Online Professional Development for Embedding Industry Credentials in Engineering Curricula

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Introduction

As the number of industry credentials embedded in engineering curricula increase, faculty must obtain these credentials to facilitate integration of the affiliated learning objectives in existing coursework. While short-term, intensive professional development workshops have been used as "bootcamps" to quickly teach faculty the body of knowledge associated with the credential, these training sessions require time and often travel expenses. Additionally, the faculty must complete any necessary testing to obtain the credential in a timely manner. Professional development for these credentials and other ongoing changes to curricula has long been viewed as an important part of teacher satisfaction and student achievement, barriers, including limited time, financial support and applicable content, can make professional development of educators difficult to maintain on an ongoing basis [1].

Professional development can occur in a wide variety of formats including partial day or one-day workshops, multi-day workshops and conferences, multiple week intensive training courses or long-term mentor-based relationships [2]. With the onset of online learning platforms, teachers have additional opportunities for access to training and resources that eliminates the expense of travel. Online learning platforms also provide larger networks for communication and peer support than regional based opportunities [3], [4]. Online platforms also facilitate asynchronous activities, allowing participants to complete work in ways that best fit their schedule.

Studies related to online professional development have been qualitative in nature, often focusing on teacher preferences [4], [5], perceived effectiveness [6] and establishing best practices for online content through survey data and interviews [7], [8]. While best practices based on teacher perceptions and preferences have been documented for online professional development, there are no studies documenting the effectiveness of professional development for

technical educators delivered online, compared to the same content being taught in a face-to-face format [9]. Without empirical data, it is difficult to conclude if online professional development is as effective as face-to-face methods, and thereby a suitable solution for providing low-cost, convenient professional development for technology instructors.

Background

Professional development in education can be defined as "process and activities" that enhance knowledge, skill and attitudes of educators and can include preparation for teaching new content, support during the instructional process and reflection for continuous improvement in future instructional settings [10]. Because there are frequent changes in educational standards, changes to how teacher performance is measured, changes in student outcome assessments and changes in available technology for classroom application, teachers require ongoing professional development, regardless of the number of years of experience they have in the classroom [11]. Studies have also found that faculty were motivated to increase their development as a method to better teach their students [12]. Dash [13] stated that "professional development for teachers has been deemed the necessary approach to improving teacher quality" (p. 2). These benefits remain true even when there has not been a change to content, like the inclusion of an industry assessment. With an increase in embedded certifications, professional development becomes even more critical.

It is important to remember that teachers are also learners when in the professional development context, making it appropriate to draw on learning theories when crafting development opportunities for teachers. Some learning theories helpful in professional development include cognitivist theory and acquisition models, communities of practice and participatory models, and constructivist theory with shared knowledge creation [14].

Current Practices in Online Professional Development

Online professional development provides opportunities to supply teachers with professional development addressing pedagogical content knowledge, new technologies, classroom

management and various other topics that are relevant to the individual teacher's needs [4], [5]. Online professional development increases accessibility through self-paced and asynchronous activities that would not be possible in a face-to-face format [3], [8]. Online professional development also offers opportunities for self-directed learning, echoing previous research on the benefits of a constructivist approach to professional development [7]. Dash [13] also noted that online professional development promotes the ability to balance professional development activities amidst other professional demands.

While online professional development seeks to take advantage of scalability and access, not all methods work for all teachers. Professional development must blend sound research-based insights with the wisdom of practical implementation to bridge the gap between the goals of the professional development and what teachers implement in the classroom [4]. However, current research acknowledges the difficulty of quantifying the effectiveness of online professional development [9], [13]. While studies have shown some teachers prefer online professional development, the data is often gathered through surveys or interviews with participants who volunteered for the study [9], [15]. As such, ongoing research that addresses efficacy of online professional development compared to face-to-face professional development are beneficial as school systems consider making online professional development their primary platform [16].

Methodology

This study addressed the adequacy of online professional development as preparation for technical educators completing the Manufacturing Skills Standards Council (MSSC) Certified Logistics Associate (CLA) certification. To assess the adequacy of online training for industrial certifications, the researcher reviewed both the qualitative data of the participants reflecting on their experience completing the online course, as well as the quantitative data from the certification exam results. A comparison of technical educators completing the same training in a face-to-face workshop format was used as the control for the study. This work was funded through National Science Foundation Advanced Technological Education (NSF ATE) grant (award number 1304619).

The MSSC CLA certification is a nationally recognized, industry credential, which has been accredited by the ANSI ISO 17024 standard [17]. In 2009, subject matter experts created the CLA credential to recognize a body of knowledge required for entry-level logisticians. The CLA certification exam has been tested for reliability and validity through statistical analysis and been adopted by numerous federal agencies for assessing foundational logistics knowledge and has been used in training programs in 28 states, issuing over 15,000 credentials nationwide. The credential was also chosen by the U.S. Army for training 4,300 active duty service men and women in the U.S. Army Quartermaster Corps [17]. Both face-to-face participants and online participants in this study were required to complete the MSSC CLA certification exam as part of their technical credentialing as instructors of an entry-level college course "Introduction to Logistics".

For evaluating the qualitative responses of the participants, the researcher used the Student Evaluation of Online Teaching Effectiveness (SEOTE) [18]. This survey tool has been employed to evaluate the effectiveness of online coursework for a wide variety of coursework at numerous institutions are the nation and has demonstrated internal consistency reliabilities exceeding 0.80 and coefficient alphas for the four defined factors ranging from 0.82 to 0.94 [18].

Notifications regarding the professional development opportunity were sent to 500 individuals, of which 108 registered. Registration for the course was voluntary and participants self-selected either the face-to-face workshop or the asynchronous online modality. All participants had access to the online materials, via Canvas Instructure online Learning Management Software (LMS). All participants who volunteered to participate and accepted the training requirements were informed that they could withdraw from the course at any time. All participants received an overview of training requirements, including the review of supplementary course activities, and the review of content associated with the MSSC CLA certification exam. Finally, all participants were required to complete the MSSC CLA certification exam and complete an online survey of their professional development experience using Qualtrics software. Of the 108 who registered, 81 individuals initiated training in either the face-to-face or online course.

Participant mortality was identified as a limitation of this study; however, data analysis only included those subjects who completed all required elements of the training. Therefore, the mortality rates do not impact the results of this study. Table 1 displays the mortality rates for the participants based on instructional format.

Table 1. Participant Mortality

Participant Mortality			
Modality	Initial Participation	Number of Non-Completers	Mortality Rate
Online	54	24	44.44%
F2F	27	3	11.11%

For participants who selected asynchronous online training, all training materials, guides and activities were provided through the Canvas Instructure LMS. The participants were provided with a guide for navigating the various content sections of the professional development course, however, each participant was able to select how much time was spent on each content area, based on their perceived need. For those who selected face-to-face training, the same tools and resources were made available through the Canvas Instructure LMS, however, face-to-face participants also attended a two-day workshop, which allowed them to take part in course activities and receive guided instruction regarding the MSSC CLA certification test preparation. At the completion of the established training period, participants completed both the MSSC CLA certification exam and the SEOTE survey.

Data Analysis

The MSSC CLA certification exam yielded a score for each participant, which was used for the data analysis. To determine if there was a difference between the means of the face-to-face participant group and online participant group, a one-way ANOVA with a significance level of $\alpha = 0.05$ was used. The data was analyzed using IBM SPSS Statistical software and the researcher

confirmed that the data satisfied the assumptions for normality, homogeneity of variances and independence. The results of the ANOVA are recorded in Table 2.

Table 2. One-way ANOVA for MSSC CLA Exam Scores (n=54)

One-way ANOVA for MSSC CLA Exam Scores					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	21.959	1	21.959	.657	.421
Within Groups	1738.507	52	33.433		
Total	1760.466	53			

With a *p-value* = 0.827, which is greater than $\alpha = 0.05$, it was determined that the mean difference scores for the online modality and face-to-face modality are not significantly different.

For the qualitative analysis of this study, the SEOTE survey was administered to all participants via Qualtrics. The survey responses from the SEOTE survey had three types of responses. The first five items addressed demographic information and were presented in categorical format. Items six through twenty-three of the survey addressed various aspects of participant perceptions of the course experience and used a Likert-style response. The final item was an open-ended response for comments from the participants. Frequency and percentage data were considered for the demographic items of the survey while Mann-Whitney tests were performed on each Likert-style item to determine if the online group and face-to-face group were distributed similarly. Items using the Likert-style response were grouped into seven constructs to address questions of similar nature together. Discussion of those items that were not distributed similarly and relate to the analysis of this study are discussed in the following paragraphs.

Construct One focused on the communication between the faculty and the student. Of the four items regarding communication, one item was not supported as having similar distributions

between the online and face-to-face group, as determined by the Mann-Whitney test. Construct 1 – Item 1 “The instructor communicated effectively” had a *p-value* = .023. The open-ended response related to this question indicates that at least one participant did not feel that there was effective communication and that there could have been some perceived bias about online instruction.

Construct Two had three items related to student interaction. The Mann-Whitney test for each of these three items resulted in a *p-value* < $\alpha = 0.05$, establishing that the online group and face-to-face group are not similarly distributed. The face-to-face participants worked together during their face-to-face workshop and completed numerous activities in small groups and as a class. The course was specifically designed to be asynchronous for online participants, meaning that a student did not have any specific activities that required interaction with other students. Online activities that promoted interaction included discussion boards, video chats and webinars. These activities were available to all participants but were optional. Video chats and webinars were recorded and posted to be viewed at a later time. While the literature presents asynchronous instruction as helpful for accommodating flexible schedules [3], [8], these survey results support that asynchronous instruction could reduce interaction amongst students, especially when collaborative activities are optional for participants.

Construct Five had two items that demonstrated a difference in responses between the two groups. Item 1 read “The course was structured to be user friendly” and had a *p-value* = 0.012. Item 2 stated “The course was designed to provide an efficient learning environment” and had a *p-value* = 0.002. Comments in the open-ended response section of the survey related to this topic suggest confusion within the course navigation and the presentation of content. The face-to-face group did have a portion of the workshop dedicated to orienting participants to the online course content, structure, design and intent for each activity. This same orientation was provided through a webinar to all participants, but only10 individuals attended the webinar in real-time. It is not known if this webinar was accessed at a later time by other individuals.

Construct Six had two items which read “This course used examples that clearly communicated expectations for completing course activities” and “This course provided good

examples and links to other examples published on the Web that helped to explain concepts and skills". Both items had *p-values* < α = 0.050, showing that the online group and face-to-face group responses are not distributed similarly. These items are similar to those addressed in construct 5, with the open-ended responses being applicable to this area as well. This would seem to support the difference in comfort with course navigation between the face-to-face group and the online group.

Discussion

As previously mentioned, the majority of studies examining online professional development relied on voluntary participation. As such, participants who volunteered for the online modality may have a positive bias toward online learning compared to those who wanted the face-to-face modality. Previous research has established that online professional development has been perceived to be effective for those participants who were given the choice to participate in such studies [9], [13], [15]. If random assignments had been given, there would have been the potential of having individuals in the online modality who would have preferred the face-to-face modality. However, many previous studies comparing online and face-to-face coursework use samples that are self-selected, as enrollment in online courses has been voluntary [19]. The results of this study are consistent with previous work in this area, while offering a quantitative assessment in additional to qualitative assessment and analysis techniques.

One factor of interest was the amount of time spent using the Canvas Instructure online Learning Management System. Both face-to-face participants and online participants had unlimited access to course content throughout the duration of the study. When the two groups were compared to one another, it was observed that the average number of minutes spent online was similar, regardless of the chosen modality. While it was expected that online only participants would spend more time using the Canvas Instructure LMS, the wide range of times was not expected. It was also unexpected to see a large range of times for the face-to-face participants. A Mann-Whitney test of the data yielded a *p-value* = 0.174 > α =0.05. The test indicates that the amount of time for the two groups are comparable, even though the online group only had access to the online materials, while the other group attended a face-to-face

workshop in addition to having access to the online materials. With this information, one could question how the face-to-face participants would have done in the study had they not been given access to the materials. When evaluating the time spent with the online learning materials and the responses to the survey regarding the learning experience, it appears that even those who chose the face-to-face modality received benefit from the online materials and appreciated the resources provided.

It is also important to note that all but three individuals passed the MSSC CLA certification exam. That equals a pass rate of 94.4%, which is higher than the national average pass rate of less than 75% [17]. Therefore, when evaluating this training opportunity as effective preparation for completing the MSSC CLA certification exam, one could conclude that this professional development successfully prepared individuals for the exam, regardless of modality. The success rate is important to note, as supporters of online professional development often point to the low cost of implementation, the flexibility of deployment and the increased access for teachers as being primary reasons to pursue online professional development.

Conclusion

Data gathered from this study supports previous work done in the field of expanding online professional development for educators. Quantitative measures for content knowledge, related to the MSSC CLA Certification exam demonstrated that the two groups of educators did not differ significantly regardless of modality. However, the mortality of rate of online participants for this study is similar to the mortality rate reported in other studies regarding online education [19]. With an online mortality rate of 44%, it is questionable how effective professional development would be if the online option was the only option available to instructors. Sahr [16] cautions against using results from voluntary participation to support mandatory online professional development efforts. As opportunities for online professional development increase, best practices for implementation should be used to help reduce mortality rates.

One best practice documented in literature is the use of orientation sessions for online learners. While not all individuals may feel comfortable taking an online course, best practices incorporating orientation sessions have been documented as increasing student motivation, persistence and achievement [20] – [22]. The results of the survey administered in this study support previous research. Mann-Whitney tests showed differences in the distributions of the online and face-to-face group responses primarily in areas related to course organization, navigation and interaction. Open-ended responses also showed frustration of several participants regarding the course instruction, direction and structure. Orientation to the course seemed to be helpful to participants, as they were more positive about course navigation and structure. As participants in this study accessed the online content similarly, regardless of chosen modality, future studies offering professional development solely online could be effective in training teachers, even if those teachers do not prefer online instruction. Education administrators that are considering mandating professional development that is solely online should consider requiring orientation activities to reduce mortality and decrease potential frustration of participants.

Finally, the embedding of industry credentials in engineering programs is a trend that continues to increase in both online and face-to-face coursework across the nation in all types of higher education institutions. As demands for professional development increase, online options will continue to play a vital role for increasing access to educators who may not have the time or funds to attend traditional workshops. While not all educators may feel comfortable with the online modality, best practices in orientation and instructional design make this a viable option for even highly technical content.

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