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How iLEARN Modular Scaffolding Supports Student Outcomes and Accessibility in a First-Year Graphical Communication Course

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ABSTRACT

Background: The flipped classroom space lacks a clear design framework that describes the day-to-day structure and implementation of a flipped classroom experience in a way that can be reproduced and be meaningfully compared across contexts. The ILEARN framework aims to address part of this problem by more clearly defining how course content is organized and presented to guide student learning through increasing levels of personal accountability. **Purpose**: The following describes the approaches instructors used in adopting the iLEARN framework into their course sections. **Methods**: End of course surveys were completed by students across two semesters, the second semester for two instructors with large variability in implementation style. Proportions of ratings in agreement and confidence were compared as well as numerical approximations of means to compare implementation variations using t-tests. **Results**: Students generally agreed that the iLEARN framework was able to guide them through the learning process while achieving confidence in the course learning outcomes despite varied implementation styles. **Conclusions**: The iLEARN framework provides a clear, well-organized modular format for a flipped classroom environment, enables a high degree of course flexibility, and is well received by students and instructors.

Key Words: Learning management systems, Outcomes based assessment, Active learning

INTRODUCTION

A core goal of educators is the facilitation of learning, though many factors influence how effectively students learn and outcomes resulting from the learning experience. Traditional STEM courses often utilize a linear, lockstep, teacher-centered approach to content delivery (Stains et al. 2018, 1468–1470). In spite of all the evidence (Supiano 2022), historical norms dictate passive instruction that is commonly lecture driven, followed by homework and exams that are to be completed individually and frequently removed from relevant context (Benabentos et al. 2020, 342–56). This is particularly true in first- and second-year STEM courses, where content tends to be more theory-driven than the design or project-driven approaches that are more common in later courses. This approach reduces the inclusiveness of teaching and is only marginally successful for student motivation (Dewsbury and Brame 2019, no. 2) (Pitterson et al. 2016, 1–6). With the rapid push to online and hybrid instruction in response to COVID-19, many instructors took their first steps into significant online-supported instruction. Even if their implementation was poorly planned, the initial barrier to entry was removed, opening the door for more engaging and motivational approaches to online-supported instruction.

Flipped Classroom – Research to Practice Gap

Research shows that flipped classrooms have the potential to yield stronger student outcomes but results vary based on delivery and motivational factors. Self-determination theory and cognitive load theory have been used to explain some factors that impact the effectiveness of the flipped classroom; attributing a sense of competence, sense of relatedness, and sense of autonomy as predictors of motivational factors while self-pacing and tailoring to expertise assist in managing cognitive load (Abeysekera and Dawson 2015, 1–14).

Reviews of prior studies on the flipped-classroom have shown a clear disconnect between the theoretical and applied work (Kerr 2015), (Bishop and Verleger 2013), (Eppard and Rochdi 2017, 33–40), (Tamim et al. 2011, 4–28) (Lo and Hew 2019, 523–46). At one end of the spectrum, much of the literature is focused on how flipped-classroom pedagogies fit within the fabric of broader educational theories, aligning the various components of a flipped classroom with Blooms Taxonomy (Morton and Colbert–Getz 2017, 170–75) or a more generalized “Active Learning” umbrella (Bishop and Verleger 2013). At the other end of the spectrum are a litany of case studies that presents an overview of their flipped experience in a manner that is often times vague and unreproducible. Nearly every meta-analysis and survey of the literature includes a conclusion that it is difficult to compare cases due to a lack of detail and most studies investigating a flipped-classroom rely on student opinion surveys about their experience or performance on indirect assessments (Bishop and

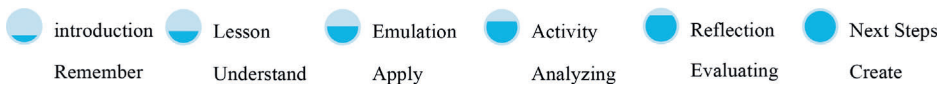

Figure 1. Pairing of iLEARN Module Elements to Blooms Taxonomy.

Verleger 2013). In general, trends indicate moderately positive outcomes with the highest impact associated with the use of a structured format that incorporates active learning and problem solving activities (Strelan, Osborn, and Palmer 2020, 100314). Some benefits of flipping the classroom is to better align with student needs for scheduling flexibility. It also allows for students to choose their dwell time with the content, slowing down content delivery or revisiting material as needed until they are confident in their understanding of (or confusion with) the material enough to bring questions to the instructors for clarification (Clark 2015, 91–115). Additionally, flipped classrooms afford the opportunity to enhance student engagement through active learning activities and social interactions and reduce cognitive load (Abeysekera and Dawson 2015, 1–14).

While there is a general framework for flipped classrooms (Eppard and Rochdi 2017, 33–40), the flipped classroom space lacks a clear design framework that describe the day-to-day structure and implementation of a flipped classroom experience in a way that can be reproduced and be meaningfully compared across contexts. The ILEARN framework aims to address part of this problem by more clearly defining how course content is organized and presented.

iLEARN Modular Scaffolding Framework

In response to the COVID pandemic, a team of instructors at Embry-Riddle Aeronautical University (ERAU) developed and adopted the iLEARN framework for an introductory graphical communication (CAD) course. iLEARN is a modular scaffolding framework that lends itself to the adoption of online or flipped-classroom pedagogies. The framework provides an organizational pattern to how content is presented that naturally scaffolds content to support self-regulated learning. Most importantly, it made the transition from traditional chalk-and-talk style instruction to online-supported instruction easy for faculty to understand, document, and manage. In the two years since the framework was adopted, student performance has been consistent with prior versions of the course and the student response to the approach has been highly favorable. The resulting course content is highly modular and has been successfully used in both asynchronous online and face-to-face iterations.

iLEARN is a second generation flipped-classroom framework developed based on the (PREP) ARE structure (Grigg and Stephan 2018) and is particularly well-suited to courses that use example problems as a primary instructional method. There are six elements of the iLEARN cycle that students' progress through during weekly modules as shown in Table 1.

Table 1. iLEARN Stage Descriptions.

Stage	Description
introduction	An overview of the learning objectives of the module.
Lesson	Content covering the basic theory/background for the topic. This tends to be textbook reading or lecture videos of theory or skills demonstrations. Critical to the design is that the lesson content is (a) short and (b) focus on the theoretical underpinnings of the content. Lessons include a content comprehension quiz or other check for understanding.
Emulate	Videos of instructors solving example problems using a think-aloud protocol explaining their reasoning throughout the solution process. Students replicate the results to build understanding and learn to apply the theory from the Lesson. In a traditional course, this component is typically done as an in-class demonstration. By shifting the format to an online video, students can follow along at their preferred pace.
Activity	Students solve problems without significant guidance to apply their understanding from the Lesson/Emulate stages and analyze new situations. In a traditional course, activities correlate with homework assignments.
Reflection	Students complete a meta-cognitive reflection survey aimed at helping them to think about their own learning such as by reflecting on module content understanding, mental workload, study methods, or self-efficacy.
Next Steps	Students evaluate, design, and create milestones to apply the content in a broader context as in milestones leading toward a summative course project.

In maturing the iLEARN framework, some course faculty requested to add a stage for formalized examinations. In the comprehensive iLEARNed adaption, additional *evaluations* and *demonstration* stages were created for summative assessments (i.e., exams) and final project deliverables, respectively. In implementing the framework, the ILEARN cycle is typically repeated weekly, while the *–ed* components (evaluations and demonstration) are intermittent and optional based on the course design.

METHODS

The format of assignments enables the in-classroom experience to be converted to a true flipped-classroom environment. The following describes the approaches instructors used in adopting the iLEARN framework into their course sections with shared goals of student success.

Course Content Redesign

During the summer of 2020, a collaborative redesign effort incorporated the ILEARN framework into a graphical communications (CAD) course. A small group of faculty led redesign efforts on three parallel tracks.

First was developing Lesson content in Articulate 360 (Articulate Global 2023). This was done largely by taking existing course PowerPoint slides, auditing them to reduce the tyranny of content

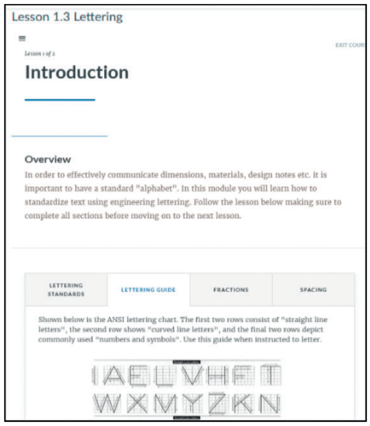

Figure 2. Example of a Lesson developed using Articulate360.

(Petersen et al. 2020, ar17), removing example problems, and then translating the results into Articulate 360 modules. Where appropriate, advanced features of Articulate 360 were adopted, such as flashcards or image-hotspots, but the result was still largely passive content with short auto-graded summative assessments at the end of each lesson. An example lesson is shown in Figure 2.

Second was developing emulation videos using the Canvas Studio video platform built into the university's learning management system (LMS). The purpose of *Emulate* tasks is to solve sample problems using a think-aloud protocol (Ericsson and Simon 1998, 178–86) to reveal how and why problems are being solved as they are. The emulate tasks are the cornerstone of the iLEARN framework, as they connect much of the Lesson theory to practical applications. Videos were between 6 and 25 minutes and each detailed the solution to a single problem.

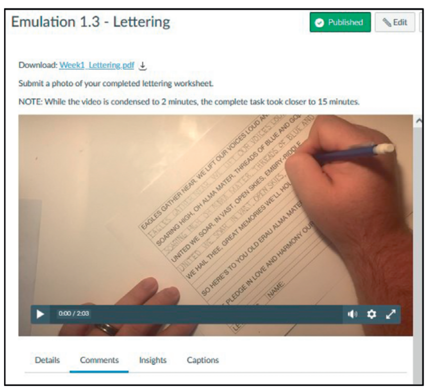

Figure 3. Example Emulation of an instructor completing a learning exercise.

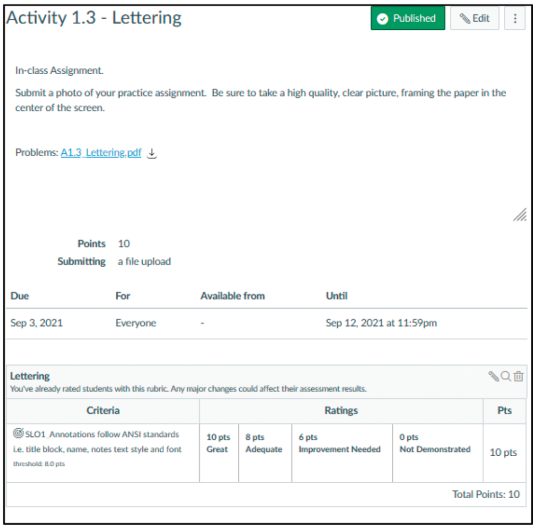

Figure 4. Activities varied by instructor and are selected from a pool or generated.

Third was auditing existing instructional materials (i.e., existing homework and project instructions) to update and translate their language into Activity & Next Steps tasks. While homework problems were often easy to translate into activities, more work was needed to translate the final project deliverables into the more frequent Next Steps tasks. Medium-sized project milestones such as "Submit a rough draft of all project parts" was split into smaller discrete goals such as "model and submit 2 project parts".

Lastly, faculty determined what questions they wanted to pose during the reflection stage of each module. Typically faculty asked students about their confidence in the material or whether there was content that needed to be revisited. Future efforts will attempt to incorporate this stage with more meaningful metacognitive tasks that help develop self-regulated learning habits or other validated measures of assessing outcomes.

Instructors integrated the stage names for assignments into the normal classroom language. While all instructors for the class incorporated iLEARN to varying degrees, there was some variability between flipped-classroom implementations.

Implementation Variations

The main variables between instructors included 1) visual organization of modules, 2) classroom policies on late work and attendance policies, 3) how in-class time was utilized and 4) how the Reflection and Next Steps tasks were implemented throughout the term. Figure 5 illustrates two variations of the same week as implemented by different instructors.

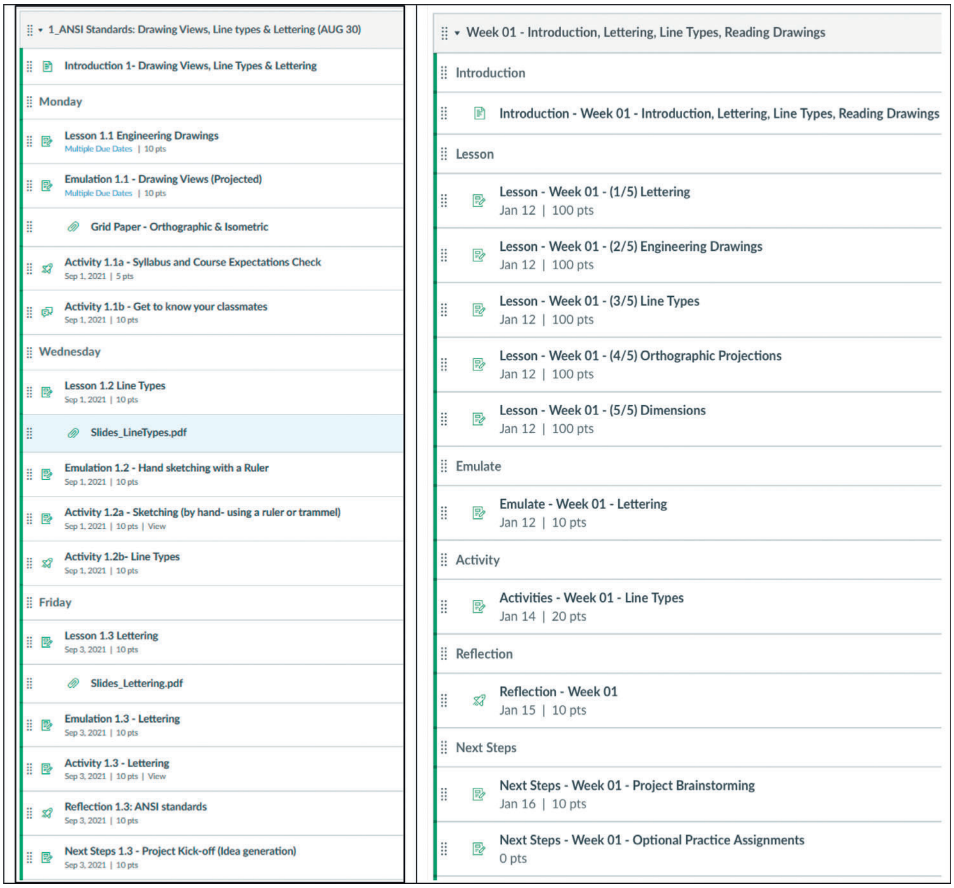

Figure 5. Variations in Canvas layout of modules.

One key benefit to the iLEARN framework is that it enables a true flipped-classroom design. Because of this, there is no longer a structural necessity for students to remain in lockstep throughout the term. This opens the door for student-supporting opportunities such as flexible deadlines, iterative feedback and revision, and permissive attendance policies. Tables 2 and 3 detail the course policies and stage variations used by the authors Fall 2021 and Spring 2022.

Data Collection Methods

Data was collected from two semesters: Fall 2021 and Spring 2022.

Sample: The Fall 2021 population of students consisted of 5 sections of EGR 120 taught by Author 1. Out of a total of 128 students, 25 identified as female (27%) and 103 male (73%). In terms of ethnicity/race, 66% of students identified as white, 16% identified at Hispanic/Latino, 5% as two or more races, 4% as African American, 3% as Asian, and 3% as international students. Based on

Table 2. Variations between course policies for the two authors.

	Author 1	Author 2
Late Work	Gave expected due dates; One Lesson, Emulation, & Activity on each Monday, Wednesday, and Friday, Reflections & Next Steps on Sunday. Assignments could be submitted up to 2 weeks late at a 10% per day late penalty.	Gave recommended due dates; Lessons on Monday, Emulates on Wednesday, Activities on Friday, Reflections on Saturday, Next Steps on Sunday. Assignments could be submitted up to 2 weeks late without late penalty.
Attendance Policy	Students were expected to attend class. Attendance was tracked in the gradebook but did not factor into the final grade. Students that had completed all of assignments for the week could leave.	Students were not required to attend class if they had completed all the Lesson, Emulate, and Activity tasks due in the 7 days prior to class. Attendance counted for 2% of the course grade.
In-Class Time	Half of class time was spent demoing with the whole class. Half was dedicated to students working through Activities and asking questions when stuck.	Almost no class time was spent talking at the whole class. Class time was dedicated to students working through iLEARN content and asking questions when stuck.

Table 3. Variations between course policies for the two authors.

Reflections	Students were asked (1) Do you feel confident applying what you have learned? (2) Do you feel that you have improved in the following learning outcomes?	Students were asked (1) Do you need additional help from the professor? (2) What could you have done to improve your own learning this past week? and (3) What could [the professor] have done to improve your learning this past week?
Next Steps	Weeks 1–3 were targeted at project brainstorming and idea selection. Week 4–6 involved planning their solutions. Weeks 7–11 were small milestones to ensure regular progress. Weeks 12–15 were “draft” portions of the project.	Weeks 1 & 2 were targeted at project brainstorming and idea selection. Weeks 3 & 4 involved planning their solutions. Weeks 5–11 involved submitting small milestones to ensure regular progress. Weeks 12–15 had full “draft” submissions of the final project.
Evaluations (added Spring 2022)	Converted 3 activities from Fall 2021 into evaluations in Spring 2022. These assignments were originally developed from exams and the CATIA certification sample exam. Students were given only one attempt at the solutions.	Added during the Spring 2022 cycle, 5 exams each worth 1% of the course grade. They occurred in-class on the last 5 Fridays of the semester (Weeks 10–14). Students needed to achieve at least a 60% average on the 5 exams to qualify for a C in the course.
Demonstration	The verbiage changed between Fall 2021 and Spring 2022. In Fall 2021, the final summative submission was simply referred to as the Final Project and was not formally part of the iLEARN structure. In Spring 2022, iLEARN was expanded to iLEARNed and the final submission was renamed to “Demonstration”.	

academic standing by credit hours earned, 70% were freshmen, 16% sophomores, 11% juniors, and 2% seniors. The mean GPA was 3.29.

The Spring 2022 population of students consisted of 5 sections of EGR 120 taught by Author 1 and 4 sections taught by Author 2. Out of a total of 178 students, 57 identified as female (32%) and 121 male (68%). In terms of ethnicity/race, 58% of students identified as white, 19% identified at

Hispanic/Latino, 4% as two or more races, 7% as African American, 4% as Asian, and 5% as international students. Based on academic standing by credit hours earned, 52% were freshmen, 33% sophomores, 10% juniors, and 5% seniors. The mean GPA was 3.08 and there was no significant difference between instructor sections ($p = 0.24$) though the GPA of the Spring student population was significantly lower than Fall ($p = 0.02$)

Survey: Surveys were distributed at the end of the semester. The Fall survey was distributed by Author 1, while Spring survey data was collected for both Author 1 and Author 2. The Fall administration of the survey had a sample size of n = 82 from a subject pool of $p = 127$ (one student withdrew). The Spring administration of the survey had a sample size of $n = 104$ from a subject pool of $p = 171$ (Author 1 $n = 54$ of $p = 93$, four students withdrew; Author 2 $n = 50$ of $p = 78$, three students withdrew). The surveys asked students to provide their perceptions of the effectiveness of the iLEARN (Fall 2021) and iLEARNed (Spring 2022) framework and rate their confidence on the course learning outcomes. The Fall 2021 survey was conducted directly in Canvas as a survey, though completion was optional. The Spring 2022 survey was distributed via a link on Canvas to the survey collected in Microsoft forms. This permitted the collection of data across multiple instructors collectively as well as removing any confusion that the survey was required and enabled responses to be collected anonymously. Results were compared based on proportion of responses receiving Likert responses as well as using two sample t tests assuming equal variance.

RESULTS

Course Format Survey: Course Objectives

Results from both semesters showed similar trends in responses seen by Author 1 in the Fall 2021 and the collective of Authors 1 and 2 in the Spring 2022. The course format survey revealed that there was an overall trend of agreement to questions regarding the effectiveness of the iLEARN framework. Over half of respondents strongly agreed that format made the material easy to locate (60%), helped guide learning gradually (50%), and helped accessibility (52%–55%). Surprisingly, there was a noticeable difference in the number of students who thought they would like other classes to adopt the iLEARNed framework between the Fall 2021 and Spring 2022 semesters. This may be explained by the growing familiarity of Canvas and ease of navigation is not as strong of a need in the spring as it is in the fall. Using a normal approximation with numerical transformation of agreement ratings, it was revealed that students only moderately agreed that they wished other classes would adopt the iLEARN framework despite strong agreement on all ratings of satisfaction where 2.5 indicates a neutral rating (strongly agree = 4, agree=3, disagree=2, strongly disagree = 1, NA were excluded).

Using a normal approximation with numerical transformation of agreement ratings, two variations were uncovered in mean responses, one significant at the $\alpha = 0.05$ significance level using a one-tailed p-test. Students taking Author 2 more highly agreed the iLEARN framework was able to guide them through learning gradually ($p = 0.06$) and that they were able to keep up with class when missed ($p = 0.04$). This is likely due to variations in the format of the learning management setup and class time utilization respectively. The total agreement in this case does not include the percentage of students who did not miss a class, so the percentage of students who did miss a class and agreed that the format enabled them to keep up was 83.7% for Author 1 and 91.3% for Author 2.

Table 4. Course Format Survey: Comparison of Fall 2021 and Spring 2022.

	Fall 2021		Spring 2022		
	Total Agreement	Strongly Agree	Total Agreement	Strongly Agree	Mean
In general, I was satisfied with the layout of the online course material in EGR 120.			93.3%	40.4%	3.33
The format of the course separated into weekly modules made the material easy to locate.	100%	60%	99.0%	59.6%	3.59
Using the iLEARN framework to break the module into introduction, lessons, emulations, activities, reflections, and next steps helps guide through learning gradually	98%	50%	91.3%	50.0%	3.40
I wish other classes would adopt the iLEARN framework in their classes	82%	27%	76.2%	28.6%	2.98
The module format helps me to access the course content from anywhere	95%	52%	96.2%	55.2%	3.51
I was able to keep up even when I missed class because of the course module format.	79% (10% NA)	35%	74.3% (15% NA)	38.1%	3.30

* NA never missed class

Table 5. Course Format Survey: Differences in Mean Response Rate by Instructor.

Question Prompt	Overall Mean	Mean Author 1	Mean Author 2	*p*-value one-tailed
"Using the iLEARN framework to break the module into introduction, lessons, emulations, activities, reflections, and next steps helps guide through learning gradually"	3.40	3.31	3.51	0.065
"I was able to keep up even when I missed class because of the course module format."	3.30	3.16	3.44	0.043

Course Format Survey: iLEARN Elements Objectives

In regard to iLEARNed stages, students felt that the Emulation stages most strongly achieved its goal of helping students replicate the steps to complete the modeling exercises (100% agreement, mean 3.66). There was also extremely high agreement that the final project was able to achieve its goal of providing a way to demonstrate the skills learned throughout the course (98.1% agreement, mean 3.47) and assignments helped students learn to analyze an illustration and differentiate tools needed to recreate an object (95.2% agreement, mean 3.48). Reflections were the least well received, with agreement dropping in the Spring. There was a moderate variation in agreement ratings for emulations with Author 2's students rating more strongly (Both had 100% agreement, with means 3.60 vs 3.72, $p = 0.997$) and significantly lower agreement on evaluations increasing awareness of knowledge and skills/deficiencies to obtain learning outcomes (87.3% vs 76.0% with means of 3.27 vs 2.98, $p = 0.042$). The timing, content, and frequency of evaluations likely impacted the perception.

In general, students felt they had confidence in their ability to demonstrate the courses' student learning outcomes (SLOs). The two learning outcomes with the lowest outcome confidence were SLO5 dimensions and tolerances and SLO6 auxiliary views achieving confidence <80% in Fall 2021 and <90% in Spring 2022. This is not surprising, as proper dimensioning technique is a highly nuanced skill and both tolerancing and auxiliary views were taught late in the semester. Note, the answer choices were updated in the Spring 2022 survey so trends across semesters can only be compared indirectly.

Table 6. Course Survey: Overall Mean Agreement that iLEARNed elements meet objectives.

	Fall 2021		Spring 2022		
iLEARNed stage objective	Total Agreement	Strongly Agree	Total Agreement	Strongly Agree	Overall Mean
"I: The Introductions helped me recognize and remember learning outcomes"	93%	33%	89.7%	32.0%	3.21
"L: The Lessons helped me understand knowledge of the topic through interactive content"	89%	37%	84.8%	30.5%	3.13
"E: The Emulations helped me replicate the steps to complete the modeling exercises."	100%	68%	100%	65.7%	3.66
"A: The Activities helped me learn to analyze an illustration and differentiate tools needed to recreate the object."	96%	51%	95.2%	53.3%	3.48
"R: The Reflections helped me judge performance and see if I needed more work on the topics."	87%	28%	75.2%	25.7%	2.94
"N: The Next steps milestones helped me progress through the design process."	85%	26%	84.8%	32.4%	3.14
"e: The Evaluations increased my awareness of knowledge and skills gains and remaining deficiencies to work on in order to obtain the learning outcomes."			81.9%	38.1%	3.13
"d: The final project allowed me to Demonstrate the skills learned throughout the course."			98.1%	50.0%	3.47

Table 7. Student perceptions of confidence with learning outcomes.

	Yes, I feel confident in this outcome. (Fall 2021)	I feel moderately or very confident (very confident) in this outcome. (Spring 2022)
Demonstrate appropriate ANSI lettering format on engineering drawings. [SLO1]	84%	96.2% (61.9%)
Distinguish between the characters and line types used in engineering drawings and apply them appropriately to communicate design details. [SLO2]	80%	94.2% (46.2%)
Interpret and create scaled engineering drawings with views proportional to the actual size. [SLO3]	84%	95.2% (58.7%)
Apply the basic principles of isometric views and orthographic projection to maintain orientation and alignment on multi-view drawings [SLO4]	94%	100% (73.3%)
Apply the ANSI principles of dimensioning and tolerancing to develop fully annotated multiview drawings [SLO5]	67%	79% (40.0%)
Apply the principles of auxiliary views and how they relate to the development of multiview drawings of parts with inclined surfaces. [SLO6]	73%	85.6% (42.3%)
Apply the principles of section views and how they relate to the development of multiview drawings of parts with interior details. [SLO7]	84%	92.4% (45.7%)
Develop 3D models with features that are present, correctly sized, and properly located using CAD software. [SLO8]	89%	99.0% (77.1%)
Utilize CAD software to generate an assembly and assembly drawings with appropriate annotations. [SLO9]	93%	98.1% (67.6%)

When comparing variations between instructors in confidence in learning outcomes, the only learning objective with significant difference in mean confidence ratings was [SLO8] as evidenced by two sample t-tests using the numerical transformation of ordinal ratings on a 1–4 scale. Author 1's students had higher mean confidence ratings (3.84 vs 3.68, $p = 0.038$) in their ability to develop 3D models with features that are present, correctly sized, and properly located using CAD. The reason for this variation is unclear, but may be due to the in-class instruction or variation in rubric grading items.

Student Testimonials

As part of the university end-of-course evaluation, students are asked to provide a free-response to the question "What elements in the course MOST helped you learn the course content?". Below is a selection of responses:

"I really liked the LEARN format for this course. Firstly, the background and theory was introduced in the lessons. Then in the emulations, we could follow along with what the instructors were doing while listening to their thought processes. The assignments gave us a chance to try out the learning objectives on our own with the knowledge gained from watching

the emulations. Reflecting on the week's work was thoughtful and necessary metacognition, and it gave the instructor the ability to review feedback from each student. Lastly, the Next Steps assignments kept us up-to-date with the final project so that it wasn't as stressful as the semester went on. Overall, the LEARN format was the most helpful for this course."

"The way the class was set up with lessons, class activities, and emulate assignments that gradually got more difficult was very helpful in mastering the techniques learned in class."

"The thing that helped me most during this semester was the inclusion of online videos. They helped a lot if I was unable to understand the material in class, I could just look at it again later."

"Being able to come to class, ask questions and get help instead of sitting and going through the lessons."

"The Emulates and Activities helped me the most. [Author 2] provided videos that showed step by step how to complete a certain task and then we'd replicate it. Then, later on in the week we would take what we learned from that assignment and apply it towards another one that was similar but this time, on our own. This was especially helpful because I learn best by watching someone do it and then following along and doing it myself."

CONCLUSION

The iLEARNed framework provides a clear, well-organized modular format for flipping a classroom environment. It enables a high degree of course flexibility and is well-received by students and instructors. Using the framework, we were able to achieve an accessible course that permitted students to achieve the course learning outcomes by providing scaffolding for their learning experience. Notable benefits of the iLEARN framework include:

(1) content coordination across sections of the course establishes common expectations and outcomes,
(2) a consistent and repeatable weekly flow through the learning stages builds students' skills for self-regulated learning,
(3) online modules increase accessibility for students absent from face-to-face instruction,
(4) student-centered modular design enables high flexibility in course design by removing the necessity of a "sage on the stage".

In-class time can now primarily focus on providing individual or small group assistance to students as they complete challenging activities. The lesson and emulation activities are always available to review outside of class; even for students who cannot attend face-to-face learning. This proved particularly beneficial during the COVID-19 pandemic, when some students were not able to attend class for multiple days due to quarantine or testing requirements. Students can elect to self-pace and review lessons and emulations as needed for additional guidance and participate in-class as much as they want, mitigating consequences of getting behind during the lecture or missing a class.

Future work will investigate the effectiveness of iLEARN in second year engineering courses. Additional efforts will go into refining the graphical communication course elements. Specific focus will go into creating question prompts for reflection tasks that are metacognitive to build self-regulation habits. Next steps tasks will be evaluated to see if the flow of workload can be better managed across the term to ensure students are making significant progress across the term rather than being so heavily loaded in the second half of the term. Lessons will be reviewed for flow of content. Based on the results, moving tolerances and auxiliary views earlier in the semester may improve confidence on those learning outcomes. For evaluations, we will explore options for incorporating validated measures of assessment such as items from a concept inventory in addition to the CATIA sample exam questions.

Overall the implementation of iLEARN was successful and the optional –ed stages did not detract from the implementation though the evaluation and demonstration stages were largely interpreted separate from the main cycle of elements. Using the iLEARN framework was instrumental in improving communication of expectations and improving accessibility. Incorporating the terminology into the classroom assisted with streamlining communication among faculty and enhanced understanding of expectations among faculty to students regarding expectations from the assignments in terms of individual accountability and how acceptable it was to work with peers.

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