

An individual case study on learning strategies and activities to increase engagement in their courses: An instructor's approach and rationale to instructional design

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Abstracts

Professional development for engineers is an essential part of career advancement and can include a wide variety of learning opportunities, ranging from asynchronous short courses to comprehensive synchronous in-person courses. Adult learning theory supports the positive influence of student engagement, but this engagement may be different from university classroom settings. There is an abundance of literature that indicates student engagement in the learning experience is important for student learning and other important educational outcomes. There is also evidence that the adoption of engaging teaching practices in professional development settings is limited. Much of the research on adoption is done in K-16 settings, which fails to address the impact among a significant population of adult and professional learners. The purpose of this research is to investigate how a teacher of synchronous engineering professional development (SEPD) courses incorporate engaging instructional practices. We used single case study analysis to closely examine and identify personal experiences and contextual details to illuminate contextually sensitive activities that were helpful in increasing learners' engagement in SEPD courses and could help others understand these phenomena and make changes in their courses. We interviewed one instructor about the course design and use of engaging activities, and the results will inform efforts to increase the use of engaging teaching practices in SEPD courses. The single case study showed this instructor used a variety of different activities to engage students in the learning experience, including self-directedness, life-centered experience, collaborative learning, and expecting a payoff. The instructor shared that previous professional development opportunities and extensive experience trying and improving teaching practices were influential on their current approach to teaching. The results highlight the importance of professional development for teachers, that it must incorporate specific approaches.

Introduction

Rapidly growing technology combined with increasing job responsibilities and fast-paced workplace environments is driving more adults to engage in professional development and continuous learning in their lives and careers [1]. It is well established that learning is an integrated process that leads to change by combining cognitive, emotional, and social dimensions of being [2]. Historically, education has depended upon several different research disciplines in the generation, collaboration, and application of theory to practice, and adult and continuing education is no exception. However, collaboration work and practices are not entirely supported in higher education and in some cases, are discouraged in favor of disciplinary work [3]. In the context of engineering, practitioners and educators must continue to learn and expand their skills and knowledge to remain competitive and current in their respective environments and workspaces [4]. According to the National Society of Professional Engineers (NSPE), more than forty-two states "require that professional engineers maintain and improve their skills through continuing education courses" for professional development [5]. Today, the most important

inputs to the core economic activities are widely distributed in the adult population, and many changes will occur in the coming decades. These concepts demonstrate the importance of adult education and how to facilitate that learning effectively to benefit both the individual learners and society [1]. Adult education is a cross-curricular experience where learners engage in cognitive, social, and psychological perspectives with a special focus on adults. Adult learners bring a grand diversity of backgrounds, expertise, and knowledge to the learning environment [6]. Mainly related to working adults, there has been a focus on teaching and learning principles that specifically revolve around the needs of the learners with different characteristics such as self-direction, problem-centered, real-world tasks, and relatable past experiences [6]. These needs are not always met in adult education courses, potentially attributed to the teaching methods implemented by educators. The focus of this study is to understand the approach and methods of a highly-experienced educator who is active in teaching engineering professional development courses [1], [6].

Literature Review

Adult Education and Workforce Development

Investment in adult education and workforce development is beneficial to the individual and necessary for society. Engineers and professionals working in the industry and educational institutions often face the challenge of growing and remaining up to date with rapidly changing technology [7]. Taking professional development courses during their careers is beneficial and even essential in many cases, such as PE continuing education requirements for license renewal [5], [7]. Professional development first appeared in the literature related to the experience with teaching quality, and later it was used as a learning strategy for learners' future needs in higher education and workforce communities. The main focus of professional development in learning is the need to change, which involves continual learning, formal or informal [7]. According to Jarvis (1999), "there are profound implications for their [the practitioners] continuing learning since they are learning incidentally and informally in practice all the time." He continues by saying, "Formal continuing learning programs need to be relevant to what they actually do and must contain opportunities for testing ideas and theories [7, p. 10], [8, p. 169]."

Instructors of continuing professional development courses are generally aware of the benefits of engaging students and interested in integrating teaching strategies that have been shown to improve learners' performance and engagement in science, technology, engineering, and mathematics (STEM) classes [9]. According to Merriam and Bierema (2013), adult learners in continuing education institutions are more self-directed with a wealth of experience compared to K-16 students. Their learning process usually comes from experience that is primarily focused on promoting a potential lifetime improvement. Thus an andragogical learning approach such as project-based learning might be more effective in their settings, and implementing active learning methods using many of the tools from andragogy could be an attractive approach to capitalize on their experience [4], [10]. However, in professional development courses, a lack of time due to being a part-time instructor, motivation, and professional development opportunities prevents the creation of new teaching practices [7], [11]. Therefore, investigating the instructor's

perspective can provide new methods and engaging instruments that can promote active learning, which can lead to higher engagement levels and a better learning experience in STEM education [11].

Engaging students in the learning experience

Active learning, which has become more common in higher education classrooms over the past two decades, encompasses a wide range of instructional methods in which students engage as active participants in their learning during the class with their classmates and their instructors. This approach is defined as anything that involves the students in the learning process through meaningful activities and encourages them to purposefully think about what they are doing [12], [13]. There is broad literature supporting the benefits of active learning, including improved learning, retention, and self-efficacy [14]. Several forms of active learning include students talking with each other about the course content through working together, including cooperative and collaborative learning and specific activities like "think-pair-share." For example, as operationalized by Michelene Chi (2014), interactive learning includes students working together on activities that require collaboration [15].

There is abundant evidence that these collaborative activities are effective for student learning. A meta-analysis by Freeman et al. (2014) compared student performance in undergraduate STEM courses under traditional lecturing versus active learning and showed the improvement of the student engagement when active learning strategies are implemented [9]. They tested the effect of active learning in undergraduate STEM education and showed that active learning resulted in higher exam scores and lower failure rates than traditional lecturing [9]. Prince (2004) also found support for different forms of active learning, such as collaborative, cooperative, and problem-based learning, to increase student engagement [14]. Other studies with open-ended interviews and qualitative experiments concluded that active learning improves the learning experience for all learners in higher education [16]. Bucklin and Asdigian (2021) used active learning strategies in continuing medical education. They concluded that the usage of active learning in continuing medical education could foster better learner engagement, critical thinking, and problem-solving abilities [17]. Active learning has been shown to have a multitude of positive effects in higher education and adult learning settings, yet adoption rates by educators are still low [14].

Active learning and its importance in continuing education

Active learning in adult education is particularly important because adult learners are more likely to be self-directed than college learners. This self-directedness leads to learners desiring to have an active say in their professional development courses. Self-directed learning is a process in which educators start proceeding in planning, formulating their learning goals, implementing the learning activities and strategies, and evaluating those, with or without the help of others [18]. They are responsible for choosing their topic, determining how they will learn more about their case, and what they will do with that new information. In this environment, the educator takes on the role of a facilitator and support [1]. Many adult learners have experienced learning as a dependent practice during school in their education, and "the teacher's purpose was to match the learner's stage of self-direction and prepare the learner to advance to higher stages" [19]. These stages prepare them to be more self-directed at the highest stage and should be considered as an

essential attribute in the teaching methods [19], [20]. Adult learners come from various backgrounds and will have different learning needs that must be addressed [1], [20]. Active learning can address these differences, and its strategies can allow effective, satisfying, and improved learning for diverse "learning styles, generational needs, and competencies" [21, p. 82]. Continuing education will benefit from incorporating active learning strategies designed to optimize the learning experience [17].

Adoption of active learning practices by CEPD instructors

Despite the known benefits of active learning, adoption of innovating teaching strategies continues to lag [22]–[25], and knowledge around its use in continuing education and professional development (CEPD) environments is particularly lacking. According to Knowles (1980), active learning is one of the fundamental assumptions in the principles of andragogy learning [20], and yet the report of using active learning strategies in adult learning and especially continuing education is very limited. In contrast, there are some existing studies around the use of evidence-based instructional practices, like active learning, in STEM courses in higher education that may shed light on challenges that CEPD instructors may face. Research has shown that STEM faculty are aware of evidence-based practices like active learning, yet the adoption rates remain low [26], [27]. Driving these low adoption rates are faculty reporting a lack of familiarity with how to apply active learning strategies to their specific courses and contexts, the significant time commitment that is needed for developing materials and course plans, and negative reactions from students that make it challenging to effectively integrate certain instructional practices [28], [29]. Additionally, research has shown that there is no "one-size-fits-all" educational approach, and sustainable implementation of new instructional practices is underpinned by adaptation to local contexts [26], [30, p. 535].

Statement of Problem

Although these findings have emerged from higher education settings, they may be relevant to CEPD instructional practices, which inherently have their own unique needs that may include logistical concerns or specific challenges with managing time and effort for the adoption of new practices. To illuminate the experiences of CEPD instructors in the class and course development strategies, with a transfer approach, this study aims to capture the development and implementation practices of an experienced educator who teaches engineering professional development courses.

Methods

Study design

To explore the ways that CEPD instructors develop and implement activities in their classrooms, we utilized the case study methodology, which provides in-depth access to specific subjects of interest and can be used to generate an understanding of a real-life phenomenon under important natural conditions that are relevant to the desired investigation [31], [32]. While the case study approach can include analyses of multiple cases, here, we present a detailed assessment of a single CEPD instructor whom we recruited through a survey distributed to a CEPD institution.

Recruitment and case selection

The instructor was recruited from an institute offering CEPD courses. The research team contacted the institute's education activities division and asked them to email a recruitment document to the potential participants. From the responses, we chose the case study participant based on the courses they were offering and the course's potential for implementing engaging instructional strategies. Once the participant was identified, we contacted them directly, described the research project, and obtained informed consent for their participation. In addition, the instructor was offered a \$25 gift card for their participation.

Interview protocol and implementation

This qualitative research is characterized by an interpretive paradigm that focuses on the instructor's individual experiences and views. We developed a semi-structured interview protocol that focused on teaching experience, background, implementation, and factors that resulted in the change. The interview, consisting of open-ended questions, was designed to prompt the interviewee to what types of teaching practices they implement in their classroom and how and why they decided to incorporate those activities. To begin the interview, the researcher asked the participant about their teaching experience, how long they have been teaching, how they think about teaching, and what essential aspects they think need to be present in teaching. In addition, the open-ended questions helped us capture the instructor's insights on their role in improving the students' learning experience. The questions also prompted the instructor to explain how adult educators help the learning environment by bringing new ideas from past experience and how it is utilized in the class environment. The interviewer was also careful not to provide the participant with specific details of the different engaging tools in active learning in order to solicit unbiased responses from the participant. Based on the given response to the questions, the researcher added follow-up questions for further clarification. After reviewing the essential strategies from the first interview, we conducted an additional follow-up interview to better understand how and why they implement these active learning strategies in their courses. The first interview with our selected participant lasted one hour, and the follow-up interview lasted thirty minutes. Both interviews were audio-recorded and transcribed in their entirety. To protect the identity of our participant, all direct identifiers were removed, and we used a pseudonym, David, for our reporting.

Data analysis

This paper uses a single case study on learning strategies to increase engagement in their courses. A single case study offers compelling data to the theories and strategies if the single case provides unique strategies and features related to the research objectives [31], [33]. Generally, in a case study analysis, one or more cases can be analyzed [34]. Researchers refer to the analysis as a singular or single case study when examining one case. In multiple cases, each case will be investigated as a singular case, and then the results will be compared to each other. One advantage of the single case study is the ability to easily add more results based on the acquired outcomes and compare them to the existing materials [34]. Further, the single case study can be particularly appropriate when the cases are highly descriptive, and it is less practical to measure the desired outcomes than to explain them [35]. Additionally, single case studies are suitable for understanding the issues and are an easy way to confirm the effectiveness of the findings [34].

Just as there are advantages to a single case study methodology in this research, there are limitations such as generalizability, bias, time, and proof [36]. In the context of generalizability, the focus of this study will be on the transferability of the results from this qualitative research and how it can be transferred to other contexts and studies. Although limiting the focus to a single case study can possess some limitations in drawing broad conclusions around strategies in active learning and engagement, here it allows us to inductively identify the effective activities and capture their implementation in adult education and transfer those results to aid future research in continuing professional development education. The purpose of using the single case study analysis was to find a better understanding of the participant's views and examine and identify their personal experiences and the unique strategies that the instructor used in CEPD classes to increase the learner's engagement.

In this study, we used a disciplined configurative single case study to analyze the data and use the established theories related to adult learning, interactivity in the class, and engagement to explain the case. There have been many strategies and activities in adult education to increase the learner's engagement. Proper case study development can be useful for both quantitative and qualitative investigations because the results can be transferred to other studies with more complex data, and it allows for future research with additional participants, methods, and cross-case analysis. According to Starman (2013), case studies are generally a strong choice when other studies are hard to implement [34].

In this analysis, we conducted an inductive coding according to the participant's different engaging methods, which helped them in their teaching experience and our predetermined active learning categories for adult learning. Regarding the case analysis for the qualitative single case study, we followed the recommendations of Merriam (1998) by including the construction of categories or data themes for the data analysis, naming the categories as the strategies and the sub-categories as the activities related to the main categories. The next step was to develop a system for placing the data into these categories and the essential data themes related to adult learning and synchronous CEPD courses in the literature review [37].

Results

Analysis of our interview with David highlighted key activities and actions that he uses to incorporate active learning into his CEPD courses. Here, we provide a summary of descriptive and interpretive results in the context of David's course development as he described. We first provide a descriptive summary of the different engaging activities that he designed and implemented in his classes. The critical elements of this part will focus on the inductive procedure and the implementation process. In the interpretive part, the main focus is to understand the reasoning behind his decision to change his teaching practices over time and recognize the importance of active learning.

Descriptive findings

Here, we provide insight regarding David's course development approach, starting with his background and then describing themes including self-directedness, student feedback, life-

centered experience, payoff expectation, visualization technologies in active learning, collaborative learning, and project-based activities. David received his Ph.D. from a university in California and spent a few years working for a consulting company before working for a CEPD institute, where he has been working for more than 25 years. After earning his Ph.D., he gained early experience in teaching university courses for a brief time and, shortly thereafter, started teaching continuing education courses for engineering practitioners. He described some of his current work responsibilities to include developing material for courses, webinars, and instructional workshops. He then mentioned that he needed to redesign the courses several times and has **"done several versions of these courses over the years."** These courses are engineering-related short seminars, one-day courses, three-day courses, etc.

Payoff expectation

According to David, one of the main goals of the course redesigns was to provide them with a **"foundation that'll help the learners and practitioners do better in the jobs they're doing and be more successful."** During the interview, David mentioned how essential it is to understand the adult learners' needs and goals in the class, which might be very different from students in college. Adult learners in CEPD classes are usually intrinsically motivated, and they expect a payoff from their course contents. **"I am more often talking to professionals who have been around for a while. Very often, what I'm trying to do, is to communicate to them about the applications of the course content."** According to him, it would be beneficial to speak with the experienced professionals about the course content and focus on designing the course based on the learners' needs in their workplace rather than basic.

Life-centered experience

In CEPD learning environments, the learners come with a wealth of personal knowledge and experience, and their orientation to learning is life-centered. Because of this, learning through life situations can offer a better output than learning through subjects in adult education. During the interview, the instructor's experience in CEPD courses showed the importance of this attribute and its impact on better designing the courses for adults and practitioners. He mentioned, **"But that instruction is not complete until they've had an opportunity to think through it themselves in a real-world situation."** He also believed that life-centered learning is an important attribute that distinguishes adult learners from university students. **"If I am talking to an audience that already understands that, I could spend more time on the application and probably would have more exercises that focus on implementation, as opposed to some of the basic knowledge."** In order to implement this strategy into the course, the instructor believed in the use of real-world examples in the coursework and explained how instructors should help adult learners and practitioners envision this explicitly through the course design. **"Ultimately, we have to design not to a code. We're designing the course for the users. We always have to consider our audience. What is our audience looking to learn? Why are they taking the course?"** This ultimately can help the learners share how they will use their newly developed knowledge in their jobs. Other participants can also use this information which they had not recognized before. During the interview, the instructor mentioned in CEPD courses that, unlike university courses, quizzes usually do not motivate adult learners. However, they have an essential role in the coursework. They will show a degree of audience participation, engagement,

and involvement. During the interview, the instructor stated that using visualization technologies can help learners become more engaged, particularly in online courses. The results showed that using visualization technologies contributed to effective assimilation of knowledge awareness of the relationships between different components of the course. It will help the learners make a rational transition from the coursework subjects to their applications in their work.

Visualization technologies in active learning

"Workforce development courses are through the use of video examples. And so the courses that I've developed include lots of videos and lots of structured discussion around those videos. But that instruction is not complete until they've had an opportunity to think through it themselves in a real-world situation." The use of visualization allows the instructor to increase the level of imaginative thinking of the learners and help them connect the subjects of the course to their real-life experience at work. According to the instructor, active learning tools related to the class were offered in two parts. The first part introduces the module and the second part provides an inductive learning opportunity, which significantly increases class engagement.

Self-directedness, collaborative learning, and project-based activities

In the interview, it was found that David was aware of the importance of self-directedness in adult education settings. He mentioned, **"I wanted to find out what the strengths of the team were and how my team wanted to accomplish that, and what they thought would be the timing. And generally, they were pretty close to target."** Self-directedness is an attribute that can pave the way for higher engagement in the class if accompanied by related activities. Students' ability to participate in choosing the course outline, additional useful topics and elective modules can help the class be more a more engaging learning environment. He mentioned that group works, learning through collaboration and projects, and Inductive-based activities were the foundational attributes in CEPD courses and the learners' engagement. When discussing his views on the course content and use of interactivity with the learners and assignments, he presented an interesting viewpoint on the bounds of these questions. He suggested, **"I immediately saw that getting people engaged and taking the time to structure exercises that could be done in the formal breakout groups within the participants, clearly, was a very good idea."** Using group activities helped learners improve their engagement, and inductive methods helped adult learners suggest the related sub-topics beneficial for the practitioners in their work-related areas.

Feedback

He suggested that any form of feedback from the students can provide the instructor with information to adjust their course content and future lesson plans. Implementation of interactive feedback can be beneficial for instructors. He often asks students to provide feedback by self-reflecting on their learning instead of simply recalling facts learned in lectures. He mentioned the limitation of getting feedback in some online classes resulted in less effective activities during the course. **"But I think that the in-person, it's much easier because you get that feedback from the students, right? You can see people's faces."** In this situation, he used daily quizzes as a tool to gather additional feedback. This helped him for future activity design and implementation. According to the instructor, after implementing feedback in the quizzes, they

"realized that the students were paying more attention and were more engaged in the topic." It was also mentioned that polls and pre-course surveys would help them design better modules for the course. **"Pre-course surveys would be more useful than just a general feeling of the people developing the course."** The pre-course survey does not directly impact the class engagement, but It will help the instructor design the course materials and syllabus based on the learners' needs and the specific tasks interesting to them. According to the instructor, this can increase the learners' engagement in the class. Because adult learners usually come with existing knowledge related to the course, some practitioners do not agree with the course materials. He explained how implementing different visual activities, and insightful comments from other peers in the class can help provide concrete suggestions and act as a transformational process for the engineering practitioners.

Interpretation

The main focus of this interpretation is to understand how the instructor came to implement their current teaching practices. He talked about how his experience with designing and teaching courses for National Highway Institute (NHI) was pivotal and helped him implement engaging activities in the course design. **"There, I was getting paid by a serious client who had some expectations, and so that contract had some requirements. I was working with some really good people, a really good project panel that helped me. You had to include modules with learning objectives, follow up, and quizzes, the mini-quizzes, and big quizzes."** He continues by saying, **"And I hadn't taught that way before, and it was very hard to do it. But once I had done it, then you kind of see the value in it. And I think the things I've done since then have benefited from that experience."** According to the instructor's experience, after implementing the engaging activities into the course design, they realized an increase in the level of interactivity compared to the previous teaching experience in the past years. The implementation of these engaging activities was very hard and time-consuming in the beginning, and over time, with the experience and proper guidance and resources for incorporating active learning strategies, he began to see their values in the class and the significant benefits to the learner's engagement. During the follow-up interview, the discussion was more about why he decided to implement these learning strategies in his classes and what experiences helped him to improve his teaching. He mentioned how working with institutes that focused on the interests and objectives of the course design changed his learning strategies during the course. He talked about these courses being **"very helpful in forcing me to organize the course by sections or modules, and really think about what those ought to look like, and then identify learning objectives and materials, and then quizzes that fit into those learning modules. And so it was sort of that structured approach forced me into ways of thinking sort of systematically and clearly about what I wanted to accomplish and what were the best ways to accomplish that. And so it served to break the course up into pieces and then allowed me to focus on objectives and content and quizzes associated with those pieces."** According to him, when the clients took an interest in designing the courses, it allowed him to spend a reasonable amount of time reviewing earlier materials as sections and modules, which helped him find better learning strategies in that particular course. He then mentions that continuous feedback from the client was also critical in this process. Although the continuous feedback was **"painful in the sense that you're constantly revising things and having to go back and change things and make**

sure that you understand what they're really asking for. But there's no doubt that at the end, the course was much, much better than it had been when we started." During the follow-up interview, he talked about the feedback he received from the adult learners taking the course. These were particularly related to the learning strategies implemented in the course. Based on the feedback, he believed that life-centered experience and to be specific work-related experience was a vital strategy in all of his SEPD courses. **"Based on the feedback, the most important [strategies] were that people taking the course understood the relevance of the material to their everyday jobs and that they walked away from the course with some clear ideas about how they could apply the material from the course to their day to day activities that they saw the value and they saw the applications."**

Conclusion

The results from the single case study showed that the instructor believed investing in the course design and implementing new learning strategies based on the research helped him in the course and the learners' engagement during the CEPD classes. These strategies and activities are *self-directedness, feedback, life-centered experience (work-related experience), payoff expectation, visualization technologies in active learning, collaborative learning, and project-based activities*. He talked about the pivotal role that the NHI course played in his development and the importance of personal development incentives in course design and a very structured experience. He also mentioned how his teaching had changed over the years and how he had come to realize the importance of engaging students in the experience. Based on the feedback from the learners and his experience in teaching CEPD courses, he believed that work-related experience is an essential factor in CEPD settings. This qualitative study is a transfer approach to explore better strategies effective in improving engagement in CEPD courses. The study results, such as the work experience-related strategies can be transferred to future research efforts by exploring these findings on a larger scale and providing insights into developing improved teaching practices in professional development educators. In this paper, we discuss two potential future research suggestions. According to the instructor, life-centered and work-related experiences are very important strategies in this single case study, and the majority of the learners in CEPD courses are working practitioners, and their main reason for taking these courses is directly or indirectly related to their work life. 1)An assessment of work-related experience activities for continuing professional development learners could be a useful tool for both researchers and educators in understanding the application of work experience and engagement in CEPD settings. 2)It would also be helpful to implement a survey of the students taking CEPD courses before and after implementing self-directedness-related activities and develop a scale to measure self-directedness in CEPD settings.

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