Insights Provided by Student Feedback on Integrated E-Learning Modules Covering Entrepreneurial Topics

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As a best practice, it is customary to ask students for their feedback on curricular interventions. The feedback is typically used to justify further changes and ascertain how well they may accept the intervention for broader implementation. At the University of New Haven, 18 e-learning modules were developed and integrated into courses spanning the 4-year engineering and computer science majors' curricula. The modules centered on topics seen to contribute to the development of students' entrepreneurial mindset. We saw this as a way to assist faculty in leveraging entrepreneurial minded learning (EML) in their courses when the topics are likely outside their area of expertise. The development, integration, and students' learning assessment efforts of the e-learning modules have been the topics of many of our previous papers and presentations.

This paper focuses on an analysis of the feedback collected from students regarding the modules and their integration. Our faculty have been using the modules for over five years. In that span, we have collected over 1000 student responses to an end-of-term survey administered in every course in which a module was integrated. The survey includes questions pertaining to time spent on the module and the associated course assignment, their level of agreement related to statements about their perceived effectiveness of the curricular intervention, and open-ended response questions focused on what they liked/did not like about the modules and their integration.

Our findings thus far reveal a positive trend in the students' perception of the e-learning modules and their integration over the span of the deployment. Correlation analysis of several indicators provide further insights about students' attitudes towards the modules. For example, students place more value on the module if they see a connection between the module content and the content of the course, as well as if the instructor reinforces what they learned in the module through a contextual activity. However, despite students seeing value in the module or stating that the assignment supported the concepts taught in the module, we do not find a strong correlation to students expressing interest in additional modules of this type integrated into their courses. These findings are insightful and timely given the increased use of hybrid learning in a COVID and post-COVID academic environment.

Introduction

At the University of New Haven, 18 e-learning modules were developed and integrated into courses spanning the 4-year engineering and computer science majors' curricula. The modules centered on topics seen to contribute to the development of students' entrepreneurial mindset (EM). EM has gained momentum as a needed component in undergraduate engineering programs as a way for students to be prepared to handle the challenges of a rapidly changing and demanding world. We take the attributes of an EM as those defined by the KEEN Framework (1) that call for students to leverage their *curiosity*, ability to make *connections*, and understand how to *create value*.

In most cases, faculty teach courses in subject areas closely related to their degrees and research interests. The modules were seen as a way to assist faculty in leveraging entrepreneurial minded learning (EML) in their courses when the topics are likely outside their area of expertise. The development, integration, and students' learning assessment efforts of the e-learning modules have been the topics of many of our previous papers and presentations (2, 3, 4, 5, 6, 7). The basic strategy is as follows: The content is delivered via online modules deployed through the Learning Management System (LMS); typical module requires 4 – 8 hours of time and students complete this outside of class time. Students engage in in-class or online discussions promoting deeper learning of the module content. However, the key aspect of the

integrated e-learning modules is the reinforcement of the learning through a contextual activity. This links the course content with the module content and helps to connect the ideas for the students. Assessing student learning through an *activity* or exam question(s) completes the integration.
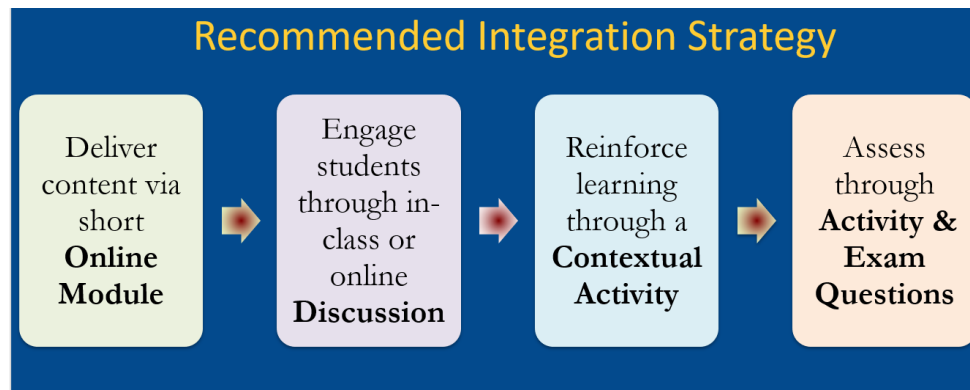

Figure 1: Recommended Integration Strategy for e-Learning Modules supporting Entrepreneurial Minded Learning

The e-learning modules are openly accessible through the Engineering Unleashed portal (8) and summarized in Table 1. This paper focuses on an analysis of the feedback collected from students regarding some of the modules and their integration. An abbreviation of the module title is included for the modules for which data is presented in later figures.

Student Feedback

Feedback is defined in the dictionary as "the transmission of evaluative or corrective information about an action, event, or process to the original or controlling source" (9). Bisieux argued that the word is so frequently used that its meaning depends on its contextualization (10). It is widespread practice to collect user feedback to improve a product or experience. Bisieux specifically identified two types of feedback: feedback about the process (how it was done) and feedback about the "performance" (what was done) (10). Student feedback surveys are widely used in educational settings. Their implementation ranges broadly from end of term questionnaires used to evaluate and improve teaching to short forms distributed at the end of a presentation or an exercise used to judge perceptions and experiences.

The modules were developed starting in 2014. In the pilot stages, student and faculty feedback were collected to inform changes to the modules as well as build instructional guides to facilitate integration by others. Our 2017 ASEE paper detailed the external deployment of 6 of the modules at 25 institutions (4). At the time, we reported that students saw value in the modules and agreed that the contextual activities were effective in connecting and reinforcing the material covered in the modules.

At our university, the modules are used by courses spanning all the engineering and computer science majors over their 4-year curricula. Data and feedback have been collected as part of a larger effort to measure EM growth of our students during their undergraduate programs. Our faculty have been using the modules consistently for over five years. In that span, we have collected well over 1000 student responses to an end-of-term survey administered in every course in which a module was integrated.

Table 1: Summary of available e-learning modules grouped thematically

	Ideation, Innovation and Execution	Abbreviation
1	Generating New Ideas Based on Societal Needs and Business Opportunities	GNI
2	Thinking Creatively to Drive Innovation	TC
3	Innovative Client-Centered Solutions Through Design Thinking	DT
4	Innovating to Solve Problems under Organizational Constraints	
5	Applying Systems Thinking to Complex Problems	ST
	Entrepreneurial and Business Concepts	Abbreviation
6	Developing Customer Awareness and Quickly Testing Concepts Through Customer Engagement	CA
7	Adapting a Business to a Changing Climate	
8	Cost of Production and Market Conditions	COP
9	Role of Product in Value Creation	
10	Determining Market Risks	
11	Financing a Business	
12	Defining and Protecting Intellectual Property	IP
13	Developing a Business Plan that Addresses Stakeholder Interests, Market Potential and Economics	
	Organizational, Professional and Behavioral Skills	Abbreviation
14	Building, Sustaining and Leading Effective Teams and Establishing Performance Goals	ET
15	Building Relationships with Corporations and Communities	
16	The Elevator Pitch: Advocating for Your Good Ideas	EP
17	Resolving Ethical Issues	REI
18	Learning from Failure	LFF

Our Student Feedback Survey

Integration and deployment of the modules in our classes has become increasingly efficient. Course coordinators remind faculty prior to the start of the term regarding the module-deployment logistics in our LMS (at present time we are using Canvas). At this time, faculty are also reminded of what is expected from them by the end of the term, notably their direct assessment data and requesting students complete the Student Feedback Form. Access to the form is provided via a paper copy or a Survey Monkey URL. The same form is used for all classes. Completion of the form is voluntary, and we do not track who does/does not respond.

The student feedback form is comprised of 12 questions which follow a brief consent section. The questions include:

1. Select which module was completed
2. Identify level (graduate vs undergraduate)
3. Select major
4. How much time on average was spent on the e-learning module
5. How much time on average was spent on the class assignment (or project) related to the e-learning module
6. Five statements on a Likert scale from s*trongly disagree* to *strongly agree*
   - The instructor reinforced what you learned in the e-learning module through an assignment or a project
   - The assignment or the project was effective in reinforcing what you learned in the e-learning module
   - I found the e-learning module of value
   - I was able to see the connection between the module and the content of the module
   - What I learned in this module is applicable in my current and/or future career
7. Four statements regarding their perception on a scale from *far too much* to *far too little*
   - The readings on each page
   - The additional readings accessed via web links
   - Videos
   - The overall length of the module
8. Do you think you would acquire useful knowledge and skills by having similar e-learning modules embedded in other courses? (yes/no)
9. Explain what about the embedded e-Learning module(s) you liked/didn't like that made you respond to the prior question (open ended)
10. Any other comments/suggestions
11. Select section number and instructor
12. Provide Full Name (used for correlation with other data collected but not provided to instructor)

In most instances, the deployment of the feedback form is towards the end of term. Unfortunately, if left for too late in the term this may conflict with the end of term evaluations and results in lower response rates. The number of student responses received from our students between Fall 2017 and Spring 2021 is tallied in Table 2.

Table 2: Count of student feedback forms received listed per term (F – Fall; S – Spring)

Year 1	F17	352	S18	103
Year 2	F18	145	S19	8
Year 3	F19	192	S20	100
Year 4	F20	130	S21	75
			Total Data	1105

Results and Discussion

The student feedback forms compiled represent data related to 11 of the 18 modules that have been consistently used and deployed since Fall 2017. The abbreviations used in the graphs correspond to those listed on the right column of Table 1.
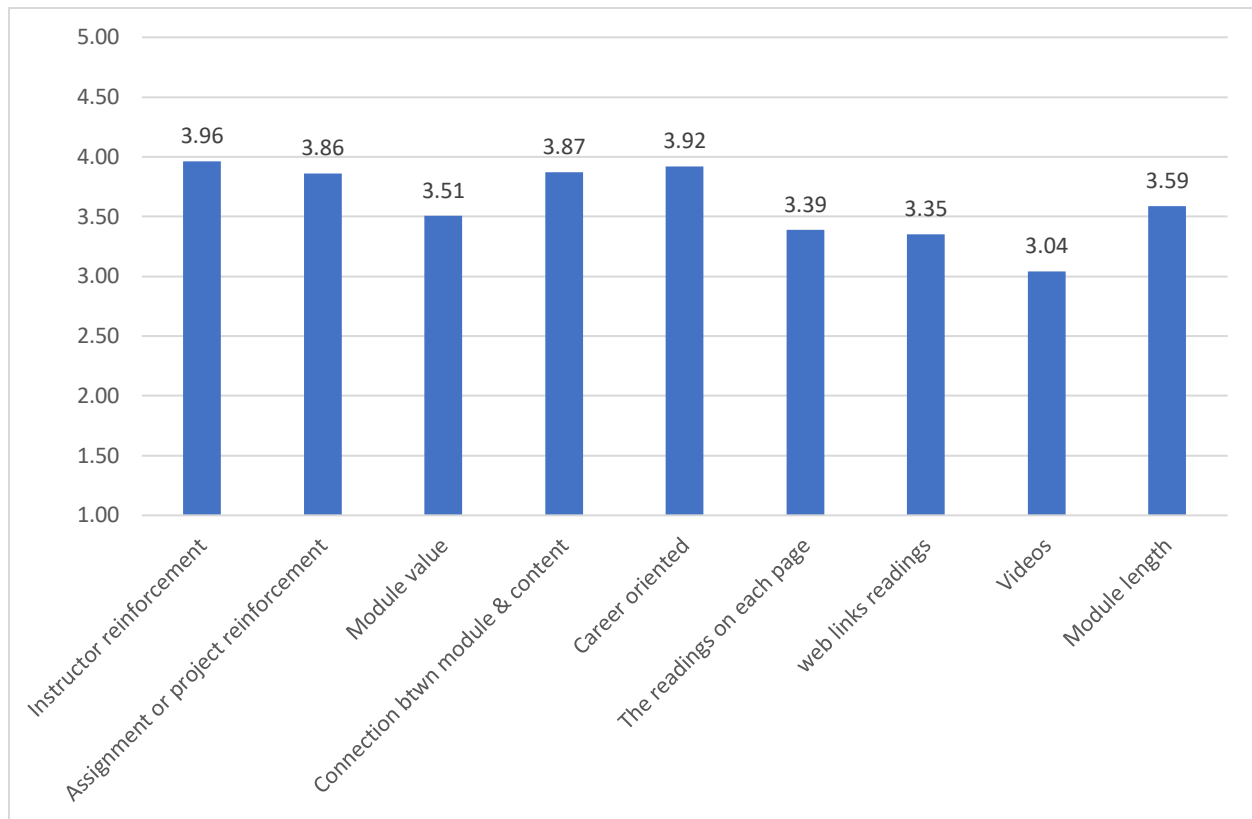

Figure 2: Average of responses for all student feedback forms received; The y-axis value of 5 would correspond to Strongly Agree for the left 5 bars or Far Too Much for the last 4 bars.

In figure 2 we show the average results of all student responses received over the four-year period for questions #6 and #7. We note that in aggregate, the students lean towards agreement in the statements related to the integration (question #6; left 5 bars on the figure). With regards to module content (question #7; right 4 bars on the figure), the aggregate student responses indicate *just right* amount of readings, links, videos, and are of an appropriate length. If the data is looked at by year of deployment, we can see, in figure 3, a little more detail but minor variation for each of the questions.

When students were asked *how much time on average was spent on the e-learning module,* over 80% of the responses stated maximum of 5hrs. Figure 4 depicts the responses broken out by module; Table 3 indicates the percentage of the student responses for each module for this question. It is worth noting that the question specifies that e-learning module here refers to the content that was made available online.

If the results are analyzed by Academic Year deployment, we see some consistency across the years, (Figure 5). Years 3 and 4 overlap with the COVID Pandemic when more content was moved online for

the students to review. We do see an increase in the time spent on reviewing the module but remain within our estimated allowed it time of 4 – 8 hrs.

Figure 3: Aggregate of student responses to Likert scale questions (#6, and# 7); The y-axis value of 5 would correspond to Strongly Agree for the left 5 statements or Far Too Much for the last 4 statements.

Figure 4: Count of student responses filtered by module deployed; refer to Table 1 for the module abbreviations

Table 3: Percentage of students' responses to question regarding how much time they spent on the e-learning module; Counts are reported in Figure 4

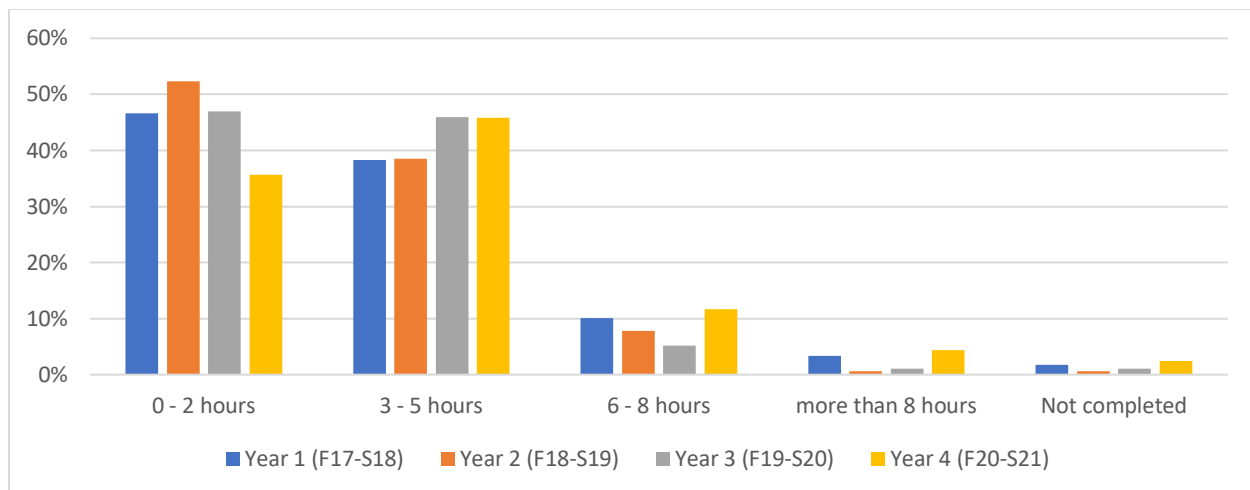| Count of Time (e-learning)	Column Labels											
Row Labels	CA	COP	DT	EP	ET	GNI	IP	LFF	REI	ST	TC	Grand Total
0 - 2 hours	47.83%	38.10%	45.57%	58.33%	47.37%	53.26%	41.51%	43.18%	63.64%	47.83%	42.52%	45.43%
3 - 5 hours	40.87%	39.05%	34.18%	27.78%	46.49%	42.39%	38.68%	43.18%	31.82%	39.13%	47.66%	41.72%
6 - 8 hours	10.43%	16.19%	8.86%	8.33%	3.51%	3.26%	13.21%	8.52%	4.55%	8.70%	7.94%	8.78%
more than 8 hours	0.87%	5.71%	8.86%	2.78%	1.75%	0.00%	2.83%	2.84%	0.00%	2.17%	0.93%	2.53%
Not completed	0.00%	0.95%	2.53%	2.78%	0.88%	1.09%	3.77%	2.27%	0.00%	2.17%	0.93%	1.54%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Figure 5: Percentage of students' responses to question regarding how much time they spent on the e-learning module broken out by academic year deployment.

When asked *how much time on average was spent on the class assignment,* we see a broader set of responses with a few more students selecting an increased number of hours. The count of the responses are shown in Figure 6 while the percentage of responses is summarized in Table 4. In this question, the feedback form specifies not to include time spent on the online portion. It is important to note that the time spent on the class assignment should vary considerably based on the type of contextual activity used in each course for integration of the module content with the course content. For instance, for the *Learning from Failure (LFF)* module, the contextual activity spans the whole semester with a team project done in a first-year course, yet we do not see students reporting an increased number of hours related to that. Similarly, the *Elevator Pitch (EP)* module is overlaid on a required component for seniors in their 2nd semester of a year-long Capstone Project. We see in the data that over 60% of the students report spending less than 2hrs, and fewer than 15% report spending more than 5hrs on the assignment.
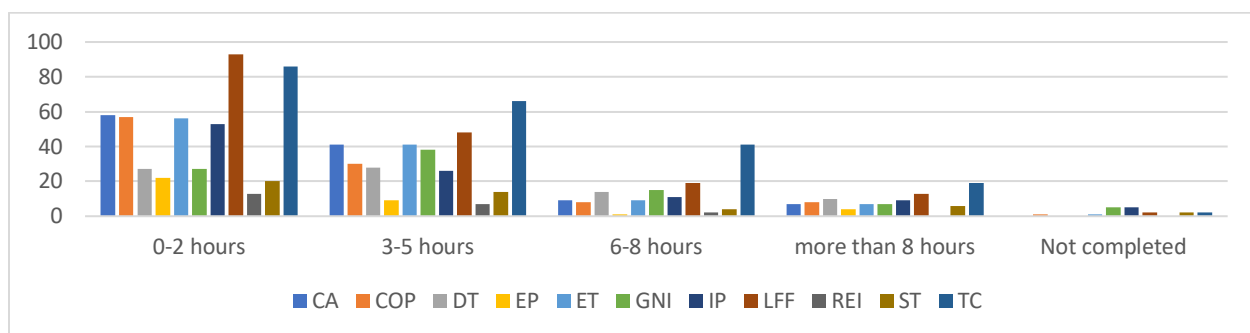

Figure 6: Count of student responses filtered by module deployed; refer to Table 1 for the module abbreviations

Table 4: Percentage of students' responses to question regarding how much time they spent on contextual assignment; Counts are reported on Figure 6.

Count of Time (Class-assignment)	Column Labels											
Row Labels	CA	COP	DT	EP	ET	GNI	IP	LFF	REI	ST	TC	Grand Total
0-2 hours	50.43%	54.81%	34.18%	61.11%	49.12%	29.35%	50.96%	53.14%	59.09%	43.48%	40.19%	46.50%
3-5 hours	35.65%	28.85%	35.44%	25.00%	35.96%	41.30%	25.00%	27.43%	31.82%	30.43%	30.84%	31.61%
6-8 hours	7.83%	7.69%	17.72%	2.78%	7.89%	16.30%	10.58%	10.86%	9.09%	8.70%	19.16%	12.08%
more than 8 hours	6.09%	7.69%	12.66%	11.11%	6.14%	7.61%	8.65%	7.43%	0.00%	13.04%	8.88%	8.17%
Not completed	0.00%	0.96%	0.00%	0.00%	0.88%	5.43%	4.81%	1.14%	0.00%	4.35%	0.93%	1.63%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Similarly, if we examine the responses to this question based on the year of deployment, we see somewhat consistent responses across the 4 academic years examined. We do note the peak of 60% reporting 0-2hrs during the second year of deployments. The shift to increased time spent on the contextual activity in the following years may be explained by increased feedback and support in our part to the faculty integrating the modules.
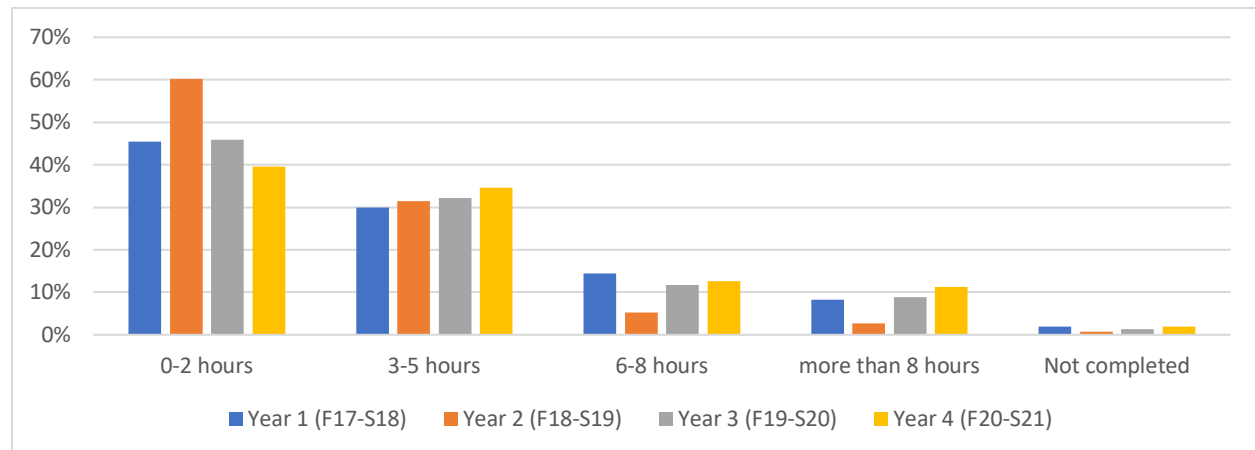

Figure 7: Percentage of students' responses to question regarding how much time they spent on contextual assignment broken out by academic year deployment.

The responses to the question *Do you think you would acquire useful knowledge and skills by having similar e-learning modules embedded in other courses?* split almost equally except with three modules: Customer Awareness (CA), Design Thinking (DT) and Resolving Ethical Issues (REI); each with a significantly larger percentage of the respondents selecting yes. The percentage of the responses are summarized in Figure 8 broken out by module. The increase in the positive responses in the first two modules can be attributable to the changes made in the deployment in the recent years and may suggest an effective method of integration. The activities associated with the module content are embedded in a project that constitutes a significant portion of the coursework and students need consider them from the very beginning.
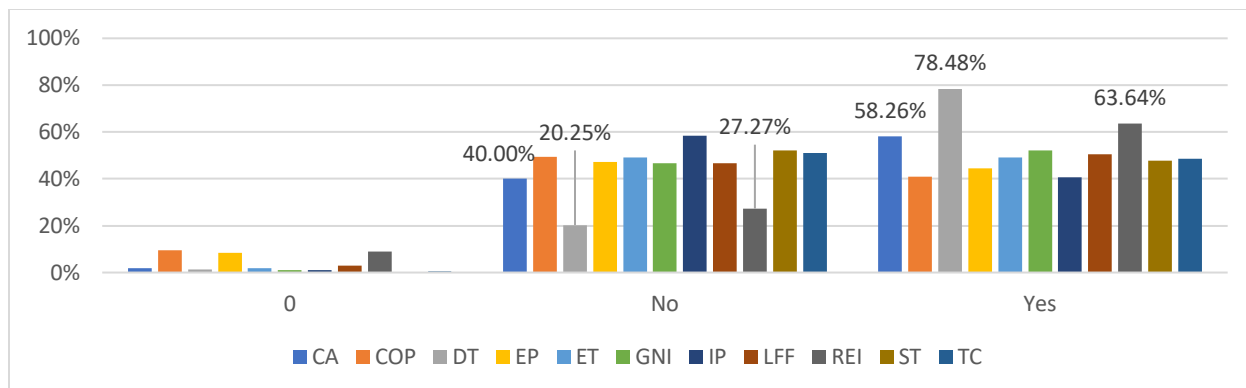
Figure 8: Percentage of student responses to *Do you think you would acquire useful knowledge and skills by having similar e-learning modules embedded in other courses?* filtered by module deployed; refer to Table 1 for the module abbreviations.

The responses averaged by module over the four years of deployment (Figure 8) do not show a strong value placement with a few exceptions. However, if we look at the responses based on year of deployment/integration (Figure 9), we do see a steady and significant increase in the percentage of students seeing value in the modules and their integration. As indicated earlier, the feedback received throughout the years was used to improve the deployment process (how it was done) and the content delivered (what was done); and the results in Figure 9 is a confirmation of their effectiveness. The "0" in Figures 8 and 9 account for the percentage of students who did not respond to this question but had responded to other questions in the survey.
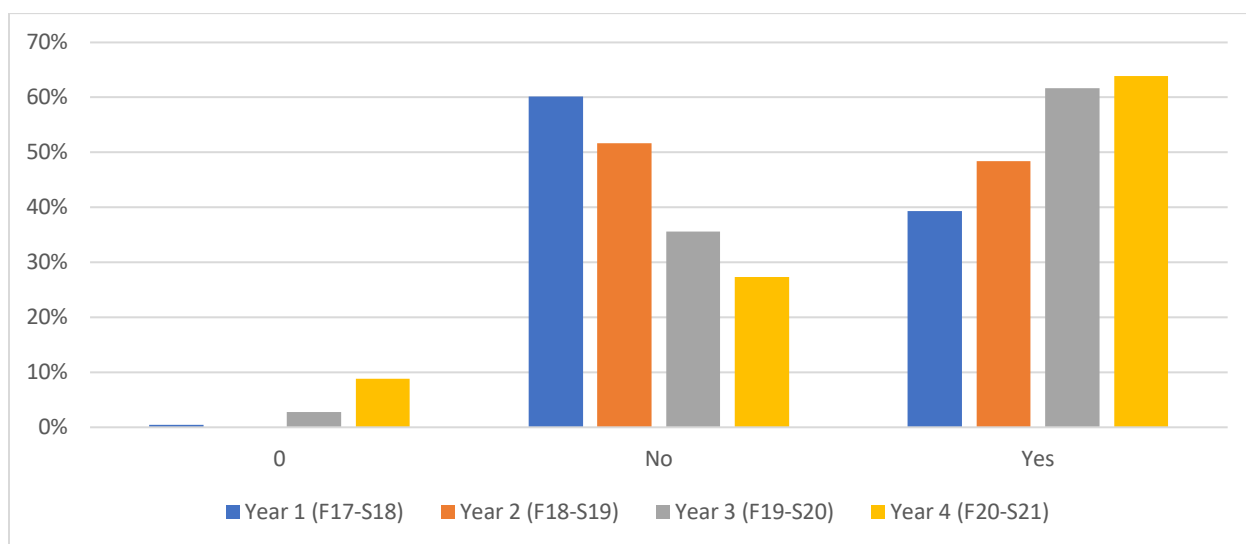

Figure 9: Percentage of student responses to *Do you think you would acquire useful knowledge and skills by having similar e-learning modules embedded in other courses?* filtered by Academic Year Deployment.

We also investigated correlations between several of the statements on the student feedback forms. Specifically, we found that if a student agreed, or strongly agreed, to the statement "*instructor reinforced the e-learning module with an assignment or project*" then they were more likely to report *finding the e-learning module of value* (correlation coefficient 0.521). Similarly, if a student agreed, or strongly agreed, to "*the assignment or project was effective in reinforcing what was learned in the e-learning module,*" the student was more likely to report *finding the e-learning module of value* (correlation coefficient 0.638). Lastly, we also saw a positive correlation between students *seeing the connection between the module*

content and the course content and students reporting *finding the e-learning modules of value* (correlation coefficient 0.687). All these results emphasize the importance of the instructors' role in facilitating the integration of the modules, the relevance of the activities to the module content, and the applicability of the module topic to the course material.

Conclusions and Recommendations for Future Deployments

Our findings thus far reveal a positive trend in the students' perception of the e-learning modules and their integration over the span of the deployment. Correlation analysis of several indicators provide further insights about students' attitudes towards the modules. For example, students place more value on the module if they see a connection between the module content and the content of the course, as well as if the instructor reinforces what they learned in the module through a contextual activity. This underscores the need for instructors wishing to integrate a module into their course to select carefully a module and explicitly help the students connect the module topic with the course content. The *why is this important* is critical to students buying in and not seeing the module and its content as external/unrelated things for them to do.

However, despite students seeing value in the module or stating that the assignment supported the concepts taught in the module, we do not find a strong correlation to students expressing interest in additional modules of this type integrated into their courses. These findings are insightful and timely given the increased use of hybrid learning in a COVID and post-COVID academic environment.

Lastly, it is worth mentioning limitations of our data and the analysis carried out. Studies have shown that individuals are not necessarily accurate in their estimates of time-on-task with people either under or overestimating their time; this may make the responses regarding time spent on module and time spent on assignment inaccurate. Additionally, we remind that the responses collected were voluntary and not all students responded. The time of term and way in which the surveys are deployed can impact response rates.

Acknowledgements

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