AC 2012-3610: ASSESSMENT OF STUDENT LEARNING THROUGH HOMEWORK INTERVENTION METHOD

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ASSESSMENT OF STUDENT LEARNING THROUGH HOMEWORK INTERVENTION METHOD

Abstract The work presented in this paper is based on a certain type of intervention strategy to the traditional college homework practice presented at the recent ASEE Conference in Vancouver [Akasheh and Davis, AC 2011-565, ASEE Conference, Vancouver, 2011]. Following the modern cognitive theories of learning and motivation, the intervention strategies proposed in that preliminary showed potential to restore the effectiveness of homework as a learning tool which in turn reflected on better student academic achievement and attitude. Following similar strategies, this work seeks further validation of the influence of such interventions on student learning outcome. It also tests these interventions in different courses and in different classroom settings as well as a variation of the intervention which expands its applicability to large classes (the previous study was performed in small classroom setting). Data will be collected from these courses and analyzed to see if general conclusions can be drawn that support the cognitive model studies presented in the literature. The idea of this study is to enhance student motivation to complete the assigned homework more thoroughly, as originally intended by assigning homework, with the assumption that better learning will occur. To assess the effectiveness of the interventions, the performance of control and experimental student samples on exams is compared and student attitudes are surveyed. Results based on student learning and motivation survey show that a large majority of the students thought that the intervention helped their motivation and hence learning. The corresponding results based on performance on exams reflect this opinion but not in a definitive manner possibly due to the small sample size dictated by the nature of classrooms involved in the study.

Introduction

In general, homework can be defined as instructor-initiated work to be completed by students outside the classroom[1, 2] with the purpose of reinforcing and expanding student learning through practice and extension of the topics presented in class[3]. Homework is widely used at the college level and it can be easily argued that it is practically the main instructor-initiated tool to promote student learning. Research supporting the effectiveness of college homework cites the benefit of learning through distributed, small doses over extended periods rather than large concentrated does as in exams[4]. According to Epstein[5], homework serves as a method to practice skills, increase learning experience, and increase self-confidence and time management skills, while others indicate that the purposes of homework include practice, preparation, extension, and creation[6-8]. Bembenutty[9] found that the active involvement of at-risk college students during homework was significantly associated with their academic success. As a side note, it is worthwhile mentioning that research on college homework is relatively scarce and indecisive about the positive influence of homework on student learning[1, 10, 11].

In recent years, the effectiveness of college homework has come under serious questioning[1, 10]. College instructors, while not disputing the value of homework as a learning tool, frequently make the observation about the lack of evidence of its desired learning outcome as measured by the academic achievement of students[12, 13]. This discrepancy between the ideal intended outcome and the actual outcome is generally attributed to flaws in the current practices and attitudes associated with college homework. Ideally, students are supposed to thoroughly complete the homework in order to solidify their understanding of the materials covered by the homework and

to expose any related misconceptions or lack of understanding that they might have. This in turn leads to positive learning outcome. In reality however, students do not get the desired learning experience because they tend to rush the homework in order to meet its submission deadline and avoid the grade punishment associated with missing the deadline. Not only that, but students also learned to find short cuts towards submitting perfect homework. Such short cuts include copying from each other and/or from the solution manuals[14]. In either case, the intended learning outcome from doing homework is either crippled or completely lost. An additional inherent disadvantage of current homework practices is the lag between doing the homework and obtaining related feedback. Typically, a week passes before the homework assignment is graded and returned to students and in many cases it is graded by a teaching assistant who does not have the full experience and involvement in the class as does the instructor. Both factors contribute to less than optimal feedback, which is known to be essential for effective learning[15].

As an attempt to circumvent this impediment to homework, a set of simple interventions to the current homework practice (hereafter referred to as traditional homework) were proposed by Akasheh *et al*. [16], which are intended to improve its effectiveness. In essence, the different interventions are based on modifying the reward system so that short cuts to the reward are not possible. Instead of grading submitted assignments, homework grade is based on the performance of an oral quiz on the homework due date. A randomly selected student would be asked to present his/her solution of a randomly selected homework problem to their peers. In this fashion, the sought grade reward cannot be obtained through short cuts, which increases the motivation of the student to thoroughly complete the homework as intended by design. Furthermore, the instantaneous feedback by the instructor provides enhanced motivation and learning. Both aspects of the intervention are founded in student motivation and learning theories. The study used students' performance on exams and student attitude surveys as instrument to measure the effect of the interventions of learning outcomes. It showed that not only do those simple interventions have the potential to restore the effectiveness of homework as a learning tool, but they also can enhance learning through different avenues. Besides enhancing student motivation to thoroughly complete homework assignments, the proposed strategies improve learning through prompt feedback, cognitive apprenticeship, and active learning.

In this work, we buildup on our previous study[16] and attempt to further validate its preliminary findings. We focus on one of the three relatively similar interventions in order to obtain more focused data within the typical college course duration, which in turn would help validate the influence of the intervention and its underlying theoretical basis for improved effectiveness of homework. In the following section we formally introduce the research questions and the objectives of this study. The Methods section describes the intervention studied and the data collection and analysis procedure. The results are presented and discussed in the Results and Discussion section. Finally, concluding remarks regarding the effect of the proposed intervention and its foundation in the motivation and learning theories are made along with recommendations for future work.

Research Questions, Goals and Objectives

The goal of this study is to validate and further investigate the results of a previous preliminary study about simple theory-based interventions to traditional homework, which have the potential of restoring the effectiveness of homework as intended by its design. In that study, three different

interventions were used but here we focus on the most representative one as far as the underlying theory goes. Additionally, the intervention is studied in different courses and classroom setups than the one previously studied. We aim to answer the following questions about the intervention to traditional homework studied in this work:

- Research Question 1: How does the proposed homework intervention affect student motivation to thoroughly complete their homework?

- Research Question 2: How is student overall learning influenced by the implementation of this intervention?

- Research Question 3: How does the specific college course and classroom setting influence the impact of the intervention?

Methods

Description of the experimental intervention:

As in the traditional approach, the homework is assigned along with a due date and the students have to submit their written homework solution. However, instead of measuring the students' performance, hence their grades, by collecting and grading the homework, the homework grade is earned based on a quiz. In the case of small class size (10-12 students), the quiz is taken orally in class. This involves the randomly calling on a number of students (usually two to three) to take the instructor role and present and articulate their solution to a randomly selected problem from the set of homework problems. By rotating the students called upon each time homework is due, the instructor makes sure that every student receives equal number of oral quizzes during the semester. From a behavior motivation point of view, this approach ensures that the sought reward (the grade) is only earned if the student has thoroughly completed the homework rather than taking shortcuts to the reward. The implication here is that this intervention would lead to better overall learning. Based on the cognitive apprenticeship model[17], this approach has the benefit of forcing students to think aloud, which helps clarify their thinking process and rectify misconceptions. This in turn leads to better long term memory encoding and retrieving in accordance with the modern cognitive model[18, 19]. Finally, an additional advantage to this approach is that students obtain prompt feedback and assessment of their learning, which is proven to increase learning[15]. For the case of large classes where the oral quiz is not feasible, from classroom time point of view, the instructor resorts to written quiz where all the students have to solve a problem which is not exactly one of the homework problems but is close enough to make the assumption that a thoroughly completed homework by the student implies excellent performance on the quiz. While written quiz intervention does not carry all the benefits of the oral quiz version, it still provides the main underlying strategy of modifying the behavior.

Participants

The Mechanical Engineering department at three 4-year engineering colleges participated in this study. Tuskegee University is a small HBCU institution with 2-semester system. Kettering University is primarily an undergraduate engineering school following a quarter system. The

primary student demographics at Baker College, also on the quarter system, consist of non-traditional, older students, many of them full-time workers. Eighteen students taking the standard course Theory of Machines, a junior-level course, during Fall 2011semester were the participants at Tuskegee University. At Baker College, five students taking the senior-level course Circuit Analysis during the Fall 2011semester were the participants. The performance of above experimental sample was compared to the control sample which consisted of the students taking corresponding courses under the same instructor in the same institution during Fall 2010 (and Fall 2009 in the case of Tuskegee University). In both of these cases, the size of the experimental and control samples was roughly equivalent from a statistical point of view. In the case of Kettering University multiple courses were included in the intervention method.

Experimental design and procedure

In our preceding preliminary study[16], three interventions to traditional homework were studied, each for one third of the typical semester time which turns out that this approach did not give enough time to fully test the influence of the interventions. Here, we focus on the most promising intervention out of the three tested, which at the same time has the main theoretical basis for the intervention. The motivation of students to thoroughly complete their homework was measured through a survey instrument shown in Appendix A. The learning outcome was measured in two ways. Firstly, a learning survey instrument was used (See Appendix B). Secondly, a standard assessment based on examination results for the control and the experimental samples were used. The exams consisted of the same problems for both samples and were graded by the same grader with the same style and standards. In the authors' opinion, the experimental group did not have access to those same exam problems given to the control sample. If the experimental group had access to the exam problems (which would also imply that the ideal solutions were available to them as it is the norm to provide such solutions) then their performance on the tests should be drastically better, even closer to perfect. Secondly, the top grades in the experimental group were obtained by the most intrinsically capable students asserting that the students did not have access to the previous exams. To assess the effect of the different interventions on student learning, the performances of the students in the experimental and control samples on those examinations were compared. More precisely, the performance was compared on a problem-by-problem basis as well as on the overall exam. Three exams were compared: two midterm exams and a final exam, each consisting of three problems. This comparison is justified by student demographic data for the two student cohorts in the same department at the same institution. Finally, the reader is reminded that the oral-quiz version of the intervention was used at Baker College due to the feasibility of the approach when only 5 students are in the class. On the other hand, the written-quiz version of the intervention was used at Tuskegee University because the oral quiz, although expected to have better learning outcome, is not feasible when 18 students are in the class.

Results and Discussion

Tuskegee University and Baker College participating in the study represent very different classroom settings as explained above. The comparison on the impact of the intervention at both institutions will help make more generalized conclusions in the case of similar findings. As

mentioned above, the number of students at Tuskegee University was 18, hence the written-quiz format of the intervention was used. At Baker College however, the oral-quiz format was used because 5 students were in the experiment. Following are the results presented by the institutions.

Tuskegee University:

Table 1 and Figure 1 compare the performance of the control and experimental student populations on the same examination problems P1 to P10. With the input variables (examination problem, instructor, grading style, and classroom setting) the difference in achievement between the control and experimental samples can be used to assess students' learning. From Table 1 and Figure 1, it can be seen that the intervention resulted in overall improvements in the average student grade on the examination problems although some problems did not show any significant improvement. Although the standard deviation is large (due to the small sample size), it is practically consistent on problem-by-problem basis indicating that both the control and experimental samples have similar variance and that all the interventions impacted the students in a relatively similar fashion. With this situation which is mainly due to the small sample size, a general definite conclusion about the improvement cannot be made. Nevertheless, claiming that the experimental interventions can potentially lead to improved learning remains plausible.

Table 1, Comparison of performance of control and experimental groups on different examination problems (P1 to P10). Units are in percentage.

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Traditional homework approach (Control)	Average	83.6	86.4	52.3	40.0	46.1	52.4	68.6	52.4	43.6	63.4
	Standard deviation	16.3	26.6	46.7	28.6	29.7	25.9	30.8	27.0	34.8	10.7
Homework intervention (Experimental)	Average	84.4	95.6	81.3	83.1	73.8	59.4	64.4	72.2	42.2	72.2
	Standard deviation	13.6	17.5	21.3	20.2	19.6	34.4	34.7	28.0	36.9	17.4

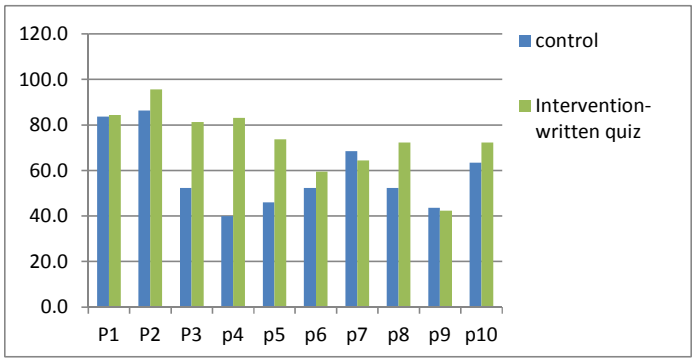

Figure 1. Bar chart comparison of performance of control (subject to traditional homework practice) and experimental (with homework intervention) groups on different examination problems at Tuskegee University.

To look for different evidence to support observed improvements, a survey of student motivation and learning was used, Appendix A. More evidence for improved student learning comes directly from a student learning survey instrument as extracted and shown in Figure 2. The survey results indicate that 61% of the students believe that the experimental intervention has led to better learning of the course material and concepts. From additional comments made by some students, it seems that the students felt that greater learning has occurred, although that might not be reflected in their grade. Taking a look at the student motivation survey indicates that students had value motivation for doing homework. They did understand the significance of the course subject and its relevance to their future career. Furthermore, they also believe in the benefits of doing homework in helping them understand the course material. Nevertheless, they acknowledged that difficulty of the assignments and the associated frustration acted as an obstacle to the successful completion of homework, see results for Question 7. Faced by this frustration with assignments, students take shortcuts in order to obtain the grade reward if this is possible as in the traditional homework practice. As well-known from cognitive theories, low expectations of being successful at completing a task acts as a de-motivator. Besides, the survey indicates that a significant portion of the students, 72% (see responses *a* and *b* of Question 8), would be motivated by the grade only if it has to be earned based on merit, which is what the experimental interventions seems to successfully address.

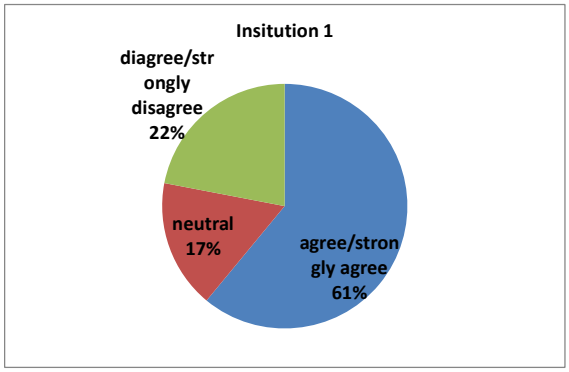

Figure 2. Student survey results regarding the improved learning due to experimental homework intervention.

Kettering University:

The first course is the 4-credit Machine Design where the class work and the homework interventions were applied for many years with positive results. This course is a pre-requisite to the senior Capstone course and hence the student population is mixed – some are juniors while few others are seniors. Ideally, this course should be taken right after they take the pre-requisite Solid Mechanics course. However, due to the type of curriculum at Kettering University, many students of the class had challenges with retaining the Solid Mechanics concepts. The intervention method helped addressing this issue to some extent as the students were assigned several conceptual problem sets from Solid Mechanics and were asked as a team to present the solutions to each set to the class. The class was divided in to several groups and each group was assigned particular but different problem sets. The student feedback was very favorable although a few students did not prepare well enough to present their solutions to the class. They realized their deficiencies in the subject matter as they learned from the student feedback to their

presentations. Several online quizzes from Statics OLI Modules have also been assigned to the students to review free body diagrams and static equilibrium concepts as applied to trusses and other rigid bodies.

The key assessment of the outcomes of the two intervention methods is the students' performance on the exams and on the final learning experiences, which is a final project. Each question on the exams addresses a particular student learning outcome (SLO) and is based on the assigned class work and home work problems.

The first intervention involved randomly asking students to present their group projects which were completed incrementally during the entire term. This intervention method has a goal of monitoring the quality of the final project which is a consolidation of work performed in different phases. The project scope has been similar in each term the course is taught. Each phase of the project dealt with design and analysis of individual components of a subsystem consisted of a stepped shaft to which a pulley and a gear are mounted using keys, two sets of bearings one on each side, bearing blocks and the bolts that attach the bearing blocks to the ground supports. Each group was free to assume a real life application for the project and the input data. Therefore, the input data (power, rotational speed, materials and geometry for the components) were all different between each group. The goal is to design and analyze each component to satisfy an assumed safety factor, which is based on both static and fatigue failures. Students used the appropriate failure theory to design each component (shaft, gear, bolts and keys), while the bearings were selected based on the load rating and an expected life. For practice, the students were asked to select a ball bearing on one side and a roller bearing on the other side of the shaft. In another design, they were then asked (again for practice) to replace the rolling contact bearings with sliding contact (journal) bearings by assuming appropriate bearing parameters (oil viscosity, etc.).

Overall, this intervention method (to present the project work at selected intervals of time during the term) proved to be useful given their knowledge and application of pre-requisite courses (Statics and Solid Mechanics) to solve machine design problems. In Table 2, columns 1 to 3 show the intervention method used and the performance metrics. Columns 4 and 5 show the student performance as a result of the type of the intervention used. For example, rows 2, 4 and 5 show that student performance on the final project due to the intervention method used is significantly better than their performance on the final exam. In other words, students performed moderately on the exam although the questions on the exams reflected the class work and home work during those academic terms.

In the second intervention method, control is exercised by randomly selecting students and/or student groups to present a randomly selected class work or homework problem. The goal is to see if their performance on the projects as well as on the exams improves. Row 3 in Table 2 shows the result of this intervention method on the students' performance on final project and on the exams. Their performance on the exams is significantly higher than that on the final project. It may be noted here that although the scope of the final project and the exam questions are similar each term the course is taught, the student population is different. However, this study shows that intervention methods such as these certainly have a positive impact on student behavior to work harder to perform well in the course. Ideally, to improve their overall

performance on the exams and the final project both intervention methods can be simultaneously used but it takes away a lot of class time to cover the syllabus.

Table 2. Comparison of performance of control groups in Machine Design Course

Intervention method	Performance metric 1	Performance metric 2	Result of performance metric 1 (% average score)	Result of performance metric 2 (% average score)	Remarks
Project presentations	Final project	Final exam	90	80	Summer 2011 students (7)
Class/Home work presentations	Final project	Final exam	82	91	Fall 2011 students (21)
Project presentations	Final project	Final exam	85	72	Summer 2010 students (15)
Project presentations	Final project	Final exam	80	78	Fall 2009 students (36)

Baker College:

Table 3 shows direct assessment results for the 2010 and 2011 groups of students based on the Midterm Exam and the Final Exam problems. Figures 3 and 4 show a visual illustration of the data in Table 3. The performance on individual problems was better for the intervention group in four of the five problems on the Midterm Exam, and the exam overall. For the Final Exam the performance on individual problems was better for the intervention group in five of the eleven problems, as well as the exam overall. The improved performance on Final Exam problems happened for problems 1 - 3, 5 and 6, which dealt with topics from the first half of the course. The results shows that the gains using the Homework Intervention method took place especially in the first half of the quarter, and these gains remained stable even during the Final Exam portion dealing with the first half of the topics. How to maintain the gains for the second half of the quarter will be investigated further by this instructor.

Table 3. Comparison of performance of control (Fall 2010) and experimental (Fall2011) groups on different examination problems on the Midterm and Final Exams. Units are in percentage. Problems 1 - 5 on the Midterm Exam were different from Problems 1 - 5 on the Final Exam.

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	Midterm/ Final Exam
Traditional homework approach – Midterm (control)	Avg.	58.8	77.9	63.8	81.3	78.8	NA	NA	NA	NA	NA	NA	75.6
	Std.	30.9	19.9	25.6	27.3	22.8	NA	NA	NA	NA	NA	NA	12.5
Homework Intervention - Midterm	Avg.	78.0	80.3	71.0	76.7	87.3	NA	NA	NA	NA	NA	NA	79.6
	Std.	17.9	9.0	23.3	34.6	12.1	NA	NA	NA	NA	NA	NA	15.4
Traditional homework approach – Final Exam (control)	Avg.	81.3	75.0	90.0	100.0	60.4	88.8	77.5	70.0	75.0	57.5	63.4	68.3
	Std.	37.2	31.6	28.3	0.0	33.3	31.8	42.0	36.6	37.8	25.8	23.0	20.6
Homework Intervention – Final Exam	Avg.	94.0	100.0	100.0	83.0	96.7	90.0	70.0	50.0	65.0	55.0	61.7	75.9
	Std.	13.4	0.0	0.0	32.7	7.5	13.7	27.4	25.0	41.8	11.2	27.3	13.5

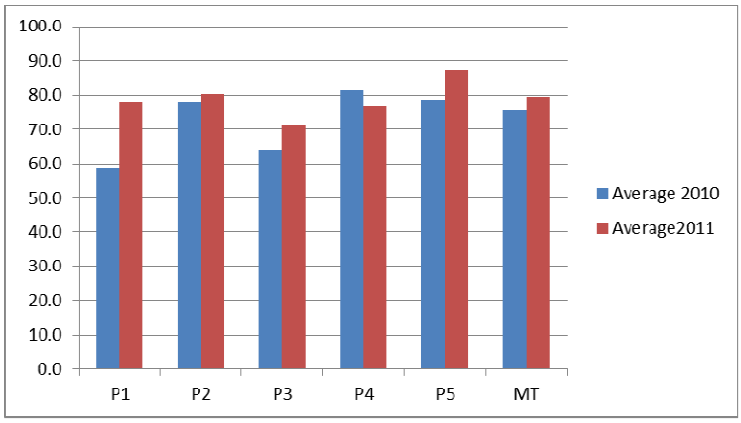

Figure 3. Average scores on Problems 1 - 5 and overall Midterm Exam for the control group (2010), and the homework intervention group (2011).

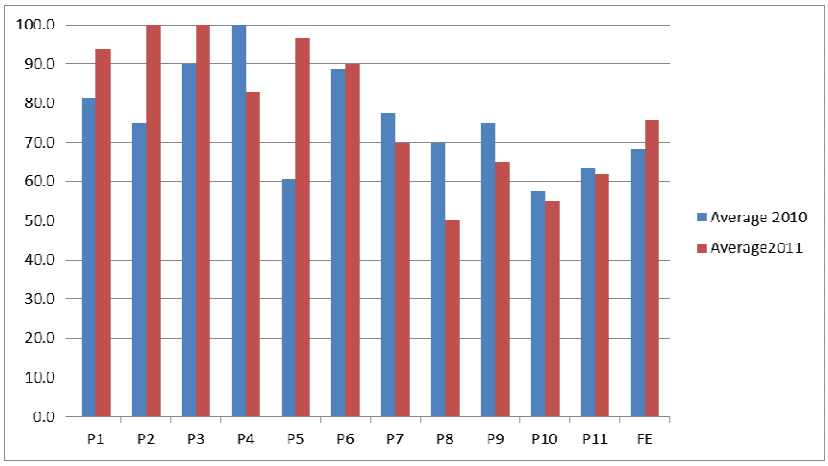

Figure 4. Average scores on Problems 1 - 11 and overall Final Exam for the control group (Fall 2010) and the homework intervention group (Fall 2011)

The effect of the Homework Intervention method was also assessed using a student learning and motivation survey adapted from the survey presented in the original paper. The complete results from the survey are included in Appendix B. A majority of students was in favor of the method in spite of the lack of strong statistical evidence for improvement in learning as measured by the difference in performance on exams, contrary to what the students expressed by the survey.

Conclusions

The results obtained by the authors support the conclusion that the Homework Intervention method has a positive effect on student learning. This has been validated through studies done in different courses taught to different students populations at different universities. As some of these populations consisted of very small groups of students, it will be helpful to continue the studies into the future, especially with the same instructors teaching the same courses, in order to further validate the conclusions of the study.

As noted by one reviewer, the homework intervention method based on an oral quiz is more difficult to apply with large size classes of 50 or more students. The method can still be applied successfully for large classes, by doing a written quiz as opposed to an oral quiz. The quiz will consist of one or two problems and is timed to 10-15 minutes, thus making the method feasible both from time and effort points of view. To get the benefit of prompt feedback (assessment), the quiz is solved interactively with the students right after finishing it and is graded by the instructor for the following class. For small class size the oral quiz method is better, however for large classes our method still catches the main underlying strategies.

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Appendix A: Student Learning and Motivation Survey – Tuskegee University

Student Learning and Motivation Survey
Fall Semester 2011
Theory of Machines, MENG 0315

To what extent do you agree with the following statements?

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	In general, homework is an effective tool for learning the course material	0%	0%	0%	44%	56%
2	I see the relevance of MENG0315 content to my future engineering career	0%	0%	11%	50%	39%
3	To fully grasp the concepts of MENG0315, it is essential that the homework be completed thoroughly	0%	0%	6%	44%	50%
4	On average, MENG0315 homework is more difficult to complete than homework in other courses	0%	11%	28%	28%	33%
5	On average, MENG0315 homework is more time consuming to complete than homework in other courses	0%	17%	27%	39%	17%
6	Having to earn my homework grade based on a quiz instead of just turning in the assignment did help me learn the course material better	0%	22%	17%	33%	28%

7. If you do not normally complete MENG0315 homework thoroughly, what best describes the main reason for that?
   a) I won't learn much from doing it anyways (0%)
   b) It is not likely to affect my final grade (6%)
   c) I am not willing to spend the time and effort it takes (0%)
   d) I get frustrated with the difficulty and quit (67%)
   e) Other: (briefly describe) (27%)

   _____

8. What can best motivate you to complete MENG0315 homework thoroughly in spite of its difficulty and time requirement?
   a) Homework carries a significant portion of the total grade (22%)
   b) My homework grade is going to be based on a quiz rather than on an assignment submitted for grading (50%)
   c) The homework is easy and not overly challenging (6%)
   d) The homework is more interesting. (22%)

   Briefly explain your answer:

   _____

9. I consider my motivation to succeed in MENG0315 as:
   a) Very low (0%)
   b) Low (6%)
   c) Moderate (11%)
   d) High (61%)
   e) Very high (22%)

10. What, if any, was the single most aspect of MENG0315 that was motivating and sparked your interest in the course?
   a) Homework and its administration style (6%)
   b) The lab/hands-on portion of course (including the hands-on project) (66%)
   c) The exams (11%)
   d) The more frequent quizzes (17%)
   e) Other: (please mention)_____ (0%)

   Briefly explain your answer or make any comment:
   _____

Appendix B: Student Learning and Motivation Survey – Baker College

To what extent do you agree with the following statements?

	Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	In general, homework is an effective tool for learning the Circuit Analysis course material.	0%	0%	0%	80%	20%
2.	I see the relevance of the Circuit Analysis course to my future engineering career.	0%	0%	20%	40%	40%
3.	To fully grasp the concepts of Circuit Analysis, it is essential that the homework be completed thoroughly.	0%	0%	0%	20%	80%
4.	On average, Circuit Analysis homework is more difficult to complete than homework in other courses.	0%	0%	60%	40%	0%
5.	On average, Circuit Analysis homework is more time consuming to complete than homework in other courses.	0%	0%	80%	20%	0%

6. If you do not normally complete Circuit Analysis homework thoroughly, what best describes the main reason for that?

a) I won't learn much from doing it (20%)
b) It is not likely to affect my final grade.
c) I am not willing to spend the time and effort it takes (20%)
d) I get frustrated with the difficulty and quit (40%)
e) Other: (briefly describe) (20%)

Comments:
"I don't feel that it is super difficult, just not explained well enough."
"I get lost sometimes."

7. What can best motivate you to complete Circuit Analysis homework thoroughly in spite of its difficulty and time requirement?

a) Homework carries a significant portion of the total grade.
b) My homework grade is going to be based on a quiz rather than on an assignment submitted for grading (60%)
c) The homework is easy and not overly challenging.
d) The homework is more interesting (20%)

Briefly explain your answer:

"If the amount of available points are less, I tend to try harder."
"The homework allows me to better understand and prepare for quizzes and tests."
"It is good to have assigned homework problems that reflects what is going to be on the quiz."

8. I consider my motivation to succeed in Circuit Analysis as:
a) Very low
b) Low (20%)
c) Moderate (20%)
d) High (40%)
e) Very high (20%)

9. In doing Circuit Analysis homework, I typically:
a) Do not complete what is assigned.
b) Complete only what was assigned (80%)
c) Complete more problems that assigned (20%)

	Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
10.	Having to present solutions to the homework problems on the board to the class did help me learn the course material better.	0%	0%	0%	60%	40%
11.	Volunteering to come to the board to present solutions to problems based on the new material just taught by instructor did help me to learn the course material better.	0%	0%	0%	40%	60%
12.	Having a group quiz instead of an individual quiz did help me learn the course material better.	0%	0%	20%	40%	40%
13.	I think that maximum learning will occur if each student is assigned a different set of homework problems to work on individually.	20%	20%	20%	20%	20%
14.	Overall, the non-traditional approaches used in my Circuit Analysis course have helped me learn the material better.	0%	0%	40%	20%	40%