline in grades for the middle third of students in each class hour](image)

**Bottom Third**

Checking homework seems to have been the most effective on the bottom third of the students in each class. Figure 4 shows the averages and standard deviations for each class’s bottom third as designated after the first exam. The average change for each class is much lower than for the top two thirds. The classes where homework was checked actually performed worse than those where homework was not checked. G hour class performed worse (-3.43%) having their homework checked than A hour class (-2.44%) which is taught at the same time of day and no homework was checked. Likewise, I hour class (-1.34%) had more of a decline than C hour (-0.62%). However, the standard deviations were all greater than the averages, meaning the data is very diverse and again no significant trends can be deduced. This data also supports the trend that the later classes perform better than the earlier classes. Both C and I hour averages show more than one percent less decline that the early morning classes. It does seem that the later morning classes outperformed the first classes of the morning regardless of whether homework was checked or not.
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It seems that checking homework did not have the desired effect on student performance. However, the data does seem to support that the time of day a course is taught correlates to student performance. For each group of students, it seems that the later morning classes, C and I hours, performed better than the first classes of the morning (A and G hours). Table 1 shows the final class average for each class.

Table 1. Class Averages at the start of the experiment and the end of the course.

<table>
<thead>
<tr>
<th>Class</th>
<th>Beginning time</th>
<th>Class average after first exam</th>
<th>Final class average</th>
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<tr>
<td>A</td>
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<td>87.34%</td>
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The early morning classes (A and G) had lower grades after the first exam and at the end of the course than the later morning classes (C and I). One possible explanation for this is that the students are more alert later in the morning. Possibly their breakfast has digested and they have had a second or third cup of coffee by the later class start time.

Another possible explanation is the instructor presents the information slightly better the more they teach the same material. This would make sense, as the instructor is able to better gauge what the students
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understand and what they do not with each presentation of the material. However, because the G hour class, the third iteration of the material for the instructor, performed worse in all groups of students studied than the C hour class, the second iteration for the instructor, this seems to be an invalid assumption. The last iteration for the instructor, I hour class, did seem to perform better than the other three classes in the top and bottom thirds of the students, but not so in the middle third. The only trend that can be discerned from this data is that later classes perform better than the early classes.

Conclusion

These findings obtained in this research support the hypothesis that checking homework has little benefit because the students get daily feedback during class. There seems to be no statistically significant correlation to checking homework and student performance in a course. The results of this research show only minor advantages in performance of those students whose homework was checked versus those students whose homework was not checked. However, these slight advantages are not statistically significant, because the student performance varied widely in each of the four classes examined. In each class and group of students examined, the standard deviation was close to, if not greater than, the average change in student performance. These very large standard deviations make it difficult to discern any trends from this data.

The one trend the data does suggest, even with the large standard deviations, is that the time of day of the class has an effect on student performance. The later in the day a course is taught seems to correlate to better performance by the students. The exact cause of this correlation is not evident from the research and data, but it seems students perform better the later in the morning they take a class.

In a course where there is daily individual feedback to the students on the lesson material, such as working problems individually at chalkboards, it seems that enforcing and checking the daily homework assignments has little or no effect on student performance. In this type of classroom environment, students do not have to solely rely on graded homework as their only feedback from their instructor. Students typically work at least 3 problems per class and get immediate feedback from their instructor on their problem solving skills. This immediate feedback is more valuable to the student than any feedback they get in the form of a grade from their homework from the night before. Instructors can get better use of their time from interacting with the students with an extra board problem than they would by spending 5-10 minutes checking homework each class.
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References


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APPENDIX A

Instructor Grades for the Experiment Group

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*25 points

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IGs: *2.5 points complete, 1 point partially complete, 0 points not done

G HOUR - BLOCK 2

IGs: *4 points complete, 2 point partial, 0 points not done

G HOUR - BLOCK 3

IGs: *5 points complete, 2 points partially complete, 0 points not done

LSN: G HOUR - BLOCK 2

LSN: G HOUR - BLOCK 3

LSN: I HOUR - BLOCK 2

LSN: I HOUR - BLOCK 3

*I Missed HW forgiven
### Appendix B

**A Hour Class Grades**

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### Difference from WPR 1

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# Appendix C

## C Hour Class Grades

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<td>1515 71.13%</td>
<td>8.33%</td>
</tr>
</tbody>
</table>

### Differences from WPR 1

- **AVG**:
  - **Difference**: -3.25%
  - **Std Dev**: 4.48%

- **Split into Top, Middle and Bottom Thirds**
  - **Difference**: -4.84% **AVG**
  - **Std Dev**: 3.57% **STD DEV**

- **Difference**: -4.28% **AVG**
  - **Std Dev**: 4.24% **STD DEV**

- **Difference**: -0.62% **AVG**
  - **Std Dev**: 6.09% **STD DEV**
# Grading Homework: Is It Really Worth the Instructor’s Time

James H. Gifford

## Appendix D

### G Hour Class Grades

<table>
<thead>
<tr>
<th>Student</th>
<th>After WPR 1</th>
<th>After WPR 2</th>
<th>After WPR 3</th>
<th>FINAL GRADE</th>
<th>Difference from WPR 1</th>
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<td>2130 %</td>
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### Split into Top, Middle and Bottom Thirds

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<th>NAME</th>
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<th>After WPR 2</th>
<th>After WPR 3</th>
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<th>Difference from WPR 1</th>
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<td>1089 74.8%</td>
<td>1583 74.32%</td>
<td>-0.95%</td>
</tr>
</tbody>
</table>

**AVG** 3.83%

**STD DEV** 4.45%
Grading Homework: Is It Really Worth the Instructor’s Time

James H. Gifford

Appendix E

I Hour Class Grades

<table>
<thead>
<tr>
<th>Student</th>
<th>After WPR 1</th>
<th>After WPR2</th>
<th>After WPR3</th>
<th>FINAL GRADE</th>
<th>Difference from WPR 1</th>
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<td>1310 90.0%</td>
<td>1884 88.45%</td>
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</table>

Difference from WPR 1:
-2.85% AVG
3.54% STD DEV

Split into Top, Middle and Bottom Thirds

<table>
<thead>
<tr>
<th>Student</th>
<th>After WPR 1</th>
<th>After WPR2</th>
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Difference from WPR 1:
-2.48% AVG
2.72% STD DEV

Difference from WPR 1:
-4.49% AVG
4.95% STD DEV

Difference from WPR 1:
-1.34% AVG
1.77% STD DEV