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Experiences Using Active Learning in Online Synchronous Learning Environments: A Multi-Institution Approach

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Abstract

During the COVID-19 pandemic, many institutions relied on online synchronous learning environments (OSLEs) using video conferencing software to conduct their classes. Initial feedback from students and instructors indicated that OSLEs did not produce learning and engagement outcomes comparable to those in face-to-face (F2F) classes. More recent research literature highlights the positive outcomes of fully integrating active learning with the features available in video conferencing software, e.g., Zoom, in OSLEs. Anecdotal evidence suggests that OSLEs are a viable modality for students who cannot attend F2F classes and would still like a fixed schedule and real-time peer connection.

In this paper, we report on our experiences with a federally funded project that explores the impact of combining active learning approaches in computing OSLEs and of sharing resources across these institutions. The active learning approaches used in this project are collaborative learning, gamification, problem-based learning, and social interaction, referred to as Learning and Engagement Strategies (LESs). This project involves six institutions with different profiles. The objectives of the project are (1) conduct professional development for faculty and learning assistants in inclusive and equitable learning and engagement strategies (IE-LESs), (2) transform currently used pedagogies and modalities for specified classes to using IE-LESs in computing OSLEs, (3) develop innovative computing OSLE courses to be shared across institutions, and (4) conduct research studies to evaluate the implementation of the three previous objectives. We present the project's initial data collected at the collaborating institutions and describe the lessons learned by the team.

1 Introduction

Before Spring 2020, the primary instruction modalities were face-to-face (F2F), hybrid (blended), or fully online (asynchronous). Since the advent of the COVID-19 pandemic in the U.S., most colleges and universities transitioned many of their F2F classes and part of their hybrid classes to live online synchronous learning environments (OSLEs) [1]. Anecdotal evidence suggests that some students find OSLE classes very convenient. This convenience stems from not having to worry about the hassles of attending F2F classes, e.g., scheduling classes around their jobs or commuting to the university, which can be costly, since they can meet synchronously in their classes from anywhere.

The literature on the different modalities of instruction has not been definitive on which approach is best from both the instructor's and the student's point of view [2, 3, 4]. Students' preference for online synchronous instruction tends to be based on the potential to support social interaction and to support the psychological needs identified by self-determination theory [5]. Unlike students, instructors perceived fewer differences between synchronous and asynchronous modalities of instruction [5]. In some studies, students also thought that the instructors used the technology effectively to keep them engaged and help them learn the course material [6].

Although there was a decrease of 5.5% in computing bachelor's degrees in 2023-24 over the previous year, the enrollment numbers are still robust [7]. The surge in enrollment during the past 5 years has exacerbated existing challenges, such as adequate instructional resources, student learning, retention, and program success rates [8, 9, 10, 11]. Although addressing the high enrollments in computing programs is a complex problem, some potential solutions include (a) adopting pedagogical strategies that ensure welcoming learning environments and (b) adopting pedagogical strategies that incorporate collaboration and team-based learning [12, 11].

To address the issues previously mentioned, a diverse collaboration of six higher education institutions embarked on a project that explores the impact of using combinations of active learning approaches in computing online synchronous learning environments (OSLEs) and sharing resources across these institutions. In this paper, we present the experiences of a federally supported multi-institution collaborative project in its third year. The initial set of institutions participating in the project included two Hispanic-Serving Institutions (HSIs) - Florida International University (FIU) and California State Polytechnic University, Humboldt (CPH); two Historically Black Colleges or Universities (HBCUs) - Alabama A&M University (AAMU) and Florida A&M University (FAMU), and two small institutions (less than 5,000 students) - Rider University (RU) and University of Wisconsin – Parkside (UWP). Recently, UWP was replaced by Georgia Southern University (GSU). These institutions also span four time zones in the US - Eastern Daylight Time (EDT), Central DT, Mountain DT, and Pacific PDT. In addition, 16 teaching faculty members are participating in the project.

The objectives of the project are as follows.

1. Conduct professional development for faculty and learning assistants (LAs) at the collaborating institutions in inclusive and equitable learning and engagement strategies (IE-LESs) in OSLEs. The learning and engagement strategies (LESs) include *collaborative learning, gamification, problem-based learning*, and *social interaction*.

2. Transform current pedagogies and modalities in specified classes to using IE-LESs in computing OSLEs, resulting in improved learning outcomes and increased retention rates.

3. Develop innovative computing OSLE courses that can be shared across the collaborating institutions.

4. Conduct studies to determine (a) the effectiveness of professional development in (1), (b) how integrating IE-LESs into computing OSLEs at diverse institutions impacts student achievement of learning outcomes, retention, and engagement in computing classes, and (c) the effectiveness of the computing OSLE courses shared across collaborating institutions.

Objectives 1 through 3 focus primarily on project-level activities, while objective 4 focuses on research activities related to the first three objectives. The expected measurable outcomes for the objectives are as follows:

1. Prepare (a) 15 faculty and 74 LAs at the collaborating institutions in using IE-LESs in the classroom and (b) 15 faculty in using LAs effectively in the classroom.

2. Transform on average three (3) classes at each collaborating institution to using IE-LESs in computing OSLES.

3. Each collaborating institution identifies at least one course to be shared across all institutions.
4. Study results reflecting positive impacts:
    (a) on the effectiveness of the professional development in preparing faculty and LAs when integrating IE-LESs in computing OSLEs measured by survey responses (students taking classes) and interviews (faculty participating in the faculty development).
    (b) on student achievement of learning outcomes, retention rates, and engagement as measured in survey responses, course grades, enrollment data, and student interviews.

We report on progress over the past two years in the context of the project's objectives, present preliminary data collected across the collaborating institutions, and describe lessons learned to date. We expect that the experiences we have reported in this paper will benefit researchers and practitioners embarking on a diverse multi-institution project. It is worth noting that, although the project is in its third year, progress toward its objectives may not be as fast as expected, as it involves six (6) institutions that entail administrative overhead and other challenges. This administrative overhead includes certifying faculty to teach OSLE classes, conducting professional development for faculty on the project, scheduling OSLE classes, and collecting historical data for classes transitioning to OSLEs. Other challenges include difficulty assigning LAs to courses in a small department due to upper-division courses being offered only once per year, and scheduling LAs to work lower-division courses that don't conflict with a required course so their time to graduation is not delayed. We expect the pace of implementing the objectives and data collection activities will likely increase in the last two years of the project.

The outline of the paper is as follows. Section 2 presents background and work related to the project. Section 3 describes the theory underpinning our approach. Section 4 reports on the current state of the project, and Section 5 preliminary data collected in the project. Section 6 describes the lessons learned, and we conclude the paper in Section 7.

2 Literature Review

In this section, we present the work related to the project described in this experience report.

2.1 Active Learning

Bonwell et al. [13] define active learning as "anything that involves students in doing things and thinking about the things they are doing." The evidence has shown that using active learning in the classroom increases student learning and engagement outcomes [14, 15, 16]. In the project described, the authors decided to use four active learning approaches referred to as *learning and engagement strategies (LESs)*; these include collaborative learning, gamification, problem-based learning, and social interaction [17].

Collaborative learning is where two or more people work in groups mutually searching for understanding, solutions, meanings, or creating a product [18]. *Gamification* uses game design elements and game mechanics to improve user experience and engagement with a system, which may be applied to an educational context [19]. *Problem-based learning (PBL)* is an approach to learning and instruction in which students tackle problems in small groups under the supervision of a tutor [20]. *Social interaction* is an approach that enhances knowledge acquisition through social activities, such as students establishing meaningful dialogue within student groups and with teachers [21].

2.2 Inclusive and Equitable Pedagogies

Several barriers have been identified in the literature that prevent marginalized student groups from succeeding in STEM undergraduate programs [22, 10]. Inclusive and equitable (IE) pedagogies can help mitigate the barriers to classroom experiences and biases. Wlodkowski et al. [23] developed an intrinsic motivation framework for culturally responsive teaching that leads to equitable classrooms and includes four motivational conditions: *establishing inclusion, developing attitude, enhancing meaning, and engendering competence*, all key to the project described. A more recent framework by Kolonich et al. [24] for inclusive three-dimensional science classrooms also leads toward a more equitable classroom. The main elements of this framework are: it positions students as knowledge generators; elicits, values, and leverages funds-of-knowledge; encourages the use and sharing of student language; values students' lived experiences as evidence; and promotes the use of students' critical lens to solve problems.

2.3 Broaden Participation in Computing

Much work has been done on broadening participation in computing (BPC) over the past two decades with great success [25]. Although this work has been funded by the NSF and other federal agencies since 2005, this initiative was enhanced by the NSF in 2017 [26]. One resource that was created to support this initiative is BPCNet [27]. The overarching goal of the BPC initiative is to broaden the participation of underrepresented populations in computing and closely related disciplines NSF [26]. Sax et al. [28] did a systematic review and meta-analysis of the research on BPC. Several directions were recommended going forward, including (a) more longitudinal and multi-institutional approaches, (b) incorporating more sophisticated and multivariate techniques, and (c) yielding insights on smaller underrepresented groups. Morrison et al. [29] suggest interventions and practices that can affect the inclusiveness of the computing classroom and improve student learning outcomes and engagement.

2.4 Online Synchronous Classes

We define the different modalities used in classes based on the work by Klinger et al. [30].

- *In-person* - also referred to as *face-to-face*, is where the instructor is physically in the classroom with students in real time.
- *Online* - also referred to as *distance learning*, is where there is a physical distance between the instructor and students during instruction. Students primarily use the internet to access the class and complete the required activities. The entire class is taught using a Learning Management System (LMS) or a Course Management System (CMS).
  - *Asynchronous* - students can participate in the course on the days/times that are most convenient to them based on the parameters provided by the instructor.
  - *Synchronous* - this is where the online course exists in the LMS or CMS, and there is an online synchronous time when the class meets the instructor using the appropriate technology, e.g., Zoom.
- *Hybrid* - this is when learning is both online and asynchronous as well as in-person and synchronous. Attempts to combine "the best of both worlds". A variant of hybrid is *blended*, where the classroom environment and community are extended beyond the walls of the traditional classroom.

Paulik [31] provided a commentary that describes the psychological underpinnings of effective learning, focusing on motivational and cognitive factors underlying strategies used by students for self-regulated learning. It was stated that online learning requires robust levels of self-regulation, intrinsic motivation, and autonomy due to the immediate lack of instructor and peer interaction. While in the synchronous setting, students are motivated by social and environmental cues. Students' performance-approach goals may be more engaged in face-to-face learning due to competitive drive, instructor feedback, and accountability for earned points and grades through attendance and class discussions. These observations can be explained using Expectancy-Value Theory (EVT), self-efficacy, and self-regulated learning. EVT [32] states that students' *confidence in their ability to succeed in a particular learning task, and task value is determined by how meaningful or useful the student perceives the learning activity to be.* Higher self-efficacy [33] has been linked to stronger motivation, persistence, and academic achievement. Students with self-efficacy are also more likely to engage in self-regulated learning, which involves setting clear goals, managing time effectively, and monitoring and adjusting learning behaviors [34].

Several works report on studies that compared the performance of students in courses using fully online, online synchronous, and in-person modalities with respect to learning outcomes and engagement. Fabriz et al. [5] surveyed 3,056 students and 396 teachers and found that students in a synchronous setting found the instruction more peer-centered. In contrast, students in an asynchronous setting found it more content-oriented. Teachers, however, found fewer differences between the two settings. Maxim et al. [35] focused on introducing active learning into a junior-level software engineering course using in-person and online modalities. Based on course evaluations, there was no significant difference between the two modalities, except for the workload, which showed a statistically significant difference. Faulconer et al. [36] conducted a study of 1964 students across different modalities, including in-person, synchronous video instruction (home and classroom), and online asynchronous. The results showed that students who took the online version (synchronous home and asynchronous) of the class had a significantly lower failure rate than those who took the synchronous instruction (video classroom and in-person). Based on the literature, additional, more comprehensive studies should be conducted to investigate differences in learning outcomes and student engagement.

3 Theoretical Frameworks

The project's activities are based on two models underlying the theory: the LES integration model [17] and the interactivity and learning online model [37]. Using these models we developed a plan of transforming current classes into classes using inclusive and equitable learning and engagement strategies (IE-LESs) for online synchronous learning environments (OSLEs).

LES Integration Model: Figure 1 shows the LES integration model that integrates various learning and engagement strategies and transforms them into inclusive and equitable (IE) pedagogies [17]. The model is iterative and can be updated by integrating different active learning strategies and new learning content. The top of the figure shows the pedagogical approaches (LESs and traditional approach) that are integrated into class activities and learning content using different modalities. The LESs shown include *collaborative learning, gamification, problem-based learning,* and *social interaction.* The traditional approach shown is lecture-style teaching. By combining the LESs and traditional approaches to learning in different ways, we can maximize student learning and possibly tailor this combination to different types of learners. The instructional activities, guided by the LESs and lecture style, and content are then transformed into IE pedagogies.

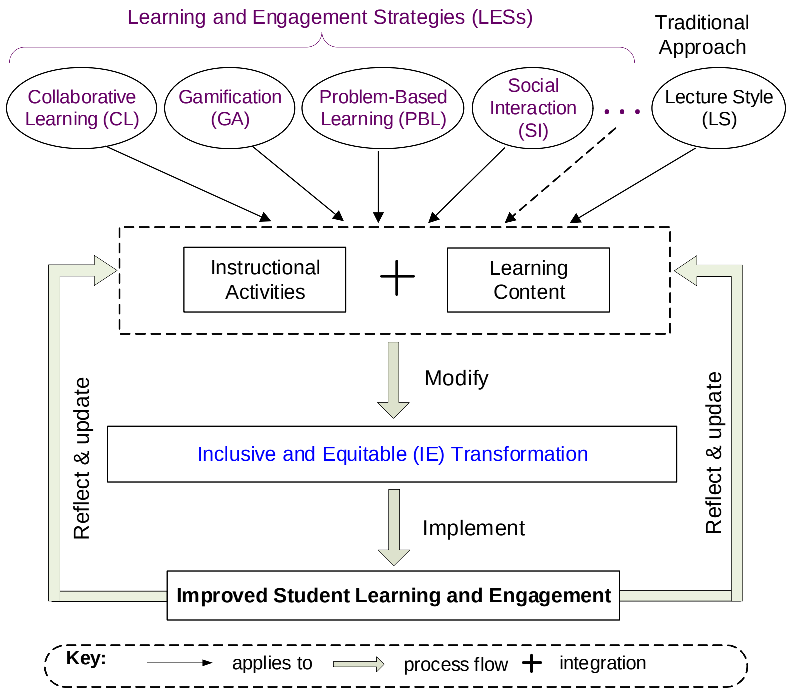

Figure 1: LES integration model.

Interactivity and Learning Online Model: Incorporates features needed for a successful online learning environment and was adapted from the community of inquiry model of online learning by Rourke et al. [38]. The model consists of three spheres representing interaction: *interaction with content* – learners interacting with course materials and with concepts and ideas they present; *interaction with instructors* – the myriad of ways instructors teach, guide, correct, and support students; *interaction among peers* - interaction among learners, e.g., debate, collaboration, discussion, peer review, and informal and incidental learning. The intersection of the three spheres is learning and engagement. The three spheres are enclosed by another sphere that represents the overarching interaction in remote learning, the *learning-interface interaction*. Based on the recent literature, the one interaction that is most lacking in online learning environments is social presence/interaction [39, 40, 41]. The use of inclusive and equitable pedagogies is one strategy that addresses the lack of social presence/interaction in online learning environments [10].

4 Current State of the Project

In this section, we provide details of the project and its current state based on the project objectives stated at the end of Section 1. The project and related studies are conducted under IRB IRB-23-0063-AM03.

4.1 Professional Development

In alignment with objective 1 of the project, we *conducted professional development (PD) for faculty and LAs on IE-LESs in OSLEs.* We conducted workshops for faculty and a biannual semester-long seminar for LAs. All faculty and LA PD activities were conducted in an OSLE. The faculty

PD materials are available on the project's events page[a].

Faculty PD: More specifically, we conducted three workshops and two follow-up workshops for the teaching faculty on the project. The curriculum and outcomes for the faculty workshops are shown in the top part of Table 1. The workshops followed best practices in professional development, including being content-focused, supporting collaboration, using models of effective practice, providing coaching and expert support, offering feedback and reflection, and putting initiatives in place for sustainability [42]. During the spring of 2026 we conducted a follow-up LA workshop for the faculty on the project. In addition to the PD provided by the project, faculty on the project needed to attend institution-specific training before they could teach online synchronous courses. The details of such institutional-specific PD can be found in Clarke et al. [43] for one of the collaborating institutions. A majority of the faculty on the project also attended the virtual workshops offered by the LA Alliance [44] and the in-person International LA Conference (ILAC) in Boulder, Colorado [45].

LA PD: All LAs hired by the project at the collaborating institutions participate in PD consisting of a semester-long seminar titled "Evidence-based STEM Instruction." The LA seminar is a one-credit, 2-hour-per-week course in an OSLE. The LA PD follows the same best practices as the faculty PD described by Darling-Hammond et al. [42] but targeted for LAs. An overview of the curriculum and outcomes for the LA PD is shown in the last three rows of Table 1. The LA seminar is currently run twice a year (Fall and Spring) to prepare new LAs joining the project. Additional details on the LA seminar can be found in Leshem et al. [46].

PD Outcomes: To date, 12 computing teaching faculty who are PIs on the project have attended the LESs, IE, and LA virtual workshops. The curricula and outcomes for the workshops are shown in Table 1. The internal evaluator on the project recently conducted interviews with the teaching faculty regarding the PD and is currently analyzing the collected data. Twenty-two (22) undergraduates have taken the LA seminar, the curricula and outcomes are shown in Table 1. The LAs are required to take the seminar in the first semester they serve as LAs. Preliminary results of the LA PD are described in Leshem et al. [46].

4.2 Transition to OSLEs

We are currently executing objective 2 of the project, which is to *transform current pedagogies and modalities in specified classes to use IE-LESs in computing OSLEs.* We expect this transition to improve learning outcomes and increase retention rates for students in the courses using OSLEs. The expectation is that at least three (3) classes will be transformed into IE-LESs in an OSLE at each of the six (6) collaborating institutions. The objective requires several steps and varies across the collaborating institutions. The general sequence of steps is as follows.

1. Faculty meeting their institutional requirements to teach classes in OSLEs. These requirements may include attending an institutional PD to get certified as an OSLE instructor.

2. Getting departmental approval to offer the classes in OSLEs and scheduling the classes.

3. Integrating IE-LESs into the OSLEs.

[a]https://cue-t.cs.fiu.edu/events/

Table 1: Curricula and outcomes for the professional development activities.

Event	Curricula	Outcomes
Faculty PD:		
LESs Workshop (10-11-2023)	1. Introduction to LESs and associated learning theories 2. Description of how to use collaborative learning and gamification in the classroom 3. Use of technology to support LESs in OSLEs.	1. Develop a plan to integrate LESs into the classroom, specifically how to integrate collaborative learning and gamification in the classroom.
Follow-up Workshop (09-30-2024)	1. Faculty present a plan and examples of how they will integrate LESs in the classroom	1. Refinement of the plan and examples.
IE Workshop (11-17-2023)	1. Motivation for why IE pedagogy is needed in the classroom 2. Identify and share specific strategies for fostering and sustaining IE in the classroom	1. Develop a plan to integrate IE pedagogy in the classroom, using Know, Want to Know, Learned and Wonder (KWL-W) chart, Exam Wrappers, and Assignment Templates
Follow-up Workshop (09-30-2024)	1. Faculty present a plan and examples of how they will integrate IE pedagogy in the classroom	1. Refinement of the plan and examples.
LA Workshop (10-20-2023)	1. Essential elements of the LA model 2. Designing your course with LAs	1. Develop a plan to integrate LAs in the classroom
Learning Assistants PD:		
Semester Seminar Started Spring 2024	1. Learning theory – mental models, social process. 2. Formative assessment & student ideas 3. Equity in the classroom – privilege, micro-aggressions, and micro-interventions 4. Bystander awareness training 5. Active learning approaches	1. Class presentations. 2. Written report – "How best to support faculty in the classroom" 3. Follow-up activity with faculty to develop a working plan
Follow-up Meetings Yearly	1. Report and discuss the classroom activities in consultation with faculty for a class using IE-LESs in computing OSLEs	1. Updated classroom activities for the next offering of a class using IE-LESs in OSLEs.

4. Collecting historical student data and conducting studies to determine if classes taught in IE-LESs computing OSLEs improve student learning outcomes and retention rates.

During the first two years of the project, all the required PD was completed to teach classes using IE-LESs computing OSLEs. Faculty on the project are now transitioning their courses from F2F, hybrid, and fully online to OSLEs.

Table 2 shows the data collected during Year 2 (2024-25) of the project for each institution. The leftmost four columns of the table show the data related to the course, including **# Cs** - number of courses offered by the faculty on the project during the year, **Modality** - modality (and number) of the course offered in that modality, **# of LAs** - number of LAs working on the project, and **Enroll.** - total enrollment of the courses offered. The rightmost six columns show the demographic data collected for the courses during the 2024-25 academic year. The totals and percentages are shown in the last row of the table. The appropriate department at each institution provided the data.

Table 2: Data for courses during the 2024-25 academic year. Cs - courses; F2F - face-to-face or in-person; Onl. - fully online; OSLE - online synchronous learning environment.

# Cs	Modality	# LAs	Enroll.	Females	Males	Asian	Black	Hisp.	White	Pell Grant
Institution 1:										
8	F2F (1), Onl. (1), OSLE (6)	7	469	134 (29%)	335 (71%)	19 (4%)	49 (10%)	303 (65%)	38 (8%)	183 (39%)
Institution 2:										
11	F2F (9), OSLE (2)	8	265	100 (38%)	165 (62%)	4 (2%)	197 (74%)	4 (2%)	5 (2%)	-
Institution 3:										
1	F2F (1)	1	61	13 (21%)	48 (79%)	7 (11%)	1 (2%)	22 (36%)	25 (41%)	-
Institution 4:										
2	F2F (2)	0	62	28 (45%)	34 (55%)	0 (0%)	62 (100%)	0 (0%)	0 (0%)	-
Institution 5:										
6	F2F (5), OSLE (1)	6	117	20 (17%)	97 (83%)	0 (0%)	15 (13%)	18 (15%)	52 (44%)	51 (44%)
Totals	F2F (18), Onl. (1), OSLE (9)	22	974	295 (30%)	670 (69%)	30 (3%)	324 (33%)	347 (36%)	120 (12%)	234 (24%)

No data was collected from one institution since the principal investigator at that institution was moving to another institution and in the process of transferring the grant.

4.3 Multi-Institution Shared Courses

Objective 3 is to develop courses that can initially be shared across the collaborating institutions on the project. We expect that the experience gained in realizing this objective will provide institutions with a pathway of sharing faculty expertise in degree programs and providing students with the opportunity to take courses not offered at their institutions. It should be noted that public college systems within some states already have a framework for sharing courses where students get credit for these courses in their respective degree programs. In this project, we seek to create a set of heuristics for sharing a course across institutions in different states, with the course taught by one institution in the group and possible rotations to other institutions during the academic year.

To date, the team has identified three courses that will be shared with other institutions. These courses have already been approved in their home departments. The courses are *Advanced Topics in Computing: Blockchain and Smart Contracts*; *Career Readiness*; and *LA Seminar*. Currently, the LA Seminar course is the only one shared across institutions, starting in Spring 2024, using an OSLE. Any LA working on the project at any collaborating institution must take this course, preferably in their first semester. Additional details on the LA seminar course are provided by Leshem et al. [46].

5 Preliminary Student Study

In this section, we describe the preliminary study that was conducted across all collaborating institutions on students' perceptions of belongingness, engagement, and self-efficacy, as well as their preference for class modality. The purpose of the study was to collect baseline data prior to more courses being transformed to IE-LESs in OSLEs. The preliminary study is in line with objective 4 of the project described in Section 1.The data presented in this section are from the six (6) institutions participating in the project, and the analysis does not account for differences in course level, discipline, or instructor experience. As the project progresses, we will perform a more detailed analysis as more data are collected, comparing the project's data to historical data at each institution and, when combining the data across institutions, using an appropriate statistical technique, such as multivariate matching [47]. Preliminary results focusing on students' learning outcomes and engagement from one faculty member's course at an institution are described by Clarke et al. in [43].

5.1 Method

Data Collection: A survey instrument was administered to all students taught by the faculty participating in the project. The population used in the study was classes taught by the project's faculty in Spring 2025. The demographic data collected is a subset of the data shown in Table 2. The survey instrument consists of the following categories: *institution (5); LA (4); demographic (3); belongingness (6), engagement (6), and self-confidence (4);* and *class modality (9)*. The values in parentheses represent the number of questions in the category. Consent was required before completing the survey. To encourage participation in the survey, faculty were encouraged to award extra course credit to all students in their classes based on the class participation rates. Note that individual credit was not awarded due to the anonymous nature of the survey.

The section of the survey instrument on belongingness, engagement, and self-efficacy was adopted from the work by Yorke [48] after receiving written permission from the author.

Approach: The preliminary study is an exploratory quantitative approach to validate the survey instrument and collect baseline data for more in-depth studies to be conducted in the subsequent years of the project. The survey was administered in the Fall 2024 and Spring 2025 semesters. The Fall 2024 distribution of the survey was to validate the instrument and identify and resolve issues related to the collaboration across the institutions. In Fall 2024, there were 96 valid responses to the survey, and in Spring 2025, there were 338 valid responses. The survey was distributed across six (6) institutions, including the new institution where one of the investigators moved. The total student population participating in the project in Spring 2025 was 457, giving a survey response rate of 74%. In this paper, we report on the Spring 2025 survey.

5.2 Results and Discussion

Due to the nature of this experience report, we only show a subset of the results for the survey data gathered in Spring 2025. The data collected included: *Institution 1* - 2 courses, 63 responses; *Institution 2* - 2 courses, 46 responses; *Institution 3* - 2 courses, 49 responses; *Institution 4*: 3 courses, 94 responses; *Institution 5*: 1 course, 46 responses; and *Institution 6*: 3 courses, 40 responses.

Tables 3 and 4 summarizes the data collected regarding class modality and student preferences. Data was collected on four modalities: in-person, fully online, hybrid, and OSLE. Based on the

Table 3: Class modality and the number of students currently taking the modality, perform better in, and number of times taken.

Modality	**Current Class**	**Perform Better In**	**Number of times taken**					
			0	1	2	3	4	>4
In-Person	207 (62%)	214 (63%)	17 (5%)	11 (3%)	14 (4%)	26 (8%)	27 (8%)	243 (72%)
Fully Onl.	29 (9%)	76 (22%)	74 (22%)	62 (18%)	50 (15%)	49 (14%)	23 (7%)	80 (24%)
Hybrid	23 (7%)	33 (10%)	199 (59%)	50 (15%)	41 (14%)	20 (7%)	9 (3%)	19 (6%)
OSLE	76 (23%)	15 (4%)	156 (46%)	95 (28%)	32 (9%)	22 (7%)	11 (3%)	22 (7%)

Table 4: Students' preference for the given modality.

Modality	**Preference**		
	1st	2nd	3rd
In-Person	216 (64%)	39 (12%)	42 (12%)
Fully Onl.	71 (21%)	97 (29%)	93 (28%)
Hybrid	37 (11%)	143 (42%)	102 (30%)
OSLE	14 (4%)	59 (42%)	101 (30%)

data shown in Table 3 students are currently taking more in-person classes (207, 62%), they tend to perform better in in-person classes (214, 63%), and have taken more than 4 in-person classes (243, 72%). Table 4 shows that students prefer to take in-person classes (216, 64%). The data shows that students appear unfamiliar with OSLEs, which is reflected in the data in Tables 3 and 4. Of the criteria shown in the tables, OSLEs rate lowest in perceptions of performance (15, 4%), have taken more than 4 times (14, 4%), and top preference (14, 4%). We expect that by the end of the project, the trends in Table 3 should shift in favor of OSLEs.

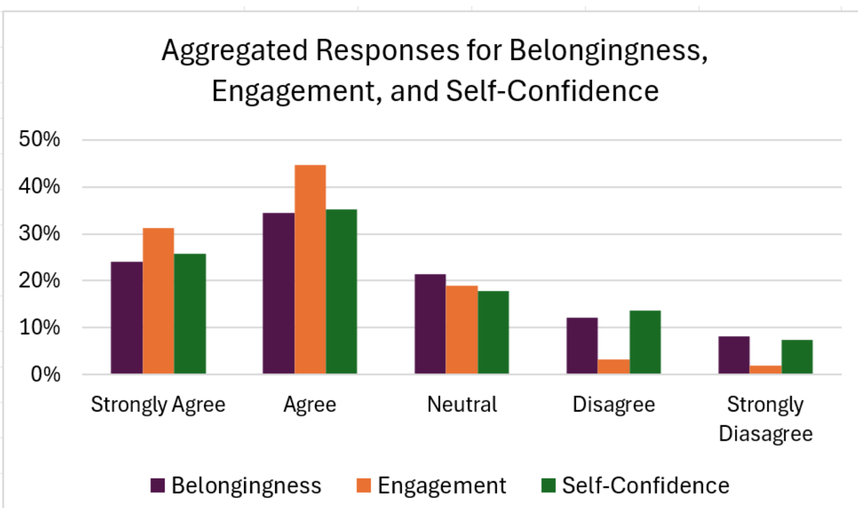

Figure 2: Students' perceptions of belongingness, engagement, and self-confidence.

Figure 2 shows the aggregated results for the survey section on the students' perceptions of belongingness, engagement, and self-confidence. Students felt that their engagement in their classes was positive, with 76% of the respondents giving a rating of *strongly agree* (31%) or *agree* (45%) for the questions in this section of the survey. Belongingness and self-confidence were the lowest performers, giving a negative rating of 20% and 21%, respectively. As the project continues, we expect that students' perspective of belongingness and self-confidence will improve as the inclusive and equitable pedagogies are fully integrated into the OSLEs. There is also some room for improvement with engagement, which will be addressed by using more active learning strategies and using LAs effectively in the classroom. A more detailed analysis of the data collected using the survey instrument may be found in the work by Ramasamy et al. [49].

6 Lessons Learned

This section summarizes the lessons learned from the project based on feedback from the participating faculty, the external evaluator, and the advisory board. Given that this project involves six (6) institutions, 12 computing teaching faculty members, and 4 administrators serving different student populations across time zones and with varying levels of resources, we primarily focus on project coordination and other institutional issues.

Collaboration. One of the key issues with the project is the overhead needed for effective collaboration. For example, it is challenging to find a time for a project meetings when everyone is available. This has resulted in finding times for meetings when most faculty are available and recording all the meetings. Recording meetings is easily achieved since all meetings use an OSLE technology.

Professional Development (PD). Similar to (1), scheduling PD faculty workshops was challenging. This meant that not all faculty could effectively implement the strategies discussed in the LESs, IE, and LA workshops. To remedy this situation, multiple versions of the same workshops were held; more importantly, the number of follow-up workshops increased, which also benefits the quality of the professional development. Increasing the number of follow-up workshops helps faculty to plan and implement their transition IE-LESs in computing OSLEs.

LA Recruitment. The recruitment of LAs to attend the LA seminar poses a problem due to faculty waiting until students complete their classes to identify potential candidates for the next semester. New LAs are required to take the seminar in their first semester when working on the project. The team continues to inform faculty to reach out to students early in the semester and tell them about the project. The LA coordinator on the project has decided to invite all potential LA candidates to attend the final class of the LA seminar in each semester to learn more about the project and interact with the existing LAs. This move has resulted in more LAs being recruited for Fall 2025.

Data Collection. Collecting institutional data is a challenge, and in some cases, it adds additional cost to the project. Budgeting for institutional data collection is essential since such a request may be outside the scope of the regular job description of employees at the respective institutions. In addition some institutions did not have access to the required data, see Table 2.

Transition to OSLEs. Transitioning classes to OSLEs involves several factors, including faculty training as prescribed by each institution, scheduling of OSLE courses in the main course schedule, and, in some cases, reducing the time allocated for classes taught in OSLEs. At one institution, in-person classes are 2.5 hours per week, but only 1.25 hours per week using the flipped classroom model. This reduces the class time dedicated to active learning activities. Discussions are currently underway at the respective institutions to ensure the class time for OSLE is the same as in-person classes.

Integrating IE-LESs in computing OSLEs. Based on this project and prior experiences with multi-institution projects, it is essential to form a community of practice for the sustainability of the approach used in this project [50, 51]. The project faculty must support each other's interests, learning, reflecting on their teaching, and having a shared vision [50, 51].

Although many of the lessons learned are mentioned in reports on large multi-institutional projects [52, 53, 54], our project is unique due to the diverse nature of institutions.

7 Conclusion

In this experience report, we present an overview of a federally funded project, its current state, and lessons learned after 2 years of work. The project focuses on transforming current in-person, fully online, and hybrid classes into classes that use inclusive and equitable (IE) pedagogies and a subset of active learning strategies in online synchronous learning environments (OSLEs). The subset of active learning strategies includes collaborative learning, gamification, problem-based learning, and social interaction, referred to as Learning and Engagement Strategies (LESs). This approach is supported by a robust learning assistant (LA) program. The project involves six collaborating institutions and 16 faculty members.

Preliminary data collected during the early stages of the project are presented, focusing on the professional development of faculty and LAs, the profile of courses currently taught by faculty at the collaborating institutions, and results of a preliminary student study. During the second year of the project, about 50% of the classes taught are in OSLEs. The results show that, across collaborating institutions, students have not been exposed to OSLEs to the same extent as in in-person classes, and there is room to improve students' perceptions of belongingness, engagement, and self-confidence by integrating IE-LESs into the classroom.

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