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What do we learn from formative feedback? A comparison of weekly reflection surveys to a midterm survey in a graphical communication course

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Comparing Weekly Reflection Surveys and a Midterm Survey: Insights on Formative Feedback in Graphical Communication Education

Abstract

The authors report on a pedagogical feedback strategy employed in a first-year engineering graphics course, which implemented a flipped classroom model for self-regulated learning. Class time was reserved for activities and content clarifications. To encourage self-regulated learning and just-in-time teaching modifications, students completed a weekly mixed methods survey in the fall semester of 2022. Over each semester, 12 weeks of student data were collected. To further understand students' concerns and capture potentially different voices, an anonymous midterm survey was administered by the Center of Teaching and Learning Excellence (CTLE) in the middle of the fall semester of 2022. A comparison of weekly reflection surveys to the midterm survey offered the instructor an opportunity to further understand the effectiveness of weekly reflection surveys and identify how to use weekly reflection surveys more efficiently.

Introduction

Reflection has become more important in engineering education as it supports diversity of ideas, allows students to critically evaluate their work, identify areas for improvement, and develop a deeper understanding of the concepts they are learning [1], [2]. It encourages students to take ownership of their learning. It fosters a growth-mindset, where students are proactive in seeking out opportunities for growth and development. This self-motivated approach to learning prepares students for lifelong learning and is essential for success in their careers as engineers. For instructors, reflection is equally important as it provides valuable insights into the learning process of students. It helps instructors to assess the effectiveness of their teaching methods, identify areas for improvement, and tailor their teaching strategies to better meet the needs of their students.

In a flipped engineering graphics course, a weekly reflection survey has been implemented for students to think about and reflect upon their learning in the past week's study and with particular emphasis on the strengths and weaknesses of pedagogical practices that they would like to continue with the following week's study. Over the semester, 12 weeks of student data were collected. While not anonymous, the weekly feedback gathers workload and study experience information to encourage constructive communication between students and instructor; the instructor can recognize patterns of student conceptual difficulties, address skill development obstacles, and emphasize behaviors that may improve their learning while students can think back on what they could have done better and take immediate action to improve their learning in a meaningful way.

To further understand students' concerns and capture potentially different voices, an anonymous midterm survey was administered by the Center of Teaching and Learning Excellence (CTLE) in the middle of the fall semester of 2022. Besides using Likert-scale and open-ended questions to evaluate teaching behaviors, the effectiveness of weekly reflection surveys was also measured. A comparison of weekly reflection surveys to the midterm survey offered the instructor an

opportunity to further understand the effectiveness of weekly reflection surveys and identify how to use weekly reflection surveys more efficiently.

Engineering graphics course

The engineering graphics course is designed to teach students the basics of both freehand engineering drawings and computer-aided design (CAD), specifically CATIA V5-6R2020. This three-credit-hour course consists of three 50-minute classes per week for a total of 14 weeks. The course outline, as shown in Table 1, covers different topics each week. In the final two weeks of the semester, students work on their final project, with no additional topics or assignments given. Figure 1 illustrates some examples of CATIA work completed by the students, including CATIA bottom-up assembly, Advanced CATIA, and final project designs.

Table 1 Weekly study topics

Week	Topics
1	Lettering, Lines and Scales (Freehand sketching)
2	Normal surfaces, and inclined surfaces (Freehand sketching)
3	Dimensions and CATIA introduction (freehand sketching and CATIA work)
4	Oblique surface and CATIA constraints (freehand sketching and CATIA work)
5	Cylindrical surface and CATIA features (freehand sketching and CATIA work)
6	CATIA drafting (CATIA work)
7	CATIA top-down assembly (CATIA work)
8	CATIA bottom-up assembly (CATIA work)
9	Advanced CATIA (CATIA work)
10	Advanced CATIA (CATIA work)
11	Tolerance and threads (freehand sketching and CATIA work)
12	Section view, and auxiliary view (freehand sketching and CATIA work)

Flipped classroom for Self-Regulated Learning (SRL) and Just in Time Teaching (JiTT)

Since a flipped classroom can be offered both online and in-person to engage students through active learning in education [3], [4], an *ILEARN* framework on Canvas in a flipped classroom setting was developed by a group of engineering graphics instructors in 2020 to accommodate students' needs during the pandemic. Students learned online *Interactive Lessons* for background knowledge including videos, audio, PowerPoints, and quizzes, then *Emulated* one or two problems by following recorded videos online. Students were encouraged to complete class *Activities* in class to demonstrate a higher-level understanding. During the class meeting, gamified activities such as *PollEverywhere* competitions were implemented to test students' understanding, clarify misconceptions, and give students opportunities to earn gamification points [5].

A weekly *Reflection* survey was given to understand students' self-generated thoughts, feelings, and actions [6]. The Canvas survey tool was used to design and collect students' feedback. Surveys were not anonymous, and the grades were given as complete or incomplete. The weekly reflection survey was available to take by Friday night once students completed a weekly study and closed by Sunday night so that the instructor could compile the comments and share the results with students without showing their names on the first-class day of the following week for JiTT modifications [7], [8]. Certain course adjustments were taken according to students' feedback to improve their SRL in the following weeks. JiTT made the instructor more aware of

students' thinking processes and encouraged student-instructor communication. The *Next* step tasks were related to a final project so that students could build up their understanding and apply their study to an open-ended semester-long project.

These weekly surveys were so successful in encouraging students' SRL and providing faculty with immediate feedback on the course that the practice was continued when the course returned to a face-to-face modality in the fall of 2021.

Midterm Survey

In Fall 2022, the researcher wanted outside evaluation regarding the weekly reflection. This was partly due to the nature of the collected weekly data which is neither anonymous nor confidential. Although the researcher had seen benefits in the reflection process, they wanted some outside confirmation of its utility and effectiveness at capturing student voice.

Midterm feedback has been an effective way for faculty to gain constructive feedback about their course and provide insights on the students' learning experience [9]–[11]. Generally, students appreciate the opportunity to provide feedback at a time when the instructor can still make meaningful changes. As Richardson [12] notes, it allows teachers to adjust to their students' needs, developing trust among the participants. Of course, the researcher was receiving this data from their students on a weekly basis, but the question remained: Did students feel confident enough to share that feedback honestly when their names were attached. Other benefits of midterm feedback include an increase in multiple instructional skills as perceived by students, especially when coupled with a teaching consultation. It can also improve student motivation and participation [13]–[15], and promote instructor reflection and course refinement [16].

To conduct the midterm survey, the researcher reached out to the Center of Teaching and Learning Excellence (CTLE) to administer the anonymous survey. CTLE facilitates a process that includes providing students with a clear statement on the purpose of the midterm feedback, highlighting that the data collected is anonymous and will be collated and analyzed by the CTLE representative, and then presented to the faculty member in a complete report. The mixed-methods survey asks students 3 qualitative questions:

1. What's working well in this class? What are the strengths of the class and which aspects are having a positive impact on your learning?
2. What's not working so well in this class? What specific changes could be made to improve your learning experience in this class?
3. What concept, if any, are you still struggling with or confused about?

Additionally, CTLE added one question for the researcher:

4. Do you believe that reflecting (i.e., writing about your knowledge, skills, and experiences) in the weekly reflection survey has enhanced your learning? If so, how?

Quantitative data that is collected is based on Critical Teaching Behaviors [17] (see Figure 1.). This data is collected into 5 distinct categories: alignment, inclusion, engagement, assessment, and integrating technology. What is unique about this instrument is that it focuses on teaching behaviors of the faculty member, steering students away from potentially biased, personality focused responses. Further, aspects of this data could be correlated with specific aspects of the

weekly reflection. For example, the survey asks the student to rate the faculty on a 5-point scale according to various teaching behaviors one might see in class. Out of the engage category one would see “Establishes regular and open communication” or out of the inclusion category one would see “Invites students’ questions examples, and experiences and listens carefully when students speak”. While the researchers recognize there are many aspects of the learning experience students are drawing from while answering these questions, these quantified statements can be loosely correlated to the weekly reflection’s overall purpose.

<p>Align Instructors who align components of learning experiences start with clear learning goals. Measurable outcomes, teaching and learning activities, assessment tasks, and feedback build on each other to support student progress towards these goals.</p>	States the learning outcomes (development of specific skills and knowledge) to be accomplished in the course assignments and activities.
	Uses time effectively and efficiently towards achievement of course learning outcomes
	Gives exams and assignments that reflect course readings, lectures, and class activities.
<p>Include Instructors who create an inclusive learning environment promote equity by using accessibility standards and learner-centered strategies when designing and delivering content. They cultivate an atmosphere in which students see themselves positively represented and experience a sense of belonging conducive to emotional well-being for learning.</p>	Invites students' questions, examples, and experiences and listens carefully when students speak
	Selects examples and activities that represent a range of perspectives and experiences
	Builds community and trust between students.
<p>Engage Instructors who engage students purposefully select research-based techniques to ensure that students actively participate in the learning process and take responsibility for their intellectual development.</p>	Encourages participation from all students through meaningful individual and/or small group activities in the classroom and/or online.
	Connects content to real-life applications and examples and/ or current research in the field.
	Establishes regular and open communication
<p>Assess Instructors who assess learning develop and facilitate transparent, meaningful tasks to provide students with timely feedback on their learning and to measure achievement of learning outcomes. They frequently review data to improve instruction.</p>	Gives timely and specific feedback that helps you improve on future assignments.
	Schedules regular tasks (quizzes, homework, discussions, project drafts, etc.) that help you prepare for bigger assignments
	Clearly communicates how to succeed on assessments by providing grading criteria or examples.

Integrate Technology

Instructors who integrate technology responsibly use tools to design accessible, high-quality instructional materials and engaging learning opportunities beyond traditional barriers of place and time.

Shares course materials on the online learning platform in a way that makes it easy to find and access them.

Uses technologies and/or apps that enhance your learning experience in the course (e.g. Canvas, multimedia content, polling, etc.)

Trains students to use course technology/apps and provides support

Figure 1. 5 categories of critical thinking behavior

This paper collected results from the weekly reflection surveys in the fall of 2022 and compared them to the results from the midterm survey in the same semester. Goodrick [18] defines a comparative case study as “the analysis and synthesis of similarities, differences, and patterns across two or more cases that share a common goal.” Such a study requires the examination of “key evaluation questions” (KEQ) which enable researchers to determine what must be evaluated [18]. For this analysis, the KEQs directly correlated between the weekly reflection and the midterm feedback. They are:

1. Are students anonymously expressing any overall course concerns that are not mentioned in the weekly reflections?
2. Are students sharing feedback concerning faculty member teaching practices that match the midterm feedback?

Comparing the weekly reflection surveys to the midterm survey offered the instructor an opportunity to further understand the effectiveness of weekly reflection surveys and identify how to use them more efficiently.

Results

There were 68 students enrolled in three class sections in the fall of 2022. From twelve reflection surveys conducted, the average response rate was 93%, with the lowest being 89%. As with any indirect assessment, there are some limitations, primarily relying on student perceptions and their ability to communicate those perceptions reliably and clearly. In this case, the instructor provided students with questions that directly related to their personal learning experience and attempted to keep the survey short with only 7 questions. The indirect assessment allowed the instructor to assess student views quickly and track opinions over time.

The first 5 multiple-choice questions highlighted weekly workload, stress level, and students’ behavior and learning. Figure 2 and Figure 3 show students’ responses to Question 1 (Q1), “How CHALLENGING were the tasks this week?” and Question 2 (Q2), “How much SKILL was needed to complete this week’s task?” from week 1 to week 12, and a 5-point Likert scale from 1 (very low) to 5 (very high) was used to evaluate their workload assessment. Overall, the skills and the tasks indicated the same trend. Students felt that they could apply the skills they learned to complete challenging tasks each week. The difficulty level was moderate across all 12 weeks of the study. The workload became more challenging in week 7 when the assembly workbench was introduced, which require a steeper learning curve. As more practices continued over the semester, students achieved more confidence, and the average ratings were close to moderate.

Figure 4 indicates students' stress over 12 weeks. Noticeably, the higher pressure was captured in week 7, which confirmed the comprehensive understanding of the CATIA assembly study as a challenging topic as depicted in Figure 1 and Figure 2. However, after week 7 students' stress levels decreased even though the tasks were still challenging.

Figure illustrates students' video access throughout the 12 weeks. There were one or two videos included in each emulate video module. The length of each video varied from 7 minutes to 20 minutes. The majority of students either watched all or most of the videos, but the rate dropped to a lower point in week 5. After it, the rate climbed up but dropped again to the lowest point in week 10. As students were getting familiar with the flipped classroom, they had a better ability to identify key content in the videos in a more efficient way. The trend is similar to the findings mentioned in [19], [20].

Figure shows how many hours students spent on their weekly studies. The majority of students read and studied 3-5 hours each week out of class, which was consistent with the ideal workload reflected by the majority from Figure . ChatGPT [21] was used to analyze students' responses to two open-ended questions, *Q6* "What could you do to be more successful next week?" and *Q7* "What could your instructor do to help you be more successful next week?".

Figure 7 Shows the sentiment results of *Q6*, "What could you do to be more successful next week?". After analyzing students' comments, the most frequent topic is "time management", indicating that students feel they need to better manage their time to keep up with the frequent assignments and achieve success in the class. Many students also express their confidence in their progress and ability to manage their workload effectively. Some of the negative comments highlighted challenges with specific tasks, such as difficulty with CATIA or struggling to understand certain concepts after the week 4 study. The next frequently mentioned topic is studying. Students reflected that they should study more, practice more, rewatch videos, and learn from their mistakes. For example, one student commented after the week 8 study that "Work hard and continue to practice CATIA". Students also reminded themselves that they could try tutoring, during office hours, and ask more questions to be successful. Overall, the feedback suggests that students are actively working to improve their time management skills, seek help when needed, and stay on top of their assignments. While some students face challenges, most express confidence in their ability to succeed in class.

Figure 8 depicts the sentiment results of *Q7*, "What can the instructor do to help you be more successful next week?". The majority of the feedback consists of compliments, with students expressing appreciation for the instructor's adaptive teaching pedagogy and motivated instruction such as "Dr. XXX is doing a great job of helping people be successful. She doesn't need to do anything else." Or "Dr. XXX was very helpful this week in coming around to each of us to check on the progress of Deliverable 1. It reminded me to get back to work on it so I could turn it in on time. Doing this again next week but for Deliverable 2 would be very nice.". Sometimes students suggested improvements such as providing more how-to screencasts, going over gamification problems in class, and explaining constraints in more detail which indicate that they are engaged in the class and interested in improving their learning experience. Overall, the finding suggests that the instructor's teaching practices are effective and well-received by the students, with only minor areas for improvement suggested. The instructor could follow students' comments to keep doing good practices and accommodate students' needs to improve their learning experience.

During week 6, a midterm survey was conducted by the Center for Teaching and Learning Excellence (CTLE). Since the midterm survey was anonymous, it could offer insights different from the weekly reflection survey. 62 responses were collected. One of the questions (Q_m) was “Do you believe that reflecting (i.e., writing about your knowledge, skills, and experiences) in the weekly reflection survey has enhanced your learning? If so, how?”. After manually coding students’ feedback regarding the reflection surveys into negative, neutral, and positive, sentiment results are depicted in Figure 8. Further descriptive coding and subsequent analysis revealed 4 themes.

Reflections help with self-assessment and improvement. Many responses commented on the opportunity to examine their own progress in the course, identify areas they can improve upon, and to goal-set. Some representative statements included:

- “Yes, as it gives me a clear way to solve my difficulties from the past week.”
- “Yes, since it helps reflect how much I put in the effort for each assignment, quiz, or exam.”
- “Yes, as it helps me look back on the week and properly consider my progress and how I can improve for the next week.”
- “I feel that it has helped me to understand what I can do differently which has helped my learning process improve.”

Reflections provide feedback to the instructor to adjust the course. Students also found it beneficial to provide feedback that the instructor was able to act upon and make changes to the course. Consider:

- “Yes, because the teacher is then able to adjust our class time and its operation to enhance efficiency and quality of work completed in class.”
- “The reflection survey helps a lot and addresses general concerns.”
- “Yes because Dr. XXX attempts to improve constantly.”

Reflections help students feel heard Some students appreciate the opportunity to ask questions or address concerns with the instructor.

- “It does help my reflect on the materials over the week, but I think it helps the students who are overwhelmed by the workload or materials voice their struggles in a way that won't embarrass them.”
- “It helps me sum up the week and feel that my voice is being heard by the professor.”
- “Yes because life is always happening, so she gets to see the students' barriers or concerns in a weekly basis.”

Reflections are not that useful Others find them less useful, either because they already know what they need to work on, do not think they lead to improvements, or feel that they do not provide enough specific feedback on skills.

- “No, I know what I know, I see little point in writing that down.”
- “Not really because I haven't had any problems with assignments yet.”
- It hasn't really enhanced anything.
- Honestly, I don't get much out of it. I am pretty comfortable with all the concepts already but I can imagine how some of the students with more standard skills can benefit greatly.

Overall, the majority of students had a positive attitude towards the weekly reflection survey and believed that it helped improve the learning process. However, a significant minority had a

negative attitude and felt that it did not help them learn anything new. Some students had a mixed attitude, appreciating certain aspects of the survey but feeling that it could be more specific or tailored to their individual needs.

The researchers attempted to examine this data to answer to a key evaluation question. Results of this comparison suggest that students feel very comfortable reflecting weekly on aspects of the course such as content, their personal learning, and more general class management concerns. However, students may be more reluctant to share some of their more challenging critiques such as questioning the pedagogical decision of using the flipped method, or reviewing how class time is used.

1. Are students anonymously expressing any overall course concerns that are not mentioned in the weekly reflections?

- “I’m not sure I don’t think it helped me learn but I think that it definitely made me think back on what I could’ve done better. It does bring me back to think about those assignments, but I don’t fix or change them in any meaningful way.”

This may suggest that the reflection is one step in the learning cycle and that it would be even more meaningful for students if they had an opportunity to act upon their insights in some way. Ideally if those actions could be recognized by the instructor in some form of formative feedback or opportunities for reengagement with the material, students may feel more engaged with the process. Of course, time constraints and workload are significant considerations.

2. Are students sharing feedback concerning faculty member teaching practices that match the midterm feedback?

- “The ability to go at your own pace is wonderful. I like that I can work ahead when I understand the material, which makes the courseload much lighter as my other classes get harder. It also gives you extra exposure to the material so that you understand it before it’s covered in class. This has allowed me to spend class time working on homework and asking any questions I might have”
- “Poll everywhere and gamification problems help with keeping grades up. The gamification due dates and regular due dates help to not feel very overwhelmed.”

These comments suggest that students appreciate the flexibility provided by the faculty member’s teaching practices, such as the ability to work at their own pace and the use of technology tools like Poll Everywhere and gamification problems. The comment about being able to work ahead when they understand the material shows that the teaching approach allows for students to engage with the content more deeply and potentially gain a stronger understanding of the material. Additionally, the use of gamification and clear due dates helps students stay on track and avoid feeling overwhelmed. Overall, these comments suggest that the faculty member’s teaching practices are effective in promoting student engagement and success.

A second area was frustration with the flipped method and feeling like they have to “teach themselves.”

- “(The) teaching style takes a little getting used to. It primarily relies on teaching oneself outside of the classroom rather than a typical in-person lecture.”
- “The “flipped classroom” idea threw me off. Basically, we’re supposed to do the work before the class, then come in with questions or concerns about the class. I like it when she walks us

through the work more than this way. She has been doing more examples in class which has been very beneficial to my learning.”

However, it is important to note that some students also found benefits to the flipped classroom approach, such as the faculty member providing more examples in class. Overall, the comments suggest that while weekly reflections are useful in encouraging students to reflect on their learning experiences and address some teaching and learning issues within the classroom, they may not always capture larger structural or challenging concerns.

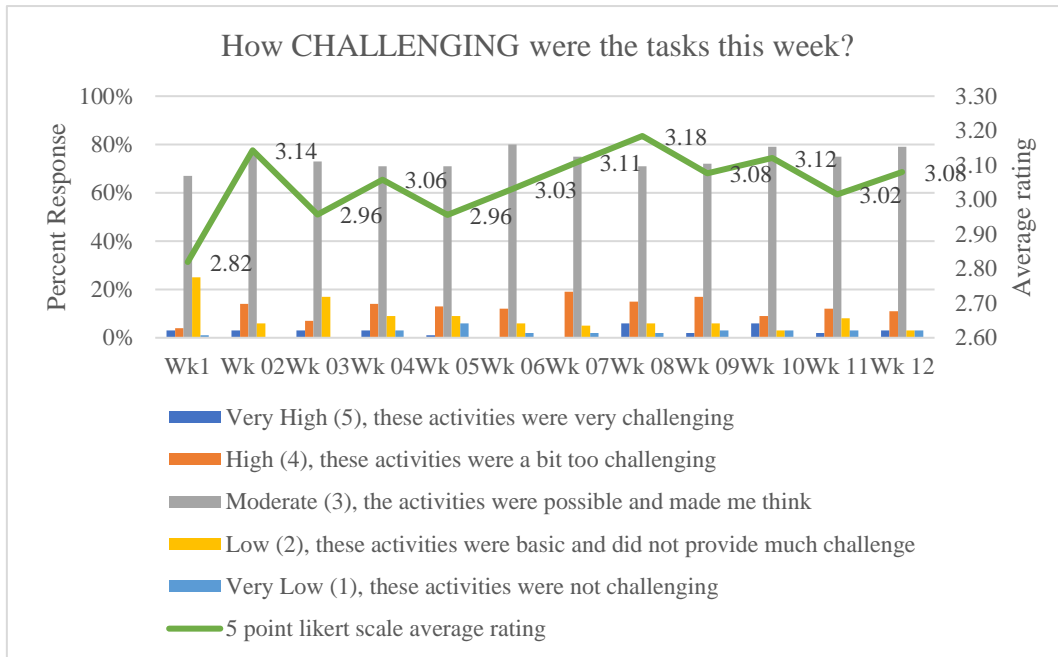


Figure 2. Students’ response to Q1 “How CHALLENGING were the tasks this week?”

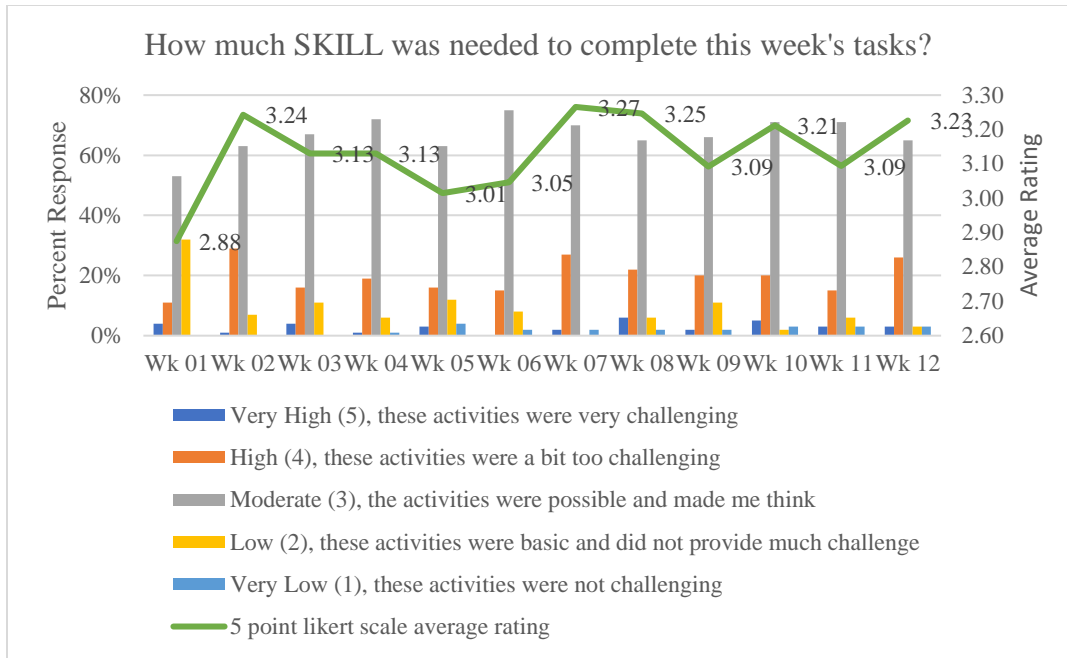


Figure 3. Students' response to Q2 "How much SKILL was needed to complete this week's tasks?"

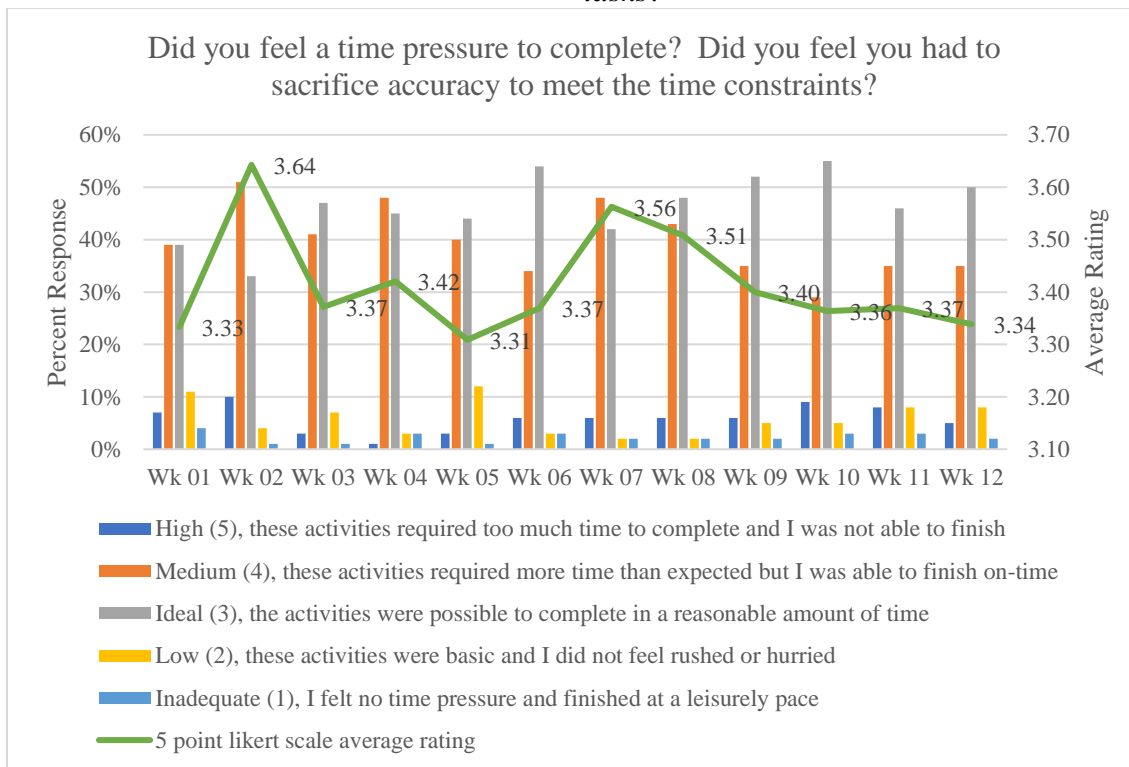


Figure 4. Students' response to Q3 "Did you feel a time pressure to complete or you had to sacrifice accuracy to meet the time constraints?"

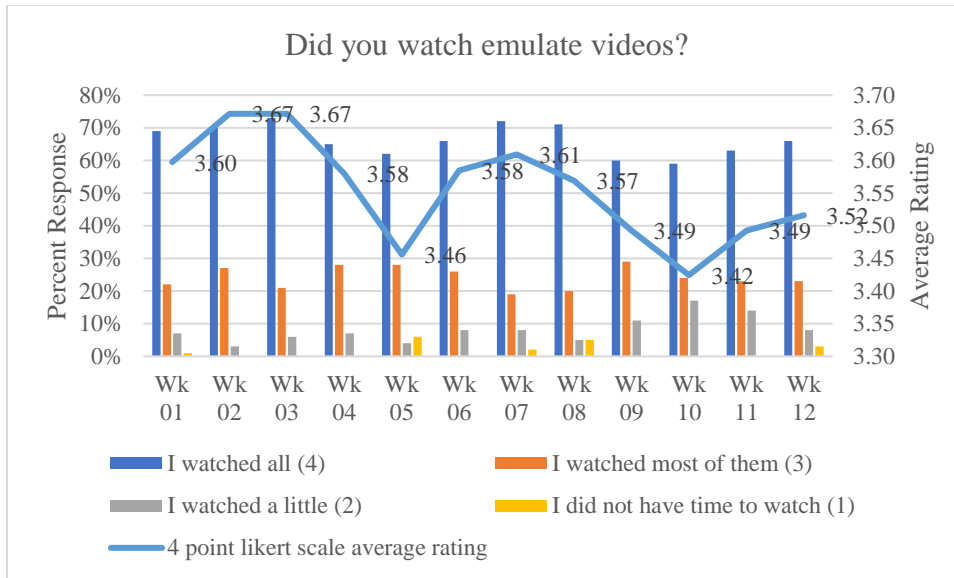


Figure 5. Students' response to Q4 "Did you watch emulate videos?"

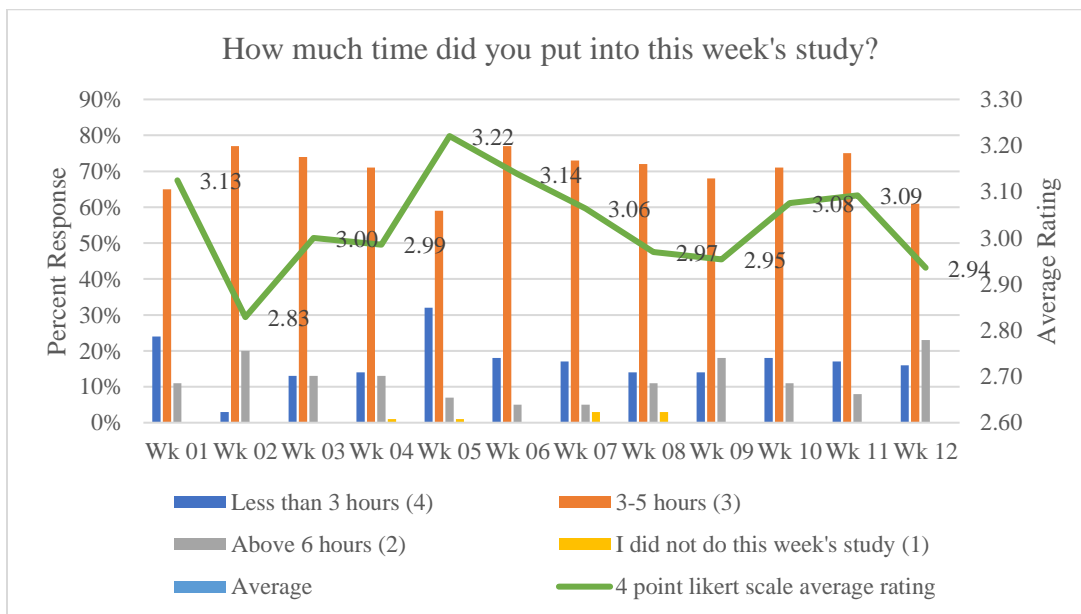


Figure 6. Students' response to Q5 "How much time did you put into this week's study?"

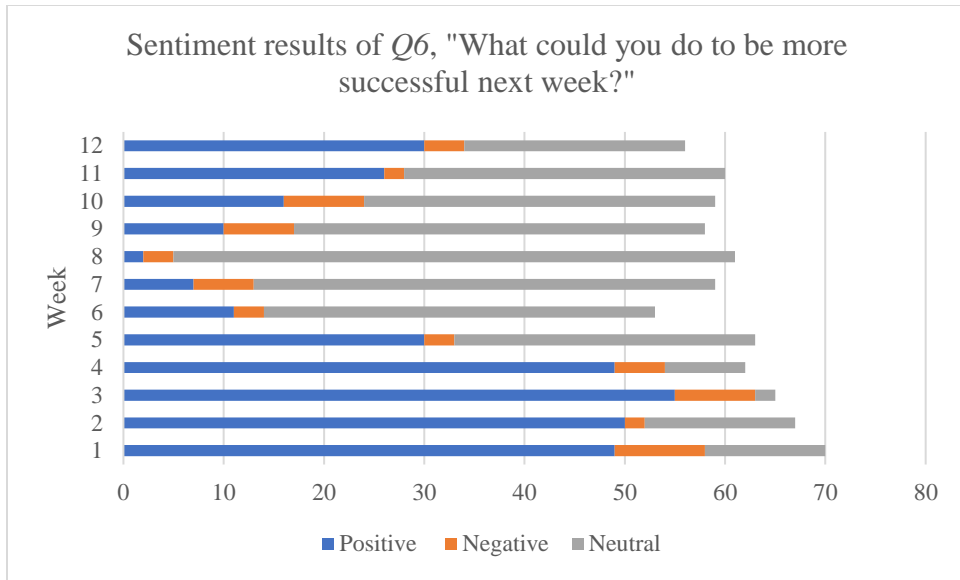


Figure 7. Sentiment results of Q6, "What could you do to be more successful next week?"

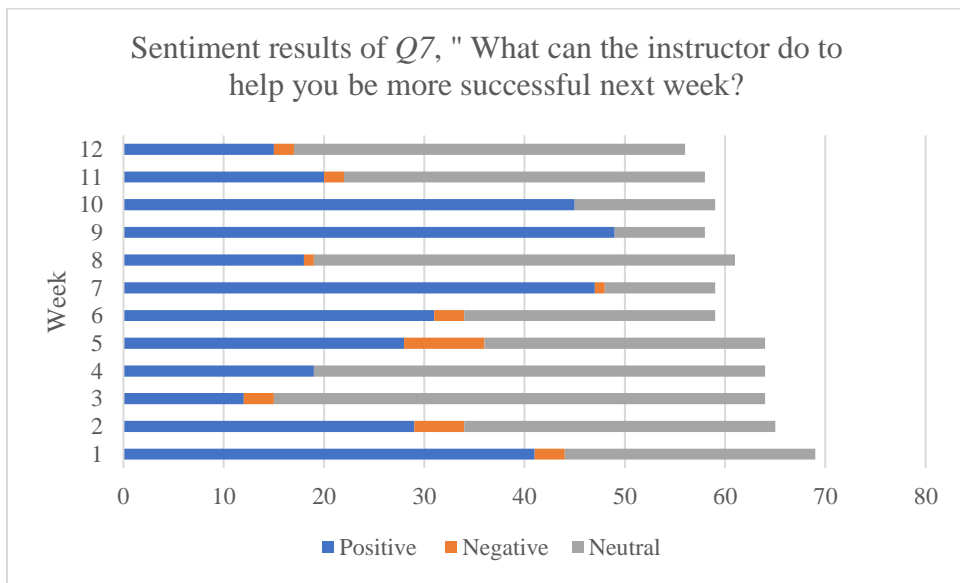


Figure 8. Sentiment results of Q7, "What can the instructor do to help you be more successful next week?"

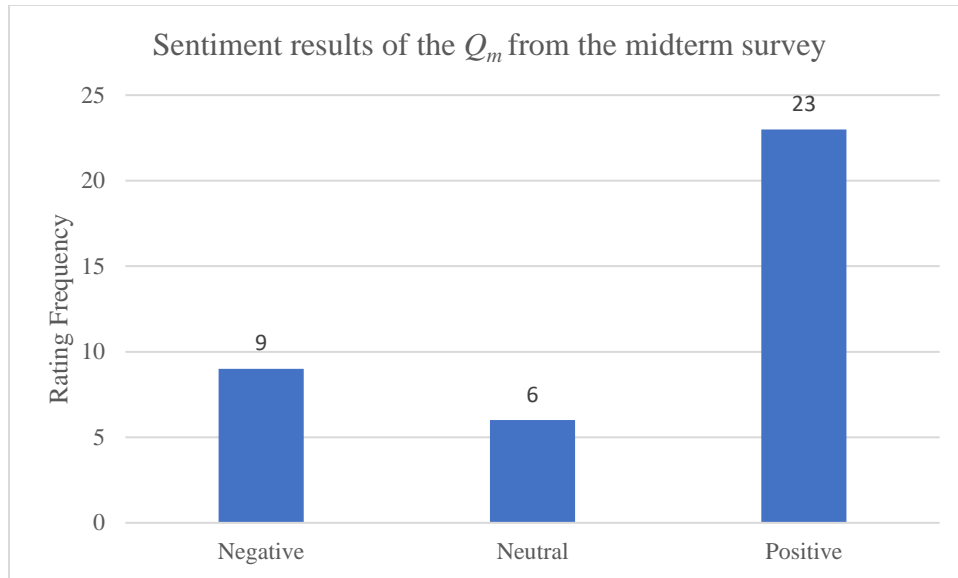


Figure 9. Sentiment results of the Q_m , “Do you believe that reflecting in the weekly reflection survey has enhanced your learning? If so, how?”

Conclusion

This paper outlines the implementation of weekly reflection surveys in a face-to-face engineering graphics course during the fall of 2022. The surveys allowed the instructor to gain insights into the difficulty level of course materials, students' engagement with course materials, workload levels, and weekly study time. The open-ended questions provided valuable feedback for timely adjustments to the course materials. While some students found the weekly surveys helpful, others felt that they already knew what they needed to work on and did not find them useful. However, the surveys can benefit the instructor by promoting metacognition and supporting student learning and understanding. It is important to note that some teaching and learning areas may not be captured in the weekly reflection surveys, and the instructor can use other methods to ensure feedback from students. Overall, the weekly reflection surveys can foster constructive communication between the instructor and students, leading to improvements in the learning experience.

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