First-Year Engineering Students' Reflections: Plans and Actions for Meeting Course Learning Objectives

Kayla Ney
Department of Biological Systems Engineering
University of Nebraska-Lincoln
Lincoln, NE, USA
kney236@huskers.unl.edu

Heidi A. Diefes-Dux
Department of Biological Systems Engineering
University of Nebraska-Lincoln
Lincoln, NE, USA
heidi.diefes-dux@unl.edu

***Abstract*— In this Research Category Full Paper, weekly structured reflections were given to students as a means to engage them in planning and acting to improve their learning. First-year engineering students struggle to self-regulate their study habits. The intention was to investigate students' planning and follow-through of different study strategies to gain a better understanding of how students formulate their study plans. This study was conducted in one section (*n*=114) of a first-year computer tools and problem-solving course. Students were given weekly structured reflections about the learning strategies they used to complete problem sets. The results showed that students overestimated the number of study strategies they planned to use. Frequently completed strategies were less time-intensive, while less frequently completed strategies were more time intensive and involved more deep-thinking. These findings can help inform instructors on how to support student learning and self-regulation.**

***Keywords*— reflection, self-regulated learning, quantitative, first-year**

I. Introduction

For decades, engineering programs have struggled to retain students [1,2]. Even though the percentage retained has increased from 50% to 75%, the number of students obtaining engineering degrees does not meet the projected number of engineers needed to secure infrastructure and ensure national security for the United States, making a focus on retaining engineering students of paramount importance [3,4].

A large percent of attrition from engineering occurs following the freshman year [4]. One huge challenge first-year engineers face is the adjustment to the rigors of their program. Studies have shown that the majority of first-year students struggle to develop adequate study strategies [5,6,7,8]. A lack of self-regulated study habits can contribute to poor performance, which leads to low self-efficacy and ultimately to attrition of first-year students [3,9,10,11]. Therefore, a lack of self-regulation ability among first-year engineering students is a large factor in attrition and must be further investigated and addressed.

Assigning structured self-reflections can provide a way for students to assess their learning [12]. Over time, these reflections can enable educators to identify and understand students' plans. It is necessary to better understand students' study habits in order to create systems which encourage the selection of beneficial study habits that can lead to greater academic success and therefore greater retention of engineering students. The purpose of this paper was to assess students' self-reported plans and actions to engage in particular learning strategies across the semester. Results of this study can inform recommendations to guide educators on how to effectively teach and support the use of beneficial study strategies.

II. Background

Past studies have revealed a few key ideas about student study habits. It has been shown that students, especially first years, do not often use deep-thinking learning strategies [6,11,13]. In a 2012 study, Hartwig and Dunlosky [7] investigated self-reported use of different study strategies and how students decided what to study. The survey consisted of 324 students from diverse majors in an introductory psychology course. Results showed that high-utility strategies such as self-testing and planning study sessions were related to high GPA. Many low-utility strategies, such as highlighting and rereading, did not predict GPA, but were highly reported as used by students. This indicates that students may not differentiate between strategies that are and are not beneficial to performance. Even though use of high-utility strategies was low overall, students who planned their studying used more strategies (including high-utility strategies) than students who did not plan [5,7].

Additional studies demonstrate that students do not understand the benefits of empirically supported (ES) learning strategies. McGabe [14] conducted a study with 255 undergraduate students with a mean 3.72 years of college completed, 50% of which were psychology students. The survey asked students to rate the effectiveness of two study strategies (one ES, one not) for a described scenario. Results found that, for four of the five study strategy scenarios, students did not endorse the ES study strategy, indicating that students may lack understanding of how certain study strategies are more beneficial than others.

Some students know of optimal strategies but do not utilize them. Susser and McGabe [6] investigated students' understanding and use of "spacing" (i.e., studying material over multiple sessions instead of in one long session). This online survey study engaged undergraduates from different colleges and universities, and the majority (71%) were not psychology majors (*n*=285). Results showed that while students understood the benefits of spacing, students reported using spacing only an intermediate amount when compared to other study strategies. Notably, the use of strategies related to metacognition and self-regulation (e.g., self-testing, making outlines, and self-referencing) were related to higher utilization of spacing, indicating a connection between metacognitive level and the decision to plan spaced study sessions.

Many studies on learning strategy selection concluded with the idea that students need help to understand the purpose and benefits of deep-thinking learning strategies [11,13,15]. These prior studies have revealed the study strategies students commonly do and do not engage in, however, less is understood about how students plan their studying and how well students follow through with their planned study strategies. To date there has been no study investigating first-year engineering students weekly study strategies.

Reflection has high utility in engineering education. Application of reflection in a professional setting is an important skill for engineers [16]. Within the academic setting, reflection has shown to help students access feedback and provide an avenue through which students can plan their learning strategies [12]. Reflection can help students better regulate their learning, as self-regulation can aid student success [17]. The use of reflection can reveal students' perceptions of their learning and learning strategies, which is vital in the development of systems to enhance student learning. In this study, weekly structured reflection was established as a controlled study habit. Reflection prompts were used to draw students into self-assessment of their performance and highlight specific learning strategies that, if employed, could lead to successful demonstration of achievement with the course learning objectives. These student reflections were examined to provide new understanding about students' learning plans and changes to their employed learning strategies over time.

III. THEORETICAL AND CONCEPTUAL FRAMEWORKS

The foundations of this work were Self-Regulation Learning Theory (SRL) [17] and the Theory of Planned Behavior [18]. SRL encompasses the idea that successful and resilient students control their own learning [17]. SRL includes three cyclic phases. Forethought is the phase that entails setting goals and creating a strategic plan. The Performance phase includes how the task is completed, which includes self-control and self-observation during the action. The Self-Reflection phase involves self-evaluation and reaction to successes and failures of one's work. Successful students focus not only on what they are learning, but also on the methods by which they are learning and how effective these methods are for learning a given topic. Students with solid SRL habits constantly evaluate and adjust their plans to enhance their processes of learning and understanding [17]. SRL helps a student understand what learning outcomes are expected from a course, how to evaluate whether or not a strategy was useful to the student's learning, and how to select better strategies for future learning. SRL has been applied to prior engineering education research to frame reflections and interpret results [19].

While SRL encompasses planning, execution, and reflection on actions, the Theory of Planned Behavior (TPB) describes the beliefs and behavioral controls that effect intentions and ultimately behaviors [18]. The theory has largely been applied in the medical field to aid patient outcomes [20]. TPB espouses the idea that with every behavior a person exhibits, there are psychological considerations that control intention, where intention is an indicator of one's readiness to exhibit a certain behavior. In this theory, three beliefs predict intention. Behavioral beliefs encompass prior experiences and expectations for the outcome of a behavior. Normative beliefs encompass perceived expectations of one's social environment, from peers to family to teachers. Control beliefs are the perception of barriers or supports that affect the task being considered. These beliefs affect attitudes, perceptions of social pressure, and perceptions of one's ability to complete the behavior; all of which then affect the intent that leads to action (or inaction).

In this study, TPB is mapped on to SRL to form a novel conceptual framework. The SRL phases of forethought/planning and performance/action are equated to intentions and behaviors, respectively. In addition, this mapping uses student self-reflection as a bridge between students' beliefs and their intentions/plans to utilize particular learning strategies to reduce the gap between their performance and the course expectations. The design of the weekly structured reflections given to students in this study attends to the three phases of SRL by having students self-report their performance (actions), self-reflect on the quality of their performance, and plan to use learning strategies to close the gap (Table I). Students' responses to the reflection prompts are assessed considering the beliefs and behavior control concepts described by the TPB, including how students' prior experiences, perceived societal expectations, and support or barriers affect how students approach their studies.

IV. RESEARCH QUESTIONS

This study focused on two research questions:

1. What learning strategies do students plan to engage in and then act upon?
2. How do students' plans and actions with regards to learning strategies change across the semester?

V. METHODS

A. Setting and Participants

The setting for this study was a required first-year engineering problem-solving and computer tools course (N ~ 1600) at a Midwest R1 institution. Classes met for 110 minutes twice per week for 16 weeks over the semester. The course was offered in Spring 2018 and there were 14 class sections, each following the same curriculum with the same assignments and exams. This study focused on one class section in which 114 students completed the course with a letter grade. In this course, 24.4% of students were female, and 75.7% were male. The racial makeup of the class was 62.6% White, 17.8% Asian, 13.1% Hispanic, 3.7% Other, 1.9% Black, and 0.9% Native American.

The course learning outcomes included applying basic programming skills to solve engineering problems, representing and interpreting data in multiple ways, selecting and using mathematical models to solve engineering problems, working effectively in a team, and demonstrating professional engineering habits. Each week, five to seven specific learning

TABLE I. STUCTURED REFLECTION PROMPTS (2018)

Item No.	Prompt	Response Type	SRL Phase [17]
Q1	While completing PS0N, what actions did you take to help you attain proficiency with the LOs? Check all that apply.	Select all that apply	Performance
Q2-Q(X[a]-3)	[Rate abilities with recent learning objectives] (For more detail, see [19])	5-point scale	Self-Reflection
Q(X-2)	Considering the evidence of proficiency for the LOs, what is going particularly well for you? Be specific.	Open-ended	Self-Reflection
Q(X-1)	Considering the evidence of proficiency for the LOs, what is particularly difficult for you? Be specific	Open-ended	Self-Reflection
Q(X)	What do you plan to do to improve your proficiency with the LOs over the next week? Check all that apply	Select all that apply	Forethought

a. X is the total number of items in a given reflection.

objectives (LOs) were introduced. LOs included specific skills such as "14.03 Employ order of operations to perform calculations, comparisons, and logical operations." Students' work on homework (called problem sets, 'PS'), exams, and projects were all evaluated based on LOs using Standards-Based Grading (SBG), which is a criterion-based grading scheme that provides students with clear expectations for their learning and feedback that can help their future learning [19].

B. Data Aquisition

Students submitted nine paired structured reflections over the semester in concert with the completion of weekly problem sets (PS). Reflections were completed in class two to three days after receiving feedback on a previous PS and submitted the next PS and before they received another assignment. Reflections were accessed by students via Blackboard®, the course learning management system.

C. Structured Reflections

For each structured reflection, the students responded to multiple closed- and open-ended prompts (Table I). The focus of this study was on students' responses to Q1 and Q(X). Students' responses Q(X) on one reflection and Q1 on the next reflection created plan-action pairs around a given PS.

For each PS, students were first asked what learning actions they had taken to improve their proficiency with course learning objectives (Table I). Students chose from a multiple-select list of 12 learning strategies (Table II). Students were then asked to rate their performance on the learning objectives associated with the PS they submitted just prior to class (Q2-Q(X-3), Table I). Then, students were asked what learning actions they planned to take (from the same list of 12) to improve their learning. The nine plan-action pairs were analyzed for patterns. Table III describes the timeline of the problem sets and number of students who submitted both the plan and action portions of the reflection for each weekly PS.

TABLE II. MULTIPLE SELECT OPTIONS FOR LEARNING STRATEGIES

Category	Plan/Action Selections	Abbrev.
Study Resources	Use/d the "help" function in MATLAB	P/A: Help Function
	Google/d for help	P/A: Google
	Watch/ed and took notes on the online modules	P/A: Modules
Ask	Ask/ed questions of my classmates or study group	P/A: Ask Peers
	Ask/ed questions of the instructional team	P/A: Ask Ins. Team
	Go/Went to office hours	P/A: Office Hours
Assessment Resources	Look/ed at the solutions to PS XX	P/A: Solutions
	Refer/red to the list [course no.] Learning Objectives (LO) website (linked from the problem sets) that lists each LO with its evidence of proficiency.	P/A: LO List
	Review/ed my performance on the Los for PS XX as soon as it is/was released	P/A: LO Performance
	Use/d the assessment of my performance on the Los for prior PSs to guide my work	P/A: Use Feedback
Practice	Fix/ed problems I had on PS XX	P/A: Past Problems
	Try/Tried the Exploration Activities	P/A: Extra Problems

TABLE III. PLAN-ACTION PAIRS OF REFLECTIONS (n=107)

Week of the Semester	Class No.	Problem Set No.	No. of Completed Pairs
Week 2 &3	3 & 6	PS02	103
Week 3 & 4	6 & 7	PS03	104
Week 4 & 5	7 & 9	PS04	102
Week 5 & 6	9 & 11	PS05	100
Week 6 & 7	11 & 14	PS06	102
Week 7 & 8	14 & 16	PS07	101
Week 8 & 9	16 & 17	PS08	95
Week 9 & 11[a]	17 & 21[a]	PS09	99
Week 11 & 13	21 & 25	PS10	100

a. Spring break occurred in week 10, there were no classes for week 10.

D. Data Cleaning and Analysis

The survey responses of 114 students were compiled and cleaned. Students that did not complete both the plan and action portions of the reflection for a given problem set were eliminated from that set of reflections (Table III). Students who had completed fewer than six reflection pairs were removed from this study. The final number of students retained in this study was 107.

The number of times each student across the nine weeks selected each of the 12 learning strategies as a planned strategy was totaled. Then, the number of times each student chose each strategy, from the minimum of zero to the maximum of nine (due to nine problem sets), were counted. The number of students that chose each strategy a specific number of times is plotted in Fig. 1. Then, this analysis was repeated for the number of times students selected a learning strategy as a completed action. In Figs. 2-5, students' responses are sorted into the four categories of learning strategies (described in Table II) to show whether students planned and/or completed learning strategies within a given category.

VI. Results

The results of the study are shown in Figs. 1-5. Fig. 1 describes the number of times each student chose each strategy over the nine problem sets. Figs. 2-5 are sorted by the learning strategy categories described in Table II and show students' plans and actions by PS. Descriptions of these results are provided below.

A. Overall Plan-Action Pairs

Fig. 1 shows the number of times students selected each learning strategy as a plan (top bar of pair) or a completed action (bottom bar of pair) across the nine weeks. The selection items were placed in Fig. 1 in order of decreasing mean number of times a strategy was planned (see right side of Fig.1). Over the nine weeks, students chose each strategy from zero to nine times, and the percent of students who selected the strategy a given number of times is represented by the different colors of the horizontal stacked bars.

The most frequent actions were googling ('P/A: Google'), taking notes on online modules ('P/A: Modules'), asking other students questions ('P/A: Ask Peers'), and using MATLAB's help function ('P/A: Help Function'). The least frequent action selections were fixing problems on old assignments ('P/A: Past Problems'), going to office hours ('P/A: Office Hours'), and completing extra problems ('P/A: Extra Problems'). The least frequent action selections were mostly chosen once or twice if they were chosen at all, while frequently selected activities were mostly selected six to nine times.

The majority of students overestimated the number of learning actions they would complete, as each learning strategy's planned mean is greater than the corresponding action mean. The largest gaps between planned and completed action means occurred for 'P/A: Past Problems', 'P/A: Office Hours', 'P/A: Ask Ins. Team', 'P/A: Extra Problems', and 'P/A: Solutions'.

B. Plan-Action Pairs by Learning Strategy Category

In Figs. 2-5, students' plan-action paired responses were sorted into four schemes: (1) 'Plan & Act', as in the learning strategy selection was both planned and completed, (2) 'Plan Only', in which the learning strategy was planned but not completed, (3) 'Act Only', in which the learning strategy was completed without planning, and (4) 'Neither', as in the learning strategy was neither planned nor completed. While three of the response types varied depending on the learning strategy, 'Act Only' was infrequent at an average of 6.8% across all learning strategies.

Overall, learning strategies that involved using Study Resources were frequently planned and completed (Fig. 2). The percent of students that planned these activities consistently exceeded 67.3%, with self-reported carry through to completion between 48.5-82.7% per week across all three activities.

The percent of students that planned and completed 'P/A: Google' averaged 74.6% across the problem sets with a slight decrease across the semester of 6.6%. Neither planning nor completing 'P/A: Google' remained relatively constant at 6.4% on average each week.

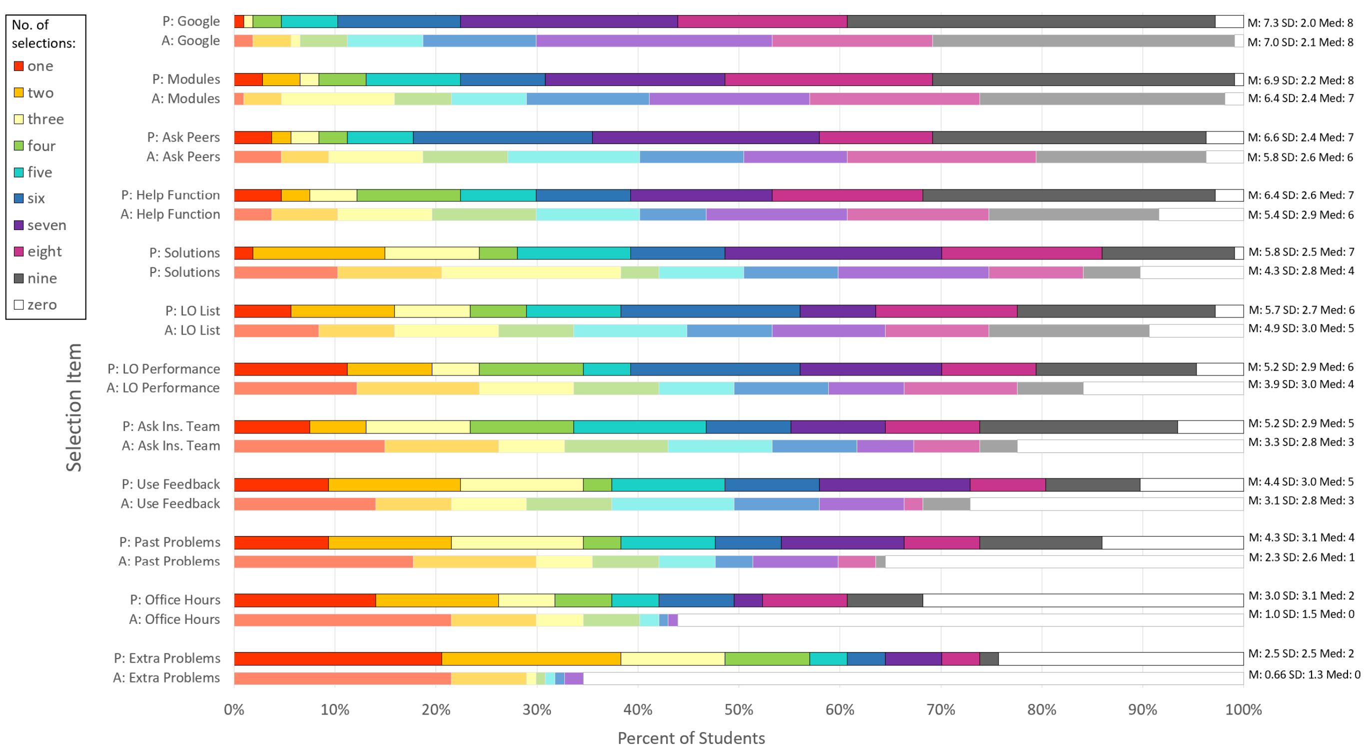

Fig. 1. Percentage of students that planned or completed each learning strategy a certain number of times across the nine problem sets (n = 107).

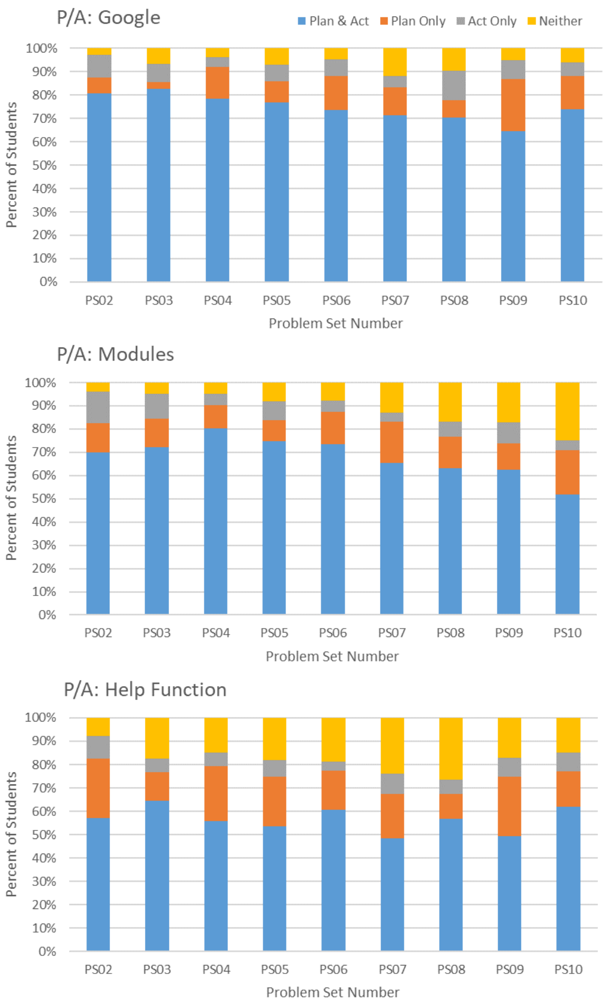

Fig. 2. Planned and completed 'Study Resource' learning strategies across the nine problem sets (n = 107)

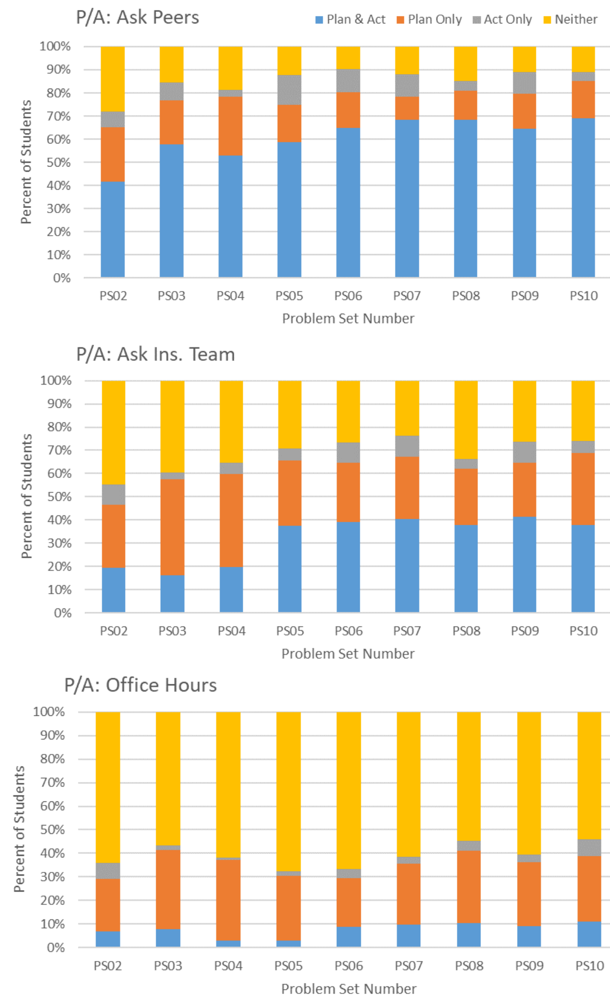

Fig. 3. Planned and completed 'Ask' learning strategies across the nine problem sets (n = 107)

Students planned and completed 'P/A: Modules' an average of 68.1% across the problem sets. After a maximum planning and completion rate of 80.4% on PS04, there was a decrease of 28.4% to 52.0% for PS10. 'Planning only' remained relatively constant at an average of 13.3% each week. Neither planning nor completing 'P/A: Modules' increased steadily by 21.1% from PS02 to PS10.

The percent of students that planned and completed using the MATLAB built-in help function (P/A: Help Function) varied from PS to PS by 5.4% but averaged 56.5%, across PSs. Neither planning nor completing 'P/A: Help Function' increased slightly from PS02 to PS08 but rebounded slightly on for PS09 and PS10.

Fig. 3 shows that of the Ask category strategies, students most frequently planned and acted on P/A: Ask Peers. Across all nine weeks, the percent of students planning to ask peers was consistently high, ranging from 65.0% on PS02 to 85.0% on PS10, and was also completed by a large percentage of the students. From the first to the last reflection, the percent of students who planned and self-reported asking peers questions increased by 27.3% from 41.7% on PS02 to 69.0% on PS10.

The percent of students that planned and self-reported completing asking questions of the instructional team or teaching assistants ('P/A: Ask Ins. Team'), increased by 18.6% from 19.4% to 38.0% over the nine reflections, with a step change of 17.4% from PS04 to PS05. The percent of students that planned but did not follow through on asking the instructional team questions was on average 29.7% each week.

With regards to visiting office hours (P/A: Office Hours), students neither planned nor completed this learning strategy an average of 60.8% each PS. While the percent of students that planned to visit office hours was on average 27.7%, this learning strategy was reported as completed on average by only 7.8% students each PS. The overall trends for visiting office hours were remarkably steady across the semester.

Fig. 4 shows the results for the Assessment Resources learning strategies category. Across the learning strategies in this category, the percent of students both planning and completing the strategy remains relatively stable across all problem sets. What changes was the percent of students planning to employ each strategy. Overall, the percent of students that did plan to refer to the learning objectives (P/A: LO List), look at the solutions to a given PS (P/A: Solutions), and review their learning objective performance on a PS soon after it is returned (P/A: LO Performance) exceeded 50% across all problem sets.

‘P/A: LO List’ was the most frequently selected learning strategy in this category, as it was both planned and self-reported as completed by an average of 48.5% of students across the reflections. While this learning strategy was steadily planned and acted on, there was a 15.3% increase from 10.7% on PS02 to 26.0% on PS09 in the percent of students who neither planned nor completed ‘P/A: LO List’ accompanied by a decrease in only planning the strategy.

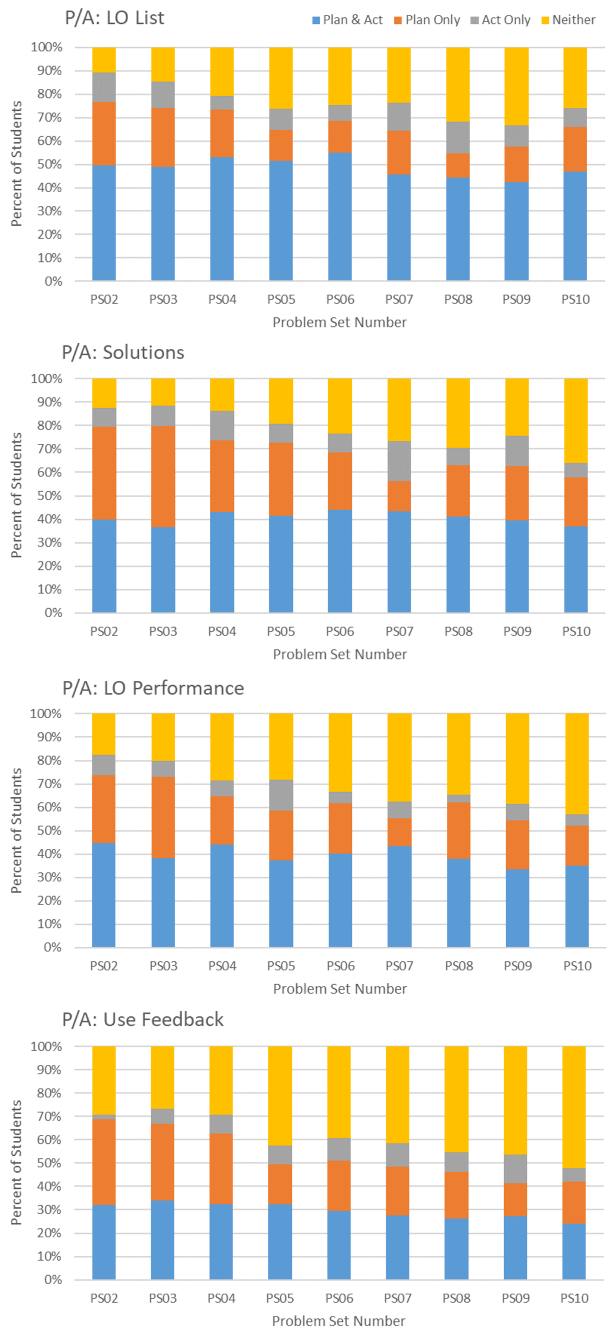

Fig. 4. Planned and completed ‘Assessment Resource’ learning strategies across the nine problem sets (n = 107)

The trends seen in ‘P/A: Solutions’ and ‘P/A: LO Performance’ are quite similar. Students planned and completed looking at a given PS solution an average of 37.0% and looking at their learning objective performance an average of 35.0%. Neither planning nor completing increased from 12.6% to 36.0% for ‘P/A: Solutions’ and from 17.5% to 43.0% for ‘P/A: LO Performance’ over the course of the PSs, with an accompanied decrease in only planning.

The use of feedback to guide future work (‘P/A: Use Feedback’) was the least frequently selected Assessment Resource learning strategy. Using feedback was both planned and completed an average of only 29.1% each week. While both planning and completing this learning strategy stayed relatively constant across the problem sets, there was a 22.9% increase in neither planning or completing from 29.1% in PS02 to 52.0% in PS10, accompanied by a decrease in only planning.

Fig. 5 shows that learning strategies associated with the Practice category were not frequently planned and completed. This is particularly true for doing extra problems. While the percent of students that planned to fix problems on problem sets (P/A: Past Problems) was in excess of 45% for all but one PS, the percent of students that followed through was on average 21.9% each week. ‘Plan only’ decreased from 41.7% to 13.9% from PS02 to PS07 but rebounded for PS08 to PS10. The percent of students that neither planned nor completed ‘P/A: Past Problems’ averaged 43.7% across the nine problem sets.

Completing extra problems (P/A: Extra Problems) was planned and completed on average only 5.1% over the nine problem sets. ‘Plan only’ decreased by 24.6% from a maximum of 43.3% at PS03 to 18.6% at PS04 and then remained at an average 19.4%. The percent of students that neither planned nor completed this learning strategy averaged 68.0% each week and increased by 18.6% over the problem sets.

Fig. 5. Planned and completed ‘Practice’ learning strategies across the nine problem sets (n=107)

VII. Discussion

The results reveal noteworthy trends about students' study strategies and planning. The most frequently planned and completed learning strategies were using Google, online modules, the MATLAB help function, and asking peers questions. These four strategies are easy to complete time- and effort-wise, and directly relate to completing assignments. It is interesting that Google was used more than resources that pertain directly to the course (e.g., modules, the MATLAB help function). Based on the idea of behavioral beliefs described in TPB, which suggests that prior experiences direct actions, students may prefer the familiarity of Google even if the results are of lower quality [18,21]. That said, finding help with MATLAB syntax and programming structures (i.e., sequences, selections, loops) may have been easier through Google. The least frequently planned and completed strategies were visiting office hours, doing extra problems, redoing past problems, and using feedback to aid future work. Studies report that students may not attend office hours due to fear of judgement or embarrassment, or due to procrastination [22,23]. These barriers map to the idea of control beliefs of TPB [18]. A study reported that many students do not believe there is a benefit to attending office hours, which accounts for the low percentage of planning and completion [22]. In addition, office hours were in the evening and during winter, potentially meaning a cold dark walk to get help. Low office hour attendance indicates that instructional teams need to focus on how to be accessible and approachable. Low completion of extra problems could indicate that the required class activities may have been sufficient for student learning and understanding. Additionally, strategies such as redoing past problems and using feedback are more time intensive and involve a high level of metacognition, which is an element of learning that many students struggle with [6,13,15,24]. Therefore, it may be necessary to explain the benefits of high-level metacognitive strategies to students.

Some learning strategies had large gaps between planning and completion. Strategies that follow this trend include all the less frequently selected strategies (i.e., P/A: Extra Problems, P/A: Office Hours, P/A: Past Problems, P/A: Use Feedback). Other strategies with a large gap between planning and completion include looking at the answer key, looking at one's own LO performance, and asking questions of the Instructional Team. These strategies were intermediately planned by students but were reported as completed significantly less than they were planned. The gap between planned and completed actions for the intermediately planned learning strategies indicates that students may see the utility of these strategies, but the imbalance between planning and completion indicates that factors are dissuading students from completing these activities. The hesitation to approach teaching assistants could be partially due to the model of the class, which encouraged students to ask questions of their work team before approaching the instructional team. However, due to the large, consistent gap in planning and completion of P/A: Ask Ins. Team, there may be more dissuading control factors similar to office hours, such as embarrassment or intimidation [22,23]. Referring to the answer key and one's own performance are reflective activities. Studies have shown that students do not regularly reflect on their work, and when they do, it is largely at a surface-level [8,24,25]. Therefore, while students may plan and act, they do not typically exhibit the self-regulation phase of SRL. If SRL is to be instilled in students, it will be necessary to design classes that support reflection.

Another trend to note is that the plans and completion rates for each learning strategy are largely steady across the semester, with only a few plan/completion trends that vary over time. This steadiness indicates that students may come in with a fixed idea of their study strategies. Past studies have shown that most student plans do not vary much from course to course [11]. The least frequently selected activities (i.e., P/A: Extra problems, P/A: Office Hours, P/A: Past Problems) are very steadily completed. The steadiness may indicate that behavioral beliefs affect students' perceived value or utility of these strategies [18].

Interestingly, planning to complete new problems and redo past problems decreased by 24.6% and 17.8% from PS03 to PS04, indicating that a fraction of students may have developed perceptions the first weeks of the course that dissuaded them from continuing to plan the strategy. It may be that students found more time to pursue these strategies early in the semester and the assigned low-cognitive level learning objectives (e.g., employ algebra functions in MATLAB) made doing or redoing problems less of a burden. As the course content became more difficult, time for these activities could have been more limited. There are a few more deviations to the steady trend. For the Assessment Resource learning strategies, the number of students that planned but did not complete these activities decreased, while number of neither planned nor completed responses increased across the semester. This indicates that while students initially intended to look at solutions, learning objectives, and feedback, students eliminated these learning strategies from their plans without even trying them. This trend may be due to behavior beliefs overcoming the initial interest in the strategy [18]. Another deviation is that the two most popular activities, P/A: Google and P/A: Modules, decrease from the start to the end of the semester. The third most completed strategy, P/A: Ask Peers, increased over the semester. The decreased planning to use Google and Modules may be compensated with an increase in asking peers for help. This possible interrelationship between the trends could be due to the increasingly collaborative nature of this course, as the semester ended with group projects.

There were three unique deviations from steady study strategy reporting. In P/A: Past Problems for PS07, 19.8% of students reported redoing past problems without planning to, while the 'Act Only' average without this outlier was 3.9%. This could be due to instructor advice or due to a joint assignment where the former assignment aided in completion of the latter. Another deviation from steady completion of study strategies was the 17.4% step-like increase at PS04 in completion of P/A: Ask Ins. Team. This could be due to an increase in difficulty in the course content. Using the MATLAB help function was the most variable study strategy. This is likely explained by the variation in techniques required from assignment to assignment. Despite these few deviations from the steady reporting of study strategy use, most strategies did not deviate a significant amount week to week, indicating that the first-year engineering students have relatively static study habits.

VIII. LIMITATIONS

In this study, students self-reported their plans, actions, and ratings on the LOs, meaning that students could have been swayed to give a socially desirable answer [26] instead of an honest one. This study was conducted in a course with a predominantly White male enrollment; therefore, the generalizability of findings is limited.

IX. CONCLUSION

The data gathered from this study revealed three ideas about the study planning and strategies of first-year engineering students. Frequently selected strategies are less time-intensive and are directly related to the completion of assignments, while the least frequently selected strategies are more time-intensive and require deeper-thinking, which is a skill first-year students may not understand. There were large gaps between planning and completion of some strategies, indicating that while students plan on engaging in certain strategies, barriers dissuade them, such as negative perceptions or low perceived benefit. Overall, most study strategies had static trends, indicating that first year engineering students are not adept at changing their plans. Under the combined lens of SRL and TPB, this study suggests that most students' prior experiences affect their plans, and that the self-reflection phase of SRL is not well-developed in the majority of first-year engineering students.

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