Can the Use of Guided Notes Lead to more Efficient Instruction?

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Abstract

Guided notes are instructor designed note packs that aim to engage student learning. Previous research has demonstrated that the use of guided notes improves student performance in non-engineering classrooms. However, the use of guided notes within engineering education is under-reported. The purpose of this research was to study the incorporation of guided notes into a senior level engineering course. The study results indicate that the implementation of guided notes led to a 28.9% time savings in covering course material. The study data also indicates that mean student performance on graded assessments did not change when the method of notes delivery was changed from a traditional style of writing all note materials on the board to guided notes (all p-values were greater than 0.05 for a two-tailed t-test assuming equal variance at a 95% confidence interval).

In addition to these findings, students from both junior and senior level classes were polled as to their desire to use or recommend guided notes in future classes. Using a Likert scale from one (strongly disagree) to five (strongly agree), the junior level class (n = 12) which used traditional notes had an average response of 2.75 ± 1.29. However, after participating in a class which used guided notes, the senior level class (n = 24) had an average response of 4.46 ± 0.98. Although this study polled two different sets of students, preliminary findings suggest that switching from traditional style notes to guided notes resulted in time savings that could be used to elaborate on or cover additional material while maintaining the integrity of the learning environment and contentment of the students.

Keywords

Guided notes, Engineering Education, Student Learning

Introduction

Heward [7] was one of the first to coin the term "guided notes", defining guided notes as "*teacher prepared handouts that guide a student through a lecture with standard cues and specific spaces in which to write key facts, concepts, and relationships*". Guided notes are instructor provided note templates consisting of mostly filled in notes that incorporate blank spaces that the students fill in based upon the in-class session. This style of notes attempts to increase a student's active engagement, which has been demonstrated to enhance student learning [11]. Because effective note taking can lead to improvements in student performance on quizzes and tests [1], providing students a means to improve note taking has been construed as a positive step to improve learning.

Student difficulties with taking notes are well documented. Students of all levels have a difficult time recording the key concepts from a lecture into their notes with any degree of accuracy [3, 12].

Fortunately, existing studies report on the positive aspects of guided notes implementation in a variety of classroom settings [1, 2, 8, 13]. The research indicates that use of guided notes improves learning outcomes. This is especially true in the case of students with disabilities [4, 9, 10]. Current sources of literature are focused on both K-12 and college students; however, the use of guided notes within engineering education is under-reported. Additionally, the efficiency of using guided notes has not been addressed as a means to cover the same amount of material.

Research Questions

The purpose of this research was to study the incorporation of guided notes into a senior level engineering course. The primary questions fuelling the research included: "Do guided notes offer a more efficient means of delivering material?" and "Do guided notes impact student learning performance in the course?" Based upon these two questions, a set of null hypotheses was used to evaluate the impact of guided notes within the course. The first null hypothesis explored was *no measurable time savings are realized when guided notes are incorporated into the course*. The second null hypothesis explored was *mean student grade performance does not change when guided notes are incorporated into the course*.

This study is important because any small changes to content delivery that can reduce the amount of time spent conveying material (i.e. gain in efficiency) will enable additional material to be covered or additional depth within the covered material to be developed. However, any alternative method of delivery must also meet the learning objectives of the course (i.e. benefit student learning). The findings of this study will offer an avenue for engineering educators interested in efficiently and effectively covering material within a lecture style course.

Methodology

A senior-level four-credit civil engineering course on water and wastewater treatment was evaluated in this study. The incorporation of guided notes occurred during the eighth offering of the course by the instructor. The course met every Monday, Wednesday, and Friday for 50-minute class periods. The laboratory portion of the course met every Tuesday for a one and a half hour block of time. This research focuses on course content delivered during the lecture portions of the course. Thirty-seven existing note packs of course content were converted to guided notes and delivered to the students over the course of the semester. Several of these note packs historically required more than one class period for completion or delivery. Course content was equally broken up between drinking water treatment topics and wastewater treatment topics. Remaining lecture time for the course included time for in-class examinations, reviews, as well as a syllabus review lecture. Prior to the use of guided notes, the instructor wrote all materials from the note packs out on the board as the lecture progressed.

Within this study the first hypothesis was explored by comparing the amount of time saved during the course of the semester from the implementation of guided notes. The metric of time savings (as % efficiency) was calculated as: 100*[# of lectures saved by using guided notes delivery/# of lectures spent to previously cover material with traditional notes]. Because the study would have to be replicated a number of times before a statistically meaningful comparison can be made between the two methods, an alternative evaluation process was used to evaluate the first null hypothesis. For the efficiency portion of the research, the decision was made to accept

the null hypothesis (no measurable time savings are realized when guided notes are incorporated into the course) when less than a 10% time savings was realized from guided notes implementation. The data supporting evaluation of the second hypothesis was analyzed by comparing student performance in the control group (traditional note style) versus test group (guided note style). While the course was modified after seven previous offerings, the instructor changed universities in 2012. Therefore, only four offerings of the course serve as a relevant source for data. The 2012 and 2013 offerings were delivered using traditional notes. The 2014 & 2015 offerings were delivered using the guided notes. A comparison of mean student performance, as evidenced by graded assignments, was carried out to evaluate the second null hypothesis. In each offering students completed a total of six homework assignments, two design labs (performing preliminary design for a complete drinking water plant in one lab and completing preliminary design for a complete wastewater treatment plant in the second lab), a mid-term exam, and a final exam.

The 2012 and 2013 offerings contained 21 and 19 degree-seeking students, respectively, whereas the 2014 and 2015 offerings contained 14 and 22 degree-seeking students, respectively. Therefore, 456 homework assignments, 139 laboratory reports (laboratory 2 was not given in 2015), 76 mid-term exams, and 76 final exams were available for performance evaluations. A total of 76 final course grades were also available for evaluation. Homework assignments, design laboratory assignments, and mid-term exams were created new for each course offering, but focused on similar content between offerings. Evaluation of student performance on homework assignments, labs, and on the mid-term offers the ability to compare student performance between offerings with the caveat that the materials used as assessment instruments were slightly variable. Final exams (on the other hand) are retained at the university and not handed back to students. Therefore, the final exams from each offering offer the ability to assess student performance on the same instrument using the same key. All available datasets (homework assignments, laboratory reports, mid-terms, final exam grades, and final grades) were compared individually. The comparison was made at the 95% confidence interval using a two-tailed t-test assuming equal variance for both groups of data (for example, mid-term grades with the traditional notes method of delivery versus mid-term grades with the guided notes method of delivery).

Results

Efficiency: During the 2012 and 2013 course offerings, the equivalent of forty-one and forty-two 50-minute class periods were required to cover the allotted thirty-seven prepared note packs, respectively. Of the forty-three 50 minute class periods available during the semester, two were used for tests and two were used for review leaving thirty-nine 50 minute class periods available to the faculty member to administer notes. Using traditional methods of notes delivery, the instructor had to utilize some laboratory time to cover the full course content as the content within several of the course lectures extended beyond a single classroom period. However, incorporation of the guided notes into the 2014 and 2015 course lectures not only avoided having to use laboratory sessions to cover lecture content, but also reduced the amount of class periods required to cover the content.

Figure 1 demonstrates the savings realized during the semester. Interestingly, the first three weeks of the course went ahead with no observable gains in time largely due to the need to set up

background knowledge and material that would later be capitalized upon in the course. The first noticeable gains in time savings occurred during weeks four and five, when the majority of material for that week was covered in the first two meetings of the Monday, Wednesday, and Friday offered course. The primary cause for the time savings originated from equation heavy notes that required spending a lot of class time to write out both the equations and all the parameters contained within each equation on the board. The guided notes themselves contained all of the parameters already written out (with units), leaving only a blank spot for the full equation to be filled in by the students.

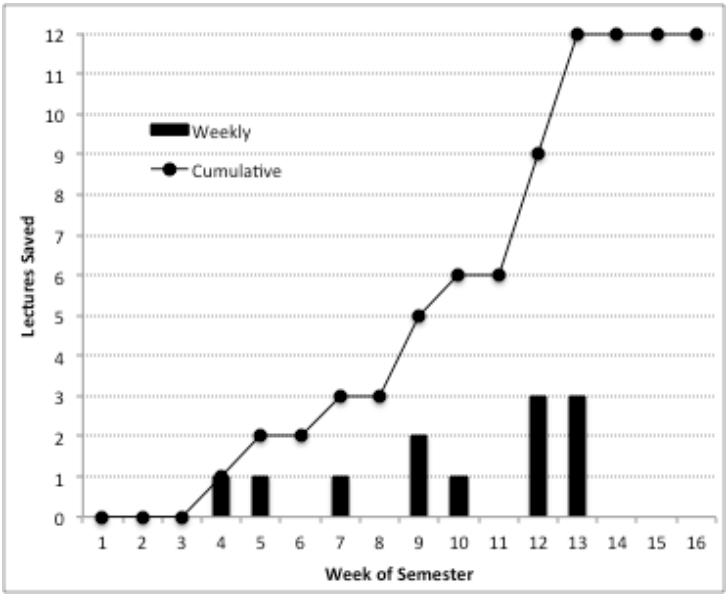

Figure 1. Class lectures saved during each week of the semester using guided notes along with the cumulative class periods saved during the semester.

Once the equation was in place, the students could work example problems that followed. Having all of the parameters present in the course packs saved the majority of time realized in the class. Many design components for water and wastewater engineering have multi-step problem solutions that require several different equations to solve. Interestingly, as the material within each topic focused on more complex equations, more time was saved (week 9). A savings of six total lectures realized in weeks 12 and 13 alone, appeared for two reasons. The first cause of the time savings is because certain topics central to water treatment are also central to wastewater treatment (for example, settling). In previous offerings the instructor repeated some of the components into the note-packs. However, for 2014 the instructor simply had the students pull the guided notes from an earlier water treatment note pack and then provided a small supplement with information on how this component was applied for wastewater.

The second cause of the time savings during weeks 12 and 13 was due to the fact that so many of the processes within wastewater are biologically based. When designing the guided note packs the author considered what was really important for the students to remember from the course and left those spots blank. Because the author was more interested in having students utilize microbial concepts to solve problems rather than memorize the details of the

microbiology, the blank spots in the guided notes were few. A lot of time savings were realized by simply having the students read through the first few pages of notes and then answering any questions on the material.

Overall, twelve 50-minute class lecture periods were saved by implementation of the guided notes during the semester. The calculated efficiency was 28.9% for both the 2014 and 2015 course offerings. Therefore, the null hypothesis was rejected and the author concluded that the use of guided notes did save time in the course.

Comparison of Student Performance: Graded assessments of 747 individual assignments and 76 final course grades covering the work of 76 students over four course offerings were evaluated to explore the second null hypothesis - *mean student grade performance does not change when guided notes are incorporated into the course*. Table 1 provides the evaluated student performance metrics along with the p-value of the t-test evaluation of the 2012 & 2013 and 2014 & 2015 offerings data.

The presented p-value listed in Table 1 is the p-value resulting from the 95% confidence interval using a two-tailed t-test assuming equal variance. Based upon the p-values, the authors failed to reject the null hypothesis for all metrics, indicating that mean student grade performance on the evaluation metrics was not different between groups at the 95% confidence interval.

Table 1. Graded performance assessments used to evaluate the second null hypothesis. The presented mean ± standard deviations and range are assessments that have been graded on a scale from 0-100.

Assessment Instrument	2012 & 2013 Offerings		2014 & 2015 Offerings		p – value
	n	mean ± stdev (range)	*n*	mean ± stdev (range)	
Homework	240	93.6 ± 16.4 (0-100)	216	94.7 ± 17.7 (0-100)	0.4789
Design Labs	80	93.1 ± 8.1 (70-100)	59	96.0 ± 4.54 (90-100)	0.0769
Mid-Term Exam	40	85.1 ± 8.6 (65-99)	36	82.8 ± 9.21 (67-97)	0.2416
Final Exam	40	80.5 ± 14.4 (44-97)	36	80.8 ± 12.2 (59-99)	0.9101
Final Grade	40	87.0 ± 6.3 (71-95)	36	84.2 ± 8.4 (72-96)	0.1103

While the decision was made to group performance indicators from 2012 and 2013 and compare to 2014 and 2015 for ease of interpretation, comparisons between all years yielded similar results. The author's findings within an engineering classroom are consistent with literature reports showing the impact of guided notes implementation in different learning environments and for different populations [2, 5, 6].

Discussion

Through examination of both hypotheses, the author concludes that the implementation of guided notes within the course led to more efficient coverage of course content (same content within a reduced time) while not impacting student performance (as evidenced by graded assessments). This raises the question of whether to utilize guided notes in all classes.

In order to address the concept of using guided notes in additional classes, students from both junior and senior level classes were polled. Using a Likert scale from one (strongly disagree) to five (strongly agree), the students were asked about their initial willingness or desire to use guided notes, the ease of using the notes, and their desire to use them in future classes. The junior level class, which had only been exposed to traditional style notes, had little desire to switch methods of learning with an average response ($n = 12$) of 2.75 ± 1.29. The senior level class, however, had an overwhelmingly positive response to the implementation of guided notes. The average response ($n = 24$) to the ease of using these notes was 4.75 ± 0.68. The average response ($n = 24$) for use in future classes was 4.46 ± 0.98, with several students actually requesting note packs from other courses be changed over to a similar method of delivery within the "comments" section on class materials.

Perception of this method appears to be its primary limitation. Future researchers should have an open mind to the outcomes of this type of course change and research. There is little doubt in the author's mind that guided notes work well. There is, however, a bit of self-evaluation that occurs when a professor realizes that a simple change in their course freed up twelve 50 minutes class periods while maintaining student performance. This is especially humbling when the realization occurred after seven previous course offerings. Because the time savings were predominantly due to reduction of the time required to write lengthy equations (and equation parameters) on the board, the suitability of implementing this pedagogical method in other engineering classes needs to be further assessed.

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