Shaping Good Old-Fashioned Students through Reading and Note-taking: A Work in Progress

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Abstract

Many students come to college ill-equipped to master content in the higher education learning environment. Innovative engineers throughout history have gained mastery of new concepts and built on the work of others by reading published works. Most courses have an available textbook, though few students invest meaningful time in reading without external inducement. Most students will require some level of coaching to learn to read well, to read with the goal of increasing their understanding. Starting with the Mortimer and Adler's classic *How to Read a Book*, students can be taught to join the engineering innovators of previous generations in reading well and taking notes on their reading. The authors' learning environment has benefited from a work-in-progress learning-management-system-powered methodology for developing better reading and note taking practices. For completion credit, students are asked to prepare notes from textbook reading assignments and post them to a discussion board. They are also required to submit their notes from class to the same discussion board. Survey results show students seem to find value in the process. Instructors find students better prepared for classroom engagement.

Keywords

lifelong learning, self-directed learning, autodidact, reading, note taking

Introduction

Many students enter college ill-equipped to master content in the higher education leaning environment. K-12 education in the US emphasizes the student's ability to return factual information and repeat standardized processes in math and science[1], frequently undermining the broader skills required to pursue and address points of individual intellectual curiosity[2]. This has led to an influx of prospective engineering students who are potentially underprepared as lifelong learners. Additionally, our society is entering a post-literate culture, with just-in-time fact acquisition via video consumption widely considered the first and only way to develop new skills[3]. Though these learning methods have their place, they tend toward passive and shallow learning. The rapid transition to widespread online learning due to COVID may have accelerated the trends toward thinking and engagement through passive video consumption, interactive virtual activities, and abbreviated social media arguments. However, upon graduation engineers need to be able to interact and synthesize non-interactive sources like codes and design guides. Innovative practicing engineers are critical thinkers, actively synthesizing knowledge, constructively developing new solutions, and interactively engaging with various stakeholders. Engineering students will require coaching and teaching to develop their understanding the way

innovative engineers of all generations have: through reading, note-taking, problems solving, peer-interaction, and mentoring[4]. Engineering educators have a role in training students to use these methods. Yet, many students are "coin-operated"; though engineers should be intrinsically motivated to engage with engineering content, most engineering students require extrinsic, grade-based motivation from their instructors. Students can develop the skills of reading and taking notes on technical material required of lifelong learning engineers through carefully designed Student Notes discussion boards.

Educational Goals

The experience of innovative engineers suggests that internalizing the concepts discovered by those who came before through writing and note taking will be essential for future engineers. In previous generations, many students would arrive in the college classroom ready to take notes on everything written on the board augmented with verbal statements from the instructor. However, the authors have noted a growing trend in students not taking notes during lecture. The reason for this lack of note taking is unclear, so often the authors will remind students to take notes, with varying degrees of student responsiveness. Furthermore, most courses have a required textbook with recommended reading assignments associated with each class period; the authors have grown tired of a late-in-the-semester reminder to read before the next class being met with a student comment of "there's a textbook for this class?" How can faculty get their students to read before class, to take notes during reading and class, and then engage with those notes and with each other after class?

The ICAP (Interactive, Constructive, Active, and Passive) model provides a helpful framework for evaluating reading assignments and note taking engagement[5]. The lowest level of content engagement is Passive. Passive engagement is the natural inclination of many current college students: watch a video or lecture, nod in agreement, and move on. This level of engagement with the content is difficult to assess in the formative stages. Yet, students who stop at this level rarely do well on other assignments or engage meaningfully with peers and mentors on the content.

Active engagement is better: can students answer questions during the lecture; can they practice a process to solve a problem? Lecture and reading quizzes, interactive textbooks, and active learning techniques can and should be used to increase student's active engagement with course content. Automatically graded learning management systems (LMS) quizzes, or student response systems can provide the extrinsic motivation desired by many students[6].

Constructive engagement is an even more impactful means of content engagement: can the students create an artifact from their learning? This creative element can be something as big as a project, or something as "easy" as note taking. Instructors can assess student engagement by reviewing student notes from reading assignments or lectures and providing feedback as necessary.

The most impactful means of engagement is Interactive: how can students engage with each other as they create their learning artifacts? LMS discussion boards provide an ideal place for students to share their note taking artifacts and learn from each other about the important concepts and how to express them. A public forum for presenting notes on reading and lectures

provide dual external motivators: instructor-graded participation and a desire to excel (or at least not look foolish) before peers.

Training and Student Note Assignments

Most students need training in both reading and note taking. During introductory lectures, instructors introduce the students to Mortimer and Adler's classic, *How to Read a Book*. During class, students are encouraged to "Inspect" the textbook for the class, collaboratively identifying the book's classification, topics, structure, and the targeted problem. Students are then introduced to the stages of "Interpretation" (coming to terms, propositions, arguments, and whether the problem was solved). Finally, students are encouraged to follow the "Maxims of Critique" (understand first, be kind, and provide good reasons) and the "Special Criteria for Critique" (authors may be uninformed, misinformed, illogical, or incomplete; otherwise, the reader has an obligation to agree with and comply with the author). Post-modern critical theory readings must be rejected in engineering disciplines. Rather, the author determines the meaning; the meaning is good, beautiful, and true to the degree it reflects the real world; and the reader's perspective and feelings about the content are not pertinent to the engineering educational endeavor. From this in-class training, students are encouraged by the syllabus to engage in author-directed learning (aka reading), pointed to resources for learning about author directed learning[7,8], and encouraged to engage with the textbook prior to class to increase the value of instructor-directed learning (aka lecture).[7]

The syllabus is the first means of introducing Student Notes activities hosted and evaluated on the course LMS. Students are encouraged to take notes that synthesize the major concepts from the reading, everything written on the boards in class, and additional annotations from classroom discussion, outside research, and the student's own thoughts. Students are also pointed to various note taking resources such as class handouts, the right tools (https://rb.gy/xm4eqp), and resources for learning about note taking (https://bit.ly/3G9sbZ9) including both Cornell Notes[9] and Sketchnotes[10].

Finally, Student Note discussion boards on the LMS provide the space for students to interactively share their constructive engagement with the reading and the class materials. Students make at least two posts to each discussion board associated with the textbook chapter sections for the next class. In the first post *before* class, they upload a picture of their notes (preferably handwritten) developed from the reading. The second post *after* class is a picture of their revised notes synthesizing both the reading and classroom experiences. Students may make additional posts discussing points of interest in other student notes, asking questions about difficult topics, or even discussing related homework assignments. The instructor grades the Student Note activities (typically for a nominal amount of the total course grade) based on completeness: partial credit for one picture upload, full credit for two picture uploads, and extra credit for additional interaction.

Student Survey Responses

Students have responded well to the Student Notes discussion boards. Anecdotally, students express greater confidence in their learning in the classroom and a general appreciativeness for being guided in how to read and take notes in college, specifically on engineering content. Though there is a level of nuisance associated with multiple posts to a discussion board nearly every class period, students appear to get better at their own note taking by observing the note taking skills of their peers.

Over 200 hundred students in freshman introductory courses and sophomore engineering mechanics courses responded to survey statements related to their perspective on how reading and note taking supported their engagement in the course, their mastery of the content, and their interaction with their peers. Figure 1 shows these survey results from a modified 4-point Likert scale where an average score of 4 indicated strong agreement, 2.5 indicates neutral agreement, and 1 indicates strong disagreement.
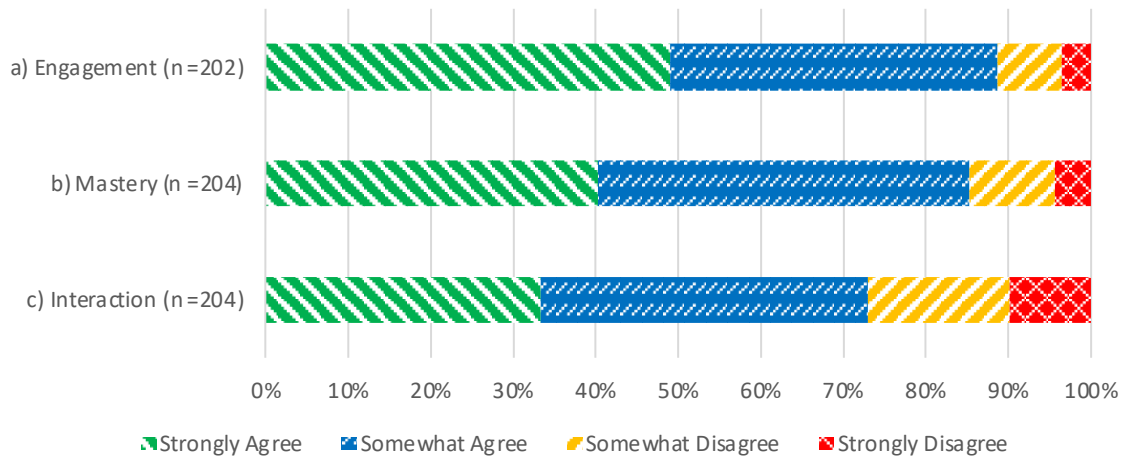

Figure 1. Student survey results stating agreement with the statements:
a) Engagement (n = 202): "Taking notes for the Student Notes helped my engagement in class."
b) Mastery (n=204): "Taking notes for the Student Notes helped me master the class content."
c) Interaction (n = 204): "Seeing and engaging with other students through the Student Note discussion boards was helpful."

Amazingly, almost 50% of the students strongly agreed that the Student Notes assignment helped their engagement with the course. With an average score of 3.34 and over 85% positive results, students reported engagement as the most pronounced benefit to the Student Note assignments. Students frequently reported feeling confused during and after the reading before class but found that an initial exposure to course content helped them gain more understanding during the class time than if they had not read. Instructors encouraged the students to feel confused and make notes on questions during the reading; everyone is confused the first time they are exposed to new ideas. Around 85% of the respondents (score of 3.21) reported that the Student Notes helped them master the course content. Most students feel that they gain the most understanding from working homework problems and preparing for exams, but the Student Notes are clearly a valued part of the learning process. The lowest response (score of 2.97) still showed over 70% of students found value in the peer interaction aspect of the Student Note discussion boards. Some students were driven to greater levels of note taking excellence through exposure to the note taking of their fellow engineering students.

From a lifelong learning perspective, the question is whether students will continue to read and take notes in future classes, either through intrinsic motivations (they see the value) or extrinsic motivations (they wouldn't mind other instructors having similar assignments). Figure 2 shows student agreement with positive statements toward their plans for future reading and note taking. Over 80% of students (score of 3.19) plan to take notes from the reading based on their own

intrinsic motivation. This is a huge improvement over instructor expectations from most students. Students are only slightly less enthusiastic (score of 3.11) about other instructors using Student Note assignments.
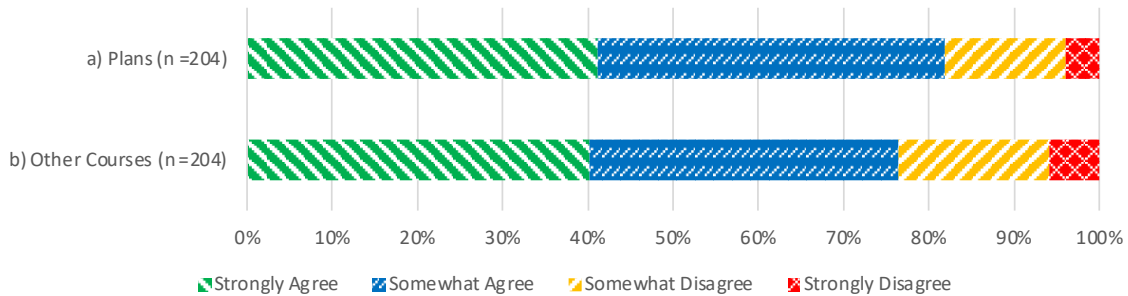

Figure 2. Student survey results stating agreement with the statements:
a) Plans (n = 204): "I plan to take notes from the reading in future classes, whether or not the professor offers credit or a discussion board."
b) Other Courses (n=204): "I hope more professors will implement Student Note discussion board assignments in their classes."

Instructor Perspectives

Instructors have also been encouraged by the effects of Student Notes to drive reading and note taking. Though course grades have not meaningfully improved since the introduction of Student Notes assignments, instructor-student engagement in the classroom is markedly livelier and more meaningful. Students have more specific questions and can more quickly refine their understanding from the effort of reading and synthesizing notes. The creation of Student Note assignments requires far less work than reading quizzes; typically, only the assigned chapter needs to be changed for a copied assignment unlike a reading quiz or guided reading assignment where new sets of questions must be created. Grading is also efficient with essentially completion-based 2-point rubrics for the first upload, the second upload, and extra credit for any additional comments. As an incidental benefit, students who miss class never come asking for notes from the instructor; they already have access to their classmates' notes. These completion-based assignments in freshmen and sophomore level classes have provided a foundation for scaffolding heavier reading assignments in junior and senior level classes. All in all, Student Notes provide meaningful benefit from the instructor's perspective without significant increases in instructor preparation or grading.

Conclusion

Engineering students learn from many sources following many methods, but their lifelong learning needs are best met by reading and note taking of technical books. Student Notes assignments and reading and note taking coaching support this goal with minimal effort from the instructor and great benefit and appreciation from students. As a work-in-progress, the authors hope to engage more engineering educators in the process of shaping good, old-fashioned engineering students who blossom into innovative engineers who change the world.

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