

Work-in-Progress: Investigation of a Fall-to-Spring Performance Drop in a First-year Experience

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Background & Purpose

This work-in-progress centers on the fall/spring semester juncture of a two-course first-year engineering experience at Ohio Northern University. As a means to provide continuity to the multidisciplinary course sequence from one term to the next, the comprehensive final exam in the fall semester is used as the initial homework assignment in the spring. These assessments cover the key content areas of the fall course, namely the engineering design process, mathematical modeling, CAD, technical writing standards, and other foundational areas.

The spring semester homework is delivered by means of a Google Form, whereby the use of an add-on script allows for student submissions to be auto-graded. The add-on script necessitates the use of easily-evaluated question types, including multiple-choice, matching, true/false, and short answer. Student averages for the past three years' assignments are: 2016-17 exam = 73%, homework = 66% (students given 2nd homework attempt = 84%); 2017-18 exam = 74%, homework = 68%; 2018-19 exam = 73%, homework = 71%.

This consistent performance drop is troubling given all the afforded homework advantages. In addition to the homework's aforementioned selected-response question style (most exam questions are free response), students are a) permitted to work with classmates, b) encouraged to ask TAs and instructors for help, c) given a week to complete the assignment, and d) reminded to review their notes and the fall course's slide deck. This investigation was initiated to gain insight into the fundamental reasons behind this performance drop after the month-long winter break. Current first-year students were asked to complete an anonymous mid-spring semester survey (N = 114 of 141, 81% response) for feedback on the course content and organization, as well as for their own thoughts on the unexpected homework results. This initial study is intended to serve as a potential starting point for other educators facing similar issues.

Literature Review

Homework completion has been demonstrated to be a critical component of the learning process and a key to learning [1], [2]. Student attitudes towards homework have also been studied extensively, indicating that student self-efficacy, motivation, and beliefs about homework are related to their likelihood to complete homework as well as to their overall academic performance [3], [4], [5]. The positive effects of homework have been demonstrated to hold true, if not be further enhanced, for online homework formats [6], [7]. Furthermore, Richards-Babb et al. found that students using online homework reported benefits such as the ability to correct mistakes in real-time [8].

Looking specifically at why students might not complete assigned homework, Bennett et al. examined first-year engineering students with low homework completion rates, identifying high school preparedness and grit as leading factors [9]. In a follow-up study, Li et al. documented a wide variety of reasons for homework incompleteness organized around Weiner's attribution theory [10]. This study identified impeding internal factors such as time management, laziness,

stress, and illness; noted external factors included having a part-time job, overwork, family or social events, and demotivation due to an expectation of high difficulty or low performance.

Data Analysis

Student input from the open-response survey was examined using qualitative analysis methods. Responses were evaluated without a pre-determined coding scheme to mitigate bias in the categorization of their responses. Common themes were then lumped into broader areas; this approach allowed for input to be quantified, but also revealed valuable insight from individuals. Because the survey was anonymous to encourage honest answers, data could not be evaluated to determine if trends existed within various students groups (e.g., by discipline, gender, etc.).

Unsurprisingly, the most common reason given (noted by 51% of respondents) for poor homework scores was related to lack of motivation because, as one student wrote, “Homework is not as important as exams.” Students with similar responses commonly cited the relatively few points of the homework assignment (~40 points vs. ~120 exam points). Students also cited motivational issues tied to their desire to “focus on more challenging classes,” as one replied (anecdotally, it is a common belief among first-year engineering students that courses such as calculus and physics are more important than their first-year engineering coursework).

The next most frequently-cited explanations were related to procrastination (22%; one student noted, “...whenever we do homework for intro we tend to finish it without any double checking”) and content retention issues (18%), especially due to winter break. Somewhat intertwined with these first three themes was a belief among students that they did not need to utilize any of the available resources. Wrote one respondent: “I think they assumed they knew the material, I did. People got it done last minute by themselves.” Another noted that classmates “tried to do it solely from memory (as I did).”

Notably, 11% of the respondents identified the homework format as a detriment, commenting that the selected-response questioning and/or online interface hindered their ability to earn a high score. This is unfortunate since manually grading the free-response exam is extremely time intensive (15-20 minutes per student) and TAs are unlikely to grade these consistently.

Lastly, 6% of the responses were related to challenges with the course’s content delivery style. Traditional content delivery is minimal because the first-year courses are project-based, with active learning ingrained into nearly all lessons. This effective approach [11], [12] aims to excite students about engineering to improve retention and motivation rather than bog them down with an overabundance of complex technical concepts they will learn in future courses.

The content that was delivered was typically done so through PowerPoint slides. This approach provided the benefits of a) keeping all course sections on the same page, b) providing an online repository of information, and c) increasing in-class time for meaningful activities and discussions. While no students complained about this practice during the fall semester, some did indeed find it disadvantageous when completing the comprehensive homework assignment. For example, one student responded, “...we never did anything that required us to take notes in class and its [sic] a pain to have to find the ‘need to know’ information in slides that date from day one to the final.”

While none of the top three themes (motivation, procrastination, content retention) are revelatory, they do confirm anecdotal evidence and provide a justification for explicitly addressing these non-ideal attitudes and study habits in future first-year courses. Responses related to overconfidence and note taking, while less prevalent, are perhaps more worthy of continued investigation since the former may give insight into a flawed mindset and the latter can be directly addressed through adjustments in the course's pedagogical style.

Discussion

Why do students *believe* they have retained enough knowledge to successfully answer a wide array of questions without utilizing available resources? Is this a continuation of their high school practices, when many of them succeeded with relatively less effort? Perhaps this is due to a combination of overlapping excuses such as the prioritization of other coursework, lack of points on the assignment, poor time management, and/or extended time since the exam. Could it be that they are "...[afraid] to ask for help because they don't want to look stupid..." as one student wrote? Although teaching assistants are available for help with assignments, only 10% of the respondents reported that they visited a TA during office hours during the first semester or halfway through the second semester.

It is similarly rare for first-year students to visit their instructors during office hours. While student questions via email are more common, there is still a dearth of interaction between instructors and first-year students outside the classroom. While this unfortunate practice typically does not prevent students from passing their first-year engineering courses, if the same lack of resource utilization is true for their other courses (e.g., Calculus I, a course students commonly cite as a primary reason for transferring out of engineering), the consequences can severely limit students' ability to persist in the college.

The lack of note-taking has not gone unnoticed by the course instructors. Although notetaking has been historically viewed by students and instructors as necessary to learn lecture content [13], it is more common for students in the course under study to not use a notebook since they are often engaged in classroom activities and know that they can reference the slides afterwards online. Thus, it may be worth piloting a slightly different approach that would balance the benefits of note-taking with an appropriate amount of classroom activity. While this trend towards a more traditional method of content delivery is not likely to be welcomed by students, some are indeed aware of the current system's limitations. One student pointed out this conundrum, writing "...there really wasn't [sic] a whole lot of notes in [the fall semester], so thus there wasn't any specific, focused sources of information to draw from... This is just a natural weakness of a class based more upon doing work than taking notes, which I personally prefer over taking notes anyways."

In conclusion, student input suggests that their decreased performance from the fall exam to the spring homework is largely due to lack of motivation and urgency, overconfidence, and poor note taking. Future studies may consider changes to the fall course such as redesigning in-class curriculum to facilitate notetaking, coaching students to seek help from instructors and TAs, and verifying their answers rather than relying on memory.

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