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Work In Progress: Implementing the "Good Old-Fashioned Student" Teaching Model in the Two-Year College Classroom

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Work in Progress: Implementing the “Good Old-Fashioned Student Framework” in the Two-Year College Classroom

Abstract

According to data compiled by ASEE from the Department of Education and the National Science Foundation, in 2019, nearly half of those in the engineering and science workforce spent some portion of their education at a two-year college. Most of those students did not complete an associate’s degree, and thus, likely transferred credits into a four-year college. Given this scenario, it is important to expose students in the two-year college environment to the learning practices of an independent learner that are part of the “hidden curriculum” of a traditional four-year college course. These skills – reading textbooks, notetaking, and reflecting on homework – are often explicitly taught in the freshmen classroom for four-year students, so transfer students miss out on this exposure. Here, we present initial findings from the first year of using the Good Old-Fashioned Student Framework at two-year Trident Technical College in an “Introduction to Engineering” course. The Framework was originally implemented at four-year college, The Citadel, and has been applied in a wide range of engineering courses. Initial data indicates students who engage with the Framework’s assignments perform better on summative assessments, with potentially a greater impact on those with less exposure to tertiary education. Assignment instructions, student submission rates, and faculty/student feedback are included to inform others who wish to implement this model.

Introduction

The Good Old-Fashioned Student Framework [1] implemented at The Citadel in the School of Engineering provides a structured and scaffolded approach to help students practice skills related to reading textbooks, taking notes, and learning reflectively from homework assignments among other activities. Many current faculty members may remember from their own undergraduate experience that they received no training on how to interact with textbooks or homework. Often described as part of the “hidden curriculum” of college, there was an understanding, often unspoken, on what activities were required outside the classroom for students to achieve academic success. [2], [3], [4], [5] Presently, faculty may be dismayed that their students do not use the textbook or do not seem to know how to use homework as an educational tool. [6] This is not a shortcoming of the students, but rather a misunderstanding of how to use out-of-class time effectively for learning and maximize the utility of their in-class interactions. Course instructors often make a variety of resources available to students but do not give guidance on how and when to engage with each. The Good Old-Fashioned Student Framework recognizes that students, especially those new to college or from underprivileged high school backgrounds, need explicit instruction, including from the faculty in engineering courses, to model traditional learning practices. Such students are present in four-year colleges and two-year colleges alike. The Framework is not meant to undermine the use of more impactful pedagogical methods in higher education, such as flipped classrooms or personalized user-responsive online homework formats. [7], [8], [9], [10] Rather, the Good Old-Fashioned Student Framework is to prepare students for traditional lecture-based course formats that are still widely employed, in both two-year and four-year institutions, so they are not negatively impacted by unspoken expectations around out-of-class learning practices. Additionally, after graduation, professional engineers must be prepared to engage in life-long learning and should be well-versed in utilizing a variety of resources, including texts, and be prepared to self-assess their mastery of new concepts while learning.

The Good Old-Fashioned Student Framework was developed at a four-year institution to help transition students from high school to upper-level undergraduate engineering course work. In that setting, faculty observed moderate increases in student academic performance when students engage with the Framework's assignment structure with minimal negative impacts on student-faculty rapport. [2], [3], [11], [12] Through on-going collaboration between The Citadel and Trident Technical College, faculty from the four-year institution were able to teach the "Introduction to Engineering" course at the two-year college in service of the "2+2" engineering transfer program. The course is a required part of engineering degrees in the state of South Carolina and is a standard course for any student planning to transfer to a Bachelor of Engineering program from the two-year Trident Technical College. It must be noted that the "2+2" program is separate from the two-year engineering technology degree programs at the institution. Students enrolling in the course discussed here do so with the intention of preparing for a bachelor's program and thus employing learning practices aligning with a four-year program is encouraged by the institution. In this initial implementation of the Framework in a two-year college setting, we aimed to quantify the impact of students' engagement with the components of the Framework on their summative assessment (i.e. test) performance. Notably different from Framework implementation at The Citadel, the timing in which students take "Introduction to Engineering" varies greatly (from first semester freshman year to several years into their degree) allowing investigation into the effect of the Framework on students with different levels of tertiary college experience. Course learning objectives, textbook, and homework problems for the course remained unchanged from prior offerings of the course. However, utilizing the Framework assignment structure, content that may have been previously part of a "hidden curriculum" was made "visible" with explicit instructions and examples. Here, we document the assignment structure, submission rates with correlations to student performance, and feedback from students and faculty from this initial implementation. This is part of an on-going study into utility of the Framework for first generation and underserved populations for whom college "hidden curriculum" can be a barrier to success.

The Good Old-Fashioned Student Framework

The Good Old-Fashioned Student Framework (hereafter, the Framework) provides educational scaffolding for students within their technical engineering courses to prepare them for future courses that may have "hidden" out-of-class learning activities as part of the course design. These practices are also intended to support student's "life-long" learning ability after graduation. The Framework identifies five main aspects of innovative professional engineers. These five aspects involve both attitudes and skills. [1]

1- Innovative engineers are committed to self-directed learning with mastery in reading, notetaking, and scaffolded approaches to learning.
2- Innovative engineers are curious about the created world, engaging through observation, exploration, experimentation, and job experience; they are eager to use every opportunity to align their understanding with the objective reality of how the world behaves.
3- Innovative engineers are eager to communicate and apply their understanding through words, sketches, and mathematics, and develop those communication skills through practice.
4- Innovative engineers also encourage one another through peer instruction, professional associations, and group work.
5- Finally, the education of innovative engineers involves sympathetic mentors who provide resources, inspiration, and awareness of the contribution of previous generations.

The Framework aims to provide explicit instruction to help students acquire the skills in this list, including skills not explicitly taught in the traditional engineering classroom. Consistent with the values of the Framework, students need practice to develop the self-direct learning skills of reading and notetaking. While pedagogical research has shown some benefit to video resources for class preparation [13], [14], [15], the Framework emphasizes interaction with text-based resources due to their ubiquity in industry. [2] Until all professional resources are converted to non-text formats, the explicit instruction provided by the Framework is still warranted to reduce "hidden" skill barriers. In the Framework, faculty require students to submit proof of interaction with the textbook before class. This could be in the form of answers to a provided list of questions or a self-directed set of notes on an assigned section of the textbook. The frequency of these "pre-read" submissions could be before each lecture session or on a weekly basis. Any misunderstandings from the preparation activity are addressed by the professor during the lecture, providing a more responsive classroom environment and promoting student-faculty interaction. This approach is like the flipped classroom model, where students prepare for the in-person class session, but the Framework emphasizes the use of text-based resources over instructor-recorded lectures or other video materials. Practicing engineers will need to competently use written materials like regulations and standards documents. The Framework is adaptable to a range of textbook formats, including both print and eBook formats (even interactive online textbooks), as well as "open educational" or free textbooks. Format flexibility can impact non-tuition educational costs for students. For students with cognitive differences, providing a guided method to interact with text-resources is potentially even more important to help prepare them for professional practice. The Framework does not preclude such students from utilizing "read aloud" features or other assistive technology tools.

Additionally, the Framework recommends a homework format that emphasizes practice, reflection, and metacognition. Many instructors using the Framework have adopted a dual submission homework methodology. Initially, students submit an initial attempt to solve the assigned problems. Then, students receive access to a complete solution guide from the instructor to compare with their own work. Finally, students must submit proof of reflection and correction of their work. One criticism of the Framework is that this increases the grading workload for faculty, but in practice, faculty experience little increase in workload as students take greater ownership for developing their engineering communication skills via homework practice. [3], [12] Students also can see a time saving-benefit from the dual submission framework. With the ability in LMS to allow access to certain files after the student meets a condition or a date is passed, students do not need to wait on the instructor to grade a submission and provide feedback. The student can access the solution guide at a time convenient for them.

Model Implementation at 2-Year College

Trident Technical College is a two-year community college in the state of South Carolina. The college has documented articulation agreements with one local four-year institution, Citadel, for a "2+2" bachelor's in engineering program consisting of five different engineering majors. The college also aligns engineering transfer courses with state-level expectations to allow students to transfer, with prior coursework counting toward a degree, to any of the other three major state institutions that offer bachelor's degrees in engineering majors.

Through the articulation agreement, an engineering faculty member from Citadel teaches the "Introduction to Engineering" course (EGR269) at Trident Technical. In the Academic Year 2024-2025, the instructor chose to apply the Framework after using it in several engineering courses at their home institution. Modifications to the course material included creating more frequent, but smaller, assignments within the course Learning Management System (LMS). No changes were made to the course outcomes, textbook, or list of semester-long assigned homework problems. In prior offerings of the course, the course grade was computed solely based on test performance and there was minimal to no explicit instruction on how to engage with the textbook and the homework assignments to scaffold learning ahead of exams.

EGR 269 is designed to introduce students to the breadth of quantitative engineering analysis at the algebra level; no calculus is used. The introduction of fundamental equations in topics such as Statics, Thermodynamics, and Circuits equips students to solve basic engineering word problems. While the course is listed at the 200-level, it is intended for first-year students planning to transfer to a 4-year institution's bachelor's in engineering program. EGR 269 does require prerequisite mathematical competency at the college algebra level. Historically, a small number of students will enroll in EGR 269 without sufficient prior math competency leading to a non-zero "DFW" rate in the class. Additionally, the program has a precedent for a small number of students to withdraw from one, or all, of their courses due to non-academic reasons.

Table 1: Standard Assignment Instructions for EGR 269

<table>
<tr><th>Homework Assignment Instructions</th><th>Pre-Read Assignment Instructions</th></tr>
<tr><td>Complete the HW problems listed in the Course Calendar (provided in lecture) for the Lecture Number listed in the assignment title.
The number of problems varies by lecture, and thus the "weight" of each HW toward your final course grade varies as it is based on a "per problem" basis.

Deliverable: Upload a legible scan(s) or photo(s) of your HW. You should keep all of your original HW pages in order to complete the HW Correction assignment at the end of the Unit.
Grading:
• 1 point overall for quality organization and legibility of your homework upload. This includes boxing your final answers on the page and clearly numbering your problems.
• Even Problems: 1 point for showing quality work
• Odd Problems: 1 point for showing quality work + 1 point for accuracy of final answer
Estimated Completion Duration: Varied by assignment but estimated to be 1-1.5 hours
Important Reminder: No late work is accepted in the class; however, it is better to submit a partially completed assignment and get partial credit than to skip an assignment entirely. There are plenty of opportunities for "extra credit" to make up points that are lost.</td><td>Using your textbook, look up the answers to the bold and italicized questions in the notes outline. You can find which textbook sections contain the answers via the Course Calendar. Do not worry too much about getting every answer correct as we will go over correct answers in class. It is recommended that you do not take up all of the provided space in your Pre-Read as you may want to add content to the space in class.

Deliverable: Upload a legible scan or photo of your notes page(s) for the lecture listed above.
Grading: Complete/Incomplete</td></tr>
</table>

The EGR 269 course content is grouped into three units, each concluding in a Unit Test. For each class "lecture" period within the unit, students were assigned a set of homework problems (ranging from 3 to 8 problems, with an average of 4 problems). At the end of each unit, students were encouraged to turn in "Homework Corrections" to "earn back" points lost on the initial submission of homework. Initial homework submissions were graded approximately 75% on completion and formatting with the remaining 25% on the accuracy of the final answer. This was intended to award credit for time and effort, and not just for accuracy, thereby supporting both intuitive and repetition-based learning modalities in students. Text instructions for the homework assignments are provided in Table 1 below. In prior offerings of the course, the same list of homework problems was used, but given as a "master list" of problems by unit with less direct tie to the content of the day and the in-class example problems. Before the lecture, students could turn in a pre-read assignment to earn "bonus" points toward their homework grade category. Pre-reads consisted of a specified sub-set of questions in the provided lecture outline. This same lecture outline was followed during the in-person class sessions. The intent of the pre-read assignment was to allow students to "annotate" the notes they took from the textbook and thus have a visual cue if there was content that was unclear in their reading. The questions selected for pre-reads were primarily definition-based topics that could be found relatively easily in the prescribed sections of the assigned textbook, thus helping students adapt to finding required information in text-based resources, but providing in-person support when needed. The instructions for the Pre-read assignments are provided in Table 1. The use of explicit instructions and consistent schedules for out-of-class work associated with EGR269 was intended to reduce the "hidden curriculum" requirements in the previous course offering as well as provide scaffolded learning experiences, both in the use of text-based resources and homework for learning, ahead of future engineering courses which may be taught with "traditional" lecture formats.

Results – Student Performance and Participation

The data presented in this work-in-progress paper is from one EGR 269 course section from Fall 2024. A total of 26 students enrolled in the section and attended at least one class session. Of these, 23 remained enrolled until the end of the semester. The three who withdrew from the course did so for a variety of reasons related to prior mathematical literacy and employment requirements. The data also includes records of two students who remained enrolled until the end of the semester but stopped participating in the course during Unit 2, thus impacting their course grade and participation data.

Student performance and participation data clusters students into "freshmen" and "sophomore" classifications. These were determined from the number of attempted course credits prior to Fall 2024. Students attempting less than 18 credits are classified here as freshmen with sophomores attempting 18 or more credits. Notably, the designation is based on attempted credits rather than passed credits. Community college programs in the state were largely "$0 tuition" in the period immediately after COVID-19 as recovery funds were used to incentivize increased enrollment. Within engineering transfer programs at Trident Technical, this led to higher than average DFW rates and increased rates of students repeating courses. Attempted credits were used to designate student status in order to visualize the impact of prior college-level course exposure on performance and participation in the assignments of the "Old Fashioned Student Model" rather than prior academic performance. Such analysis is planned for future work as well as additional demographic analysis that was precluded in the current work due to sample size.

Of the 23 students enrolled at the end of the course, 13 were sophomores (18+ credit hours attempted) and 10 were freshmen (< 18 credit hours attempted). Both students who stopped attending during Unit 2 without officially withdrawing were freshmen. According to full-time faculty at Trident Technical, this behavior and its frequency are in line with the rest of the program. The average final course grade of the sophomores was 92% with 8 earning a final course letter grade of A. Among the freshmen, the average final course grade was 66% (78% if the 2 who stopped participating are neglected) and 2 earned a final course letter grade of A. This difference in student performance by level was expected as the sophomores were enrolled in classes such as Engineering Statics or Circuits at the same time which covers concepts introduced in EGR 269, but with much more depth.

The first element of the Framework's impact assessed was participation with the homework submission process. The student submission rate of homework assignments shows a positive correlation with Unit Test performance for both freshmen and sophomores (Figure 1). The slope of the relationship appears higher for freshmen than sophomores, but true statistical analysis is currently impossible due to the small sample size. Homework, both quantity and duration, have been found to have both positive and negative effects of student outcomes depending on additional demographic and course content parameters in the literature. [16], [17], [18], [19], [20], [21], [22]

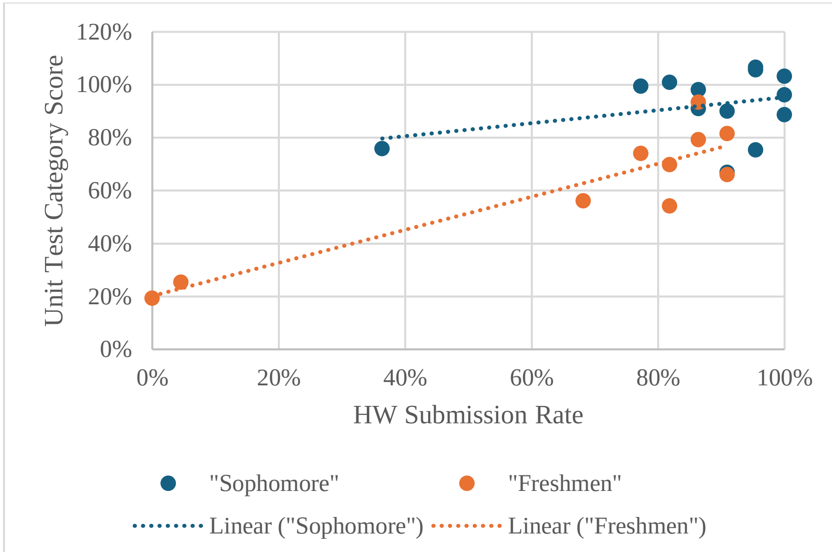

Figure 1: Homework submission rate versus unit test category score for EGR 269 students.

The second element of the Framework employed in EGR 269 was the use of a pre-read. Pre-read submissions were optional, for "bonus points," rather than a required out-of-class time commitment, however, most student submitted at least two pre-reads. The textbook for this course was one set by the prior course instructor. It was available in both physical and eBook formats, both through the campus book store and online third-party vendors. The instructor did not preference one format over another and specifically instructed students to consider price when evaluating their options. Students with documented disabilities were also reminded that they had access to screen readers and other assistive reading technology tools through the campus support services if they chose to use them. Among sophomores, the submission rate for Pre-read assignments has little correlation to Unit Test Scores (see Figure 2). It is possible this is due to their greater prior exposure to the course content from other engineering classes and thus minimal impact from looking up definitions in the textbook ahead of class. However, visually, there is a slight positive correlation for freshmen between Pre-read submission rate and unit test performance for freshmen, but the small data set in the work-in-progress complicates meaningful statistical analysis. Some literature suggests that changing to a required preparation activity rather than a suggested one could have a positive impact on test performance for some. [23]

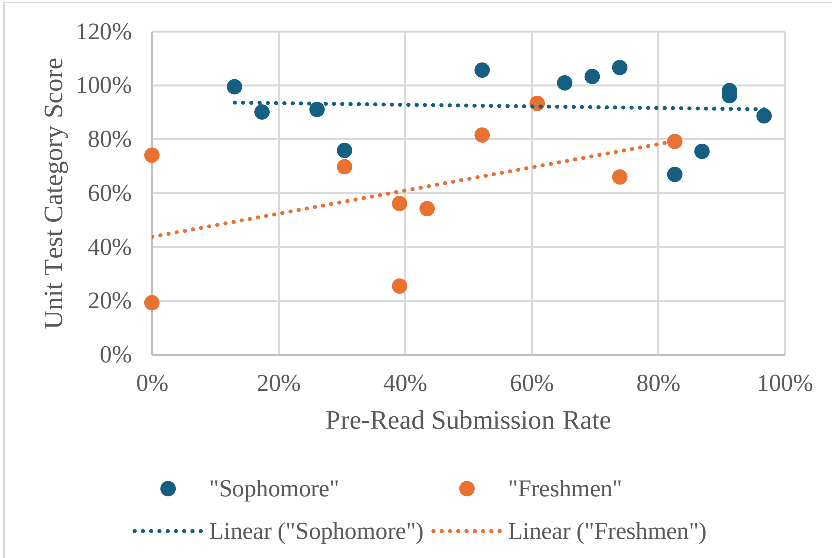

Figure 2: Student pre-read assignment submission rate versus unit test category score for EGR 269.

The third element of the Framework utilized here was the use of a homework reflection or homework corrections assignment. The original implementation of the Framework at The Citadel called for submission of homework corrections on at least a weekly basis; however, due to a limitation in the LMS at Trident Technical, homework corrections were submitted only at the end of the unit in EGR 269. Because of the disconnect between the initial submission and correction submission, corrections were submitted for bonus or "earn back" points instead of being a required component of the homework. This may have resulted in lower submission rates compared to when the Framework was previously used. As shown in Figure 3, the ratio of freshmen who submitted one or more correction assignments is greater than that of the sophomores. As mentioned previously, sophomores often took Statics or Circuits concurrent to EGR 269, thus already being exposed to the EGR 269 content at a higher level, resulting in higher scores on the initial homework attempts. It is important to note that students' homework grades were already at or above 75% as long as they made a recognizable attempt at solving the problem, even if the final answer was incorrect. Therefore, anecdotally, some students, particularly sophomores, expressed that the time it took to write a correction (rather than just reading the solution guides provided) was not worth the points towards their course grade.

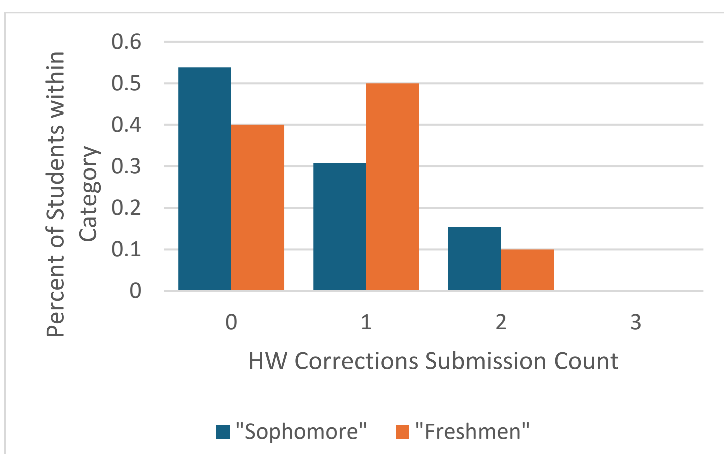

Figure 3: Percent of Freshmen versus Sophomores who submitted homework corrections

Results – Comments from Students and Faculty

Feedback on the course structure from students was largely positive. The total number of assignments associated with this class was much higher than what they had seen in other college classes, however they did note that the smaller size of each assignment helped pace themselves through the course. One freshman student explained that she appreciated the emphasis on pre-reads and the lecture outlines as they helped her know what to do even if her mind started to wander or if she missed a class session. One sophomore student on the last day of the semester told the entire class that he wished he had taken this class sooner to help prepare him for his more complex engineering classes (e.g. Statics and Circuits).

A few of the sophomore students said they disliked the increased number of assignments compared to other classes at Trident Technical because they felt too trivial. This feedback has been received in other implementations of the Good Old-Fashioned Student Framework. Students who will reflect on their performance, by viewing answer keys or instructor feedback, independent of instructor motivation (i.e. class assignments and course credit) sometimes react with annoyance at having to submit proof of work. However, once it is explained that the Model allows them to earn class credit for behaviors they would otherwise do on their own, they are often more positive. For non-traditional or working students, the emphasis on always having an instructor provided solution guide for all homework problems can help them manage their time on an initial homework attempt. They know if a single problem is taking too long that it can be "abandoned" with minimal impact. For students who regard themselves as more intuitive learners, the scaffolded learning structure implemented in the Model can also be viewed negatively. Yet, few students, whether at a two-year college or a four-year college, always learn engineering in an intuitive fashion. While a student may be able to master one concept with little practice and repetition, that does not mean they will do so for all concepts required in their entire degree program. Showing students, particularly in lower-level classes how to use textbooks, lectures, and homework assignments in a complementary fashion to scaffold to concept mastery is essential for overall academic success of the widest possible student population.

From the instructor perspective, the time required for a Good Old-Fashioned Student Framework course is minimal throughout the semester once the LMS is set up due to the grading method used. It required a few days to (1) create the lecture notes outline which became the basis of the pre-read assignments and (2) create solution guides for all the homework assignments. Once those reference documents were created, it required less than one day to create all the assignments in the LMS. This is aided by using standardized assignment instructions (Table 1) which can be copied into assignments with different lecture or homework problem numbers. Pre-reads required minimal time to grade as they were graded solely on completion. The instructor viewed the submission preview in the LMS and was immediately able to assign a grade. For students who did not submit, the LMS can be configured to automatically assign a grade of zero. Due to a challenge in the LMS formatting at the start of the class, the homework assignments were being partially manually graded by the instructor for accuracy. However, as the accuracy grade was only for odd problems in the assigned list and it was assessed as "all or nothing" based on the final numerical answer (no partial credit), grading duration was minimized to the extent possible. The grade was able to be issued with minimal individualized feedback because all students were directed to review the provided solutions guides to determine their own challenge areas. A workaround in the LMS was discovered half-way through the semester that will allow a more standard implementation of the dual reflection homework model [3] in future semesters of this course.

Conclusions

The Good Old-Fashioned Student Framework is based on the idea that students have always learned material in recognizable patterns. Students must first be exposed to the vocabulary and general concepts of a topic. They should then see calculations modeled, and finally, attempt independent work on the calculations and self-assess their inaccuracies to limit repetition. In this Framework, the instructor acts as an enthusiastic coach in the classroom and a personal trainer outside by setting small assignments that guide students through the learning process. The assignments in the Framework use consistent instructions to guide students through learning practices that may otherwise be part of the "hidden curriculum" in a traditional lecture-formatted course. Through this work-in-progress implementation of the Framework in a 2-year college setting, we have observed similar findings compared to 4-year institutions- students who submit homework and reading assignments tend to also perform better on exams. The small dataset presented here suggests that a students' prior exposure to college-level courses may influence the impact of the Framework's assignment structure on performance- with newer college students benefitting more when engaging with the Framework's assignment structure. Future work will involve continued implementation of the Old-Fashioned Student Model at Trident Technical in the Introduction to Engineering course to assess the impact of student performance within the course across the wider student demographics present in a two-year college setting. Efforts are also underway to track longer-term student academic outcomes and their independent utilization of techniques used in the Good Old-Fashioned Student Framework even when not explicitly required in later courses in both the two- and four-year college settings.

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