Usability Evaluation of a Web-Based Platform for Connecting Professional and Educational Communities: Instructors' Perspective

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ABSTRACT

Equitable access to communities of practice for future workforce development has been challenging for construction education instructors. This has been identified as one of the triggers of deficiencies and disparities in the skills and competence of new construction engineering graduates and consequently, dissatisfaction of employers. To address this challenge, a web-based collaborative platform was designed and developed to integrate both communities. This study presents a usability evaluation of the web-based platform from instructors' perspective using quantitative and qualitative analyses. The results from semi-structured interview, ratings of system usability scale, and trust scale were used to infer users' acceptance of the platform. The results reveal high acceptance of the platform by end users as a tool to connect with practitioners for workforce development collaborations. The results also show required improvements to enhance users' experience. The study provides a guide for the usability evaluation of similar matching platforms.

INTRODUCTION

In addition to the deficit in the quantity of workforce required, the construction industry is also being confronted with qualitative labor supply challenges (Christo-Baker et al. 2017). New graduates have been noted to be deficient in the new skills and abilities that industry now requires. This has led to dissatisfaction among employers and additional expenditure on training new employees (Christo-Baker et al. 2017). However, one way to address this challenge is to facilitate the integration of industry and academia to collaborate in workforce development (Jacobs et al. 2022). The professional communities have been said to possess complementary inputs in academic pedagogical efforts which could facilitate the preparation of graduates that meet industry requirements (Jacobs et al. 2022). For example, site visits are integral parts of

construction-related curricula which instructors require practitioners to help facilitate. Also, guest lectures, workshops, and seminars are avenues being used by instructors to bring practical experience and examples into the classrooms by inviting practitioners as facilitators for these activities. However, coordination between academia and industry as well as access to practitioners have been barriers limiting the effectiveness of these efforts (Lu and Jacobs 2022; Chandrasekaran et al. 2015). Hence, to address this challenge, there is a need for an industry-academia interface to provide interactive and collaborative arrangement between professional and educational communities (Rizvi and Aggarwal 2005). To contribute to the ongoing workforce development efforts, improving instructors' access to industry practitioners is required. Therefore, by leveraging the affordances of computing techniques, a new web-based platform for connecting professional and educational communities (ConPEC) was developed. The objective of this platform is to facilitate workforce development collaboration between instructors and practitioners. This is achieved by matching the course-support needs of instructors with the offerings of practitioners to ensure students have an adequate blend of theory and practice.

However, user acceptance is a determinant of the success of new information systems (Davis, 1993) i.e., for this new web-based platform to be successful, it is important to understand end-users' (instructors and practitioners) acceptance and satisfaction prior to deployment. Usability attributes such as efficiency, effectiveness, and satisfaction are important to evaluate users' acceptance of technological platforms (Ahmad et al. 2021). Hence, using quantitative and qualitative analyses, this study presents the usability evaluation of a new web-based platform (ConPEC) from instructor's perspective. Results from the ratings of System Usability Scale (SUS), trust scale and semi-structured interview were used to infer users' acceptance of the platform as a tool for connecting instructors with practitioners for workforce development collaborations.

BACKGROUND

Usability is defined as "the extent to which a product can be used by specified users to achieve specific goals with effectiveness, efficiency, and satisfaction in a specified context of use." Satisfaction is related to desirability which represents the user's desire to use the tool (Barnum, 2011). Therefore, usability evaluation is the activity performed to observe users working with a product and performing tasks that are meaningful to them. To ensure that web-based platforms satisfy users' expectations, different usability evaluation techniques have been developed and incorporated into the design and development of Human-Computer Interfaces (HCI) of which user testing is one of the most popular (Jeffries et al. 1991; Tan et al. 2009). Usability evaluation should result in finding usability problems to aid the improvement of the system being tested (Jeffries et al. 1991).

To ensure better fit for end-users' needs, usability evaluation with real-task scenarios is required. This could offer excellent opportunities for assessing how well users' needs are met as well as users' willingness for continual usage. Some standard usability attributes have been used in evaluating HCI platforms. These include efficiency, effectiveness, learnability, and satisfaction (Abuhlfaia and Ed de Quincey 2018). These attributes are based on SUS originally proposed by Brooke (1996) which is a reliable tool for evaluating the usability of web-based platforms. This method has been used to measure users' satisfaction in the usability evaluation of similar platforms (Harrati et al. 2016; Ahmad and Sazali 2021). Although the SUS is a valuable

tool for usability evaluation, Harrati et al. (2016) showed that in some cases SUS score is not a sufficient measure of users' satisfaction and acceptance of technology. The study recommended complementing SUS score with other methodology. Ahmad and Sazali (2021) recommended discussion sessions with participants in usability studies to uncover further details. Therefore, semi-structured interview is a suitable qualitative inquiry method (Creswell 2013) to complement SUS score.

In addition to effectiveness, efficiency, and users' satisfaction that SUS score can reveal, users' level of trust in a system affects its success (Beldad et al. 2010). Trust is an indicator of satisfaction, and it is considered a significant factor in user acceptance of online platforms (Urban et al. 2000). Online trust is different from offline trust in that it originates from people's interaction with an information system (Bart et al. 2005). Trust is defined as "the attitude that an agent will help achieve an individual's goals in a situation characterized by uncertainty and vulnerability" (Sharp et al. 2023). Trust is necessary when something is exchanged in a cooperative relationship characterized by uncertainty (Sharp et al. 2023) as is the case of the ConPEC platform; users will exchange information hoping for the system to perform adequately. If there is no uncertainty involved, trust may not be crucial to the relation between instructors and the platform (Sharp et al. 2023). Trust is a cognitive and emotional process which varies over time that cannot be directly observed but rather must be inferred (Kohn et al. 2021).

Theoretical underpinning. The success of any new system is hinged on users' acceptance which is greatly influenced by perceived usability as well as trust especially for web-based platforms (Davis 1993; Sultan et al. 2003). To ensure optimum usability and consequently user acceptance, any system designed for human use should be simple to use, easy to learn, useful, and enjoyable to use (Gould and Lewis 1985). To achieve this, human factors principles in user interface design (Gould and Lewis 1985) as well as user-centered design principles (Hartson and Pyla 2012) outlined certain strategies. These principles posit that early involvement of end-users and preliminary user testing are important in ensuring optimum user experience in human computer interaction. Also, the outcome of user testing is to inform improvement of system design through iterative processes. Drawing from extant studies (Sultan et al. 2003; Vlachogianni and Tselios 2022), this study leans on theoretical propositions which have shown that trust as well as usability (effectiveness, efficiency, and satisfaction) are key variables that influence users' acceptance of new technologies. Therefore, this study adopts system usability scale (Brooke 1996), trust scale (Jian et al. 2000), and semi-structured interviews (Creswell 2013) to assess the perceived usability as well as user acceptance of the web-based platform for connecting professional and educational communities for workforce development collaborations.

METHODOLOGY

The web-based platform. ConPEC was designed following human factors principles in user interface design and user-centered design principles. This was achieved through usage research involving contextual inquiry (usage research data elicitation and usage research data analysis) through surveys and focus group to secure end-users' inputs. Contextual inquiry encompasses a network of activities aimed at comprehending user needs (Hartson and Pyla 2012). The outcomes of these guided the design process to ensure optimal graphic user interface inputs. The principles help to ensure early involvement of end-users, uncover user tasks, and understand the behavioral and attitudinal qualities of end-users. To further enhance the usability of the platform, the ten (10) usability heuristics by Nielsen (1994) were employed in the user interface design. This is

because the principles are widely used in the design of user interfaces (Gonzalez-Holland et al., 2017) These include recognition rather than recall principle, user control and freedom, consistency and standard, as well as minimalist design. These usability heuristics are rules of thumb to enhance the design of user interfaces (Nielsen, 1994). The process of using ConPEC was designed to be similar to other existing web platforms that users are already familiar with. The users of the platform can either be instructors or practitioners. The user type specified would determine the segment of the platform to interact with. The platform requires users to sign up, verify email address, and complete their profile. After these steps, if the user registered as an instructor, the user could place a request for course-support, get connected with practitioners, view and download resources to enhance instructional materials, and submit feedback based on their experience with the platform.

Participant and study approval. The study was approved by Virginia Tech's Institutional Review Board (IRB# 23-046). The participants include 3 Assistant Professors, 3 Associate Professors, and 3 Assistant Professors of Practice. According to self-reporting by the participants, they were 3 males and 6 females with different ethnicities. The participants were from Architecture, Building Construction, Civil and Environmental Engineering, and Construction Engineering and Management programs. The participants had an average of 7 years of faculty experience. Hwang and Salvendy (2010) considered 10 ± 2 participants an optimal sample size for usability evaluation. An overview of the methodology is shown in Figure 1. The study was conducted in April 2023.
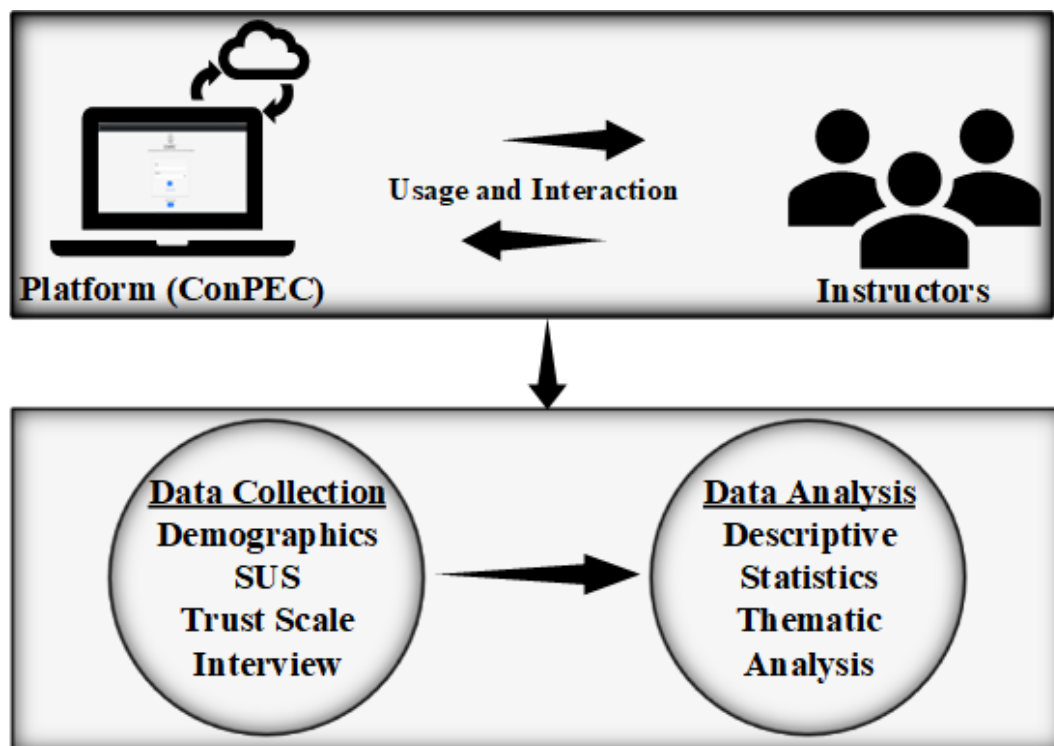

Figure 1. Overview of the Methodology.

Experimental design. This study presents the usability evaluation of ConPEC from instructors' perspective. Prior to the usability evaluation of the platform by the end-users, the

platform was piloted with 5 non-users. The issues raised were corrected to improve the platform. After the approval of the study by the IRB, all the participants indicated their willingness to participate in the study by signing the informed consent form. Thereafter, each participant was introduced to the platform and the study procedure. The participants were required to sign up on the platform, verify their email IDs, and complete their profile after the first log in by providing additional basic information about themselves and the institution where they work. Thereafter each participant placed a request for course support, viewed recommendations, selected preferred practitioners to provide the requested course-support, viewed a page containing resources to enhance instructional materials and submitted feedback on the platform. The workflow of the platform usage is shown in Figure 2.

While placing a course-support request, the participants were required to specify the type of course-support required and the details of the course-support including students' academic program, class size, date, and time the course-support is required, topic requiring course-support and student learning outcome. Participants were also required to specify their preferences regarding the practitioners they are looking for to provide the course-support. These include the area of expertise, level of education, years of experience, age range, gender, and ethnicity. Based on these inputs, participants received recommendations of practitioners to provide the requested course-support. Thereafter, participants viewed details of each practitioner in the recommendation menu and selected a preferred practitioner. The participants were then connected to the selected practitioner to provide the requested course-support by exchanging their contact details.

At the end of the experiment, participants responded to three surveys: demographics, Trust scale, and SUS questionnaires. The study was concluded with a semi-structured interview which lasted for an average of 32 minutes and 5 seconds per participant. During the semi-structured interview, participants were allowed to walk through the entire platform as they responded to questions and pointed out components of the web platform that should be modified. The experiment took approximately 1 hour 26 minutes per participant. Every participant in the experiment participated under identical conditions.
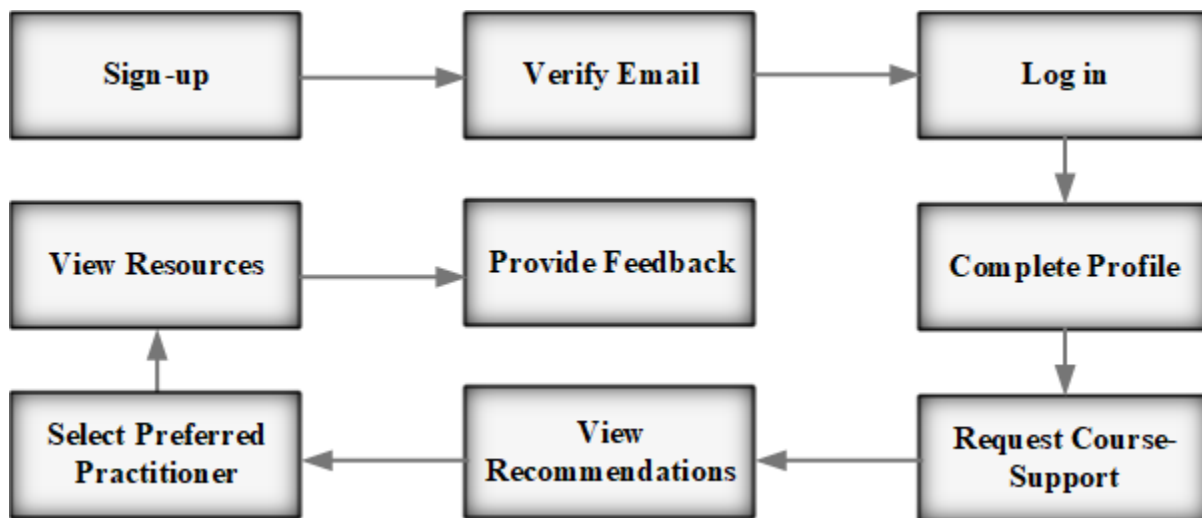

Figure 2. Workflow of ConPEC Usage.

Data collection. The SUS questionnaire contains ten (10) statements to which participants rated their level of agreement on a scale of 1 (Strongly disagree) to 5 (Strongly agree). On the SUS questionnaire, five statements are positive, while the other five statements are negative. The Trust questionnaire also contains twelve (12) statements which participants were asked to rate their agreement on a scale of 1 to 7 (1 represents Not at all, and 7 represents Extremely). Five statements are negative while the remaining seven are positive. The semi-structured interviews were audio recorded, de-identified, transcribed, and analyzed.

Data analysis. Descriptive statistics were used to analyze participants' responses to the SUS and Trust scale questionnaires. The mean scores of participants rating of each of the statements in the questionnaires were calculated. The SUS score was calculated by using the formula SUS score = (X + Y) x 2.5. This formula will give an SUS score out of 100.

Where: X = Sum of the ratings for all positive statements – 5.

Y = 25 – Sum of the ratings for all negative statements.

The transcripts of the semi structured interviews were analyzed using Dedoose, an application for qualitative data analysis. Thematic analysis through inductive coding was employed. The emerging codes and themes were grouped and classified into clusters (Saldana 2009). Reliability of the codes was ensured with an inter-rater reliability test by two different researchers (n=2) which showed 85.7% agreement.

RESULTS AND DISCUSSION

Perceived Usability (SUS). As shown in Table 1 below, all the positive statements have mean scores of ≥ 3.67 on a scale of 5.0 which shows that the participants have a high level of agreement with the statements. The platform was considered very easy to use (MS = 5.00). Hence, the participants agreed that most people would learn to use the platform very quickly (MS = 4.89). The participants likewise indicated willingness to use the platform frequently (MS = 3.67) in connecting with industry practitioners to meet their course-support needs. The functions of the platform were considered well integrated (MS = 4.00) and participants felt very confident using the platform (MS = 4.78). Hence, given these ratings, it is evident that the participants accepted the platform as a means to connect professional and educational communities for workforce development collaborations. Most of the items have standard deviations of less than one, which shows that the participants' opinions were alike. The average SUS score is 91.94. According to Bangor et al. (2009), this score is considered acceptable, with "A" grade scale and above excellent ranking. This score indicates that effortlessly, participants were able to easily accomplish their goal using the platform, and they were satisfied with the experience.

Trust Scale. As shown in Table 2 below, all positive statements in the trust scale questionnaire have mean scores of ≥ 5.0 on a scale of 7.0 which shows that the participants have a very high level of trust in the platform. The results show that the participants had high levels of confidence in the platform (MS = 6.11). They considered usage of the platform to be dependable (MS = 6.33) and reliable (MS = 6.00) in meeting their course-support needs by connecting them with practitioners within a short time. The participants also considered the platform to have integrity (MS = 5.78) and offer security (MS = 5.00) which is very important in online environments. Although the participants in the study interacted with the platform for the first time, they indicated that they are familiar with the platform (MS = 6.44) and can trust it (MS = 6.44). This is because the platform was carefully designed with heuristic design principles with

processes, icons, symbols, and presentation patterns that are similar to other platforms which the participants were familiar with. The results also showed that all negative statements in the trust scale questionnaire have mean scores < 2.0. This shows that the participants did not have high levels of agreement with the negative statements. The participants did not consider the platform to be deceptive, suspicious, injurious or behave in an underhanded manner. The participants unanimously agreed that they are not wary of the platform. Hence from these ratings, high level trust of the participants in the platform could be inferred (Kohn et al. 2021).

Table 1. System Usability Scale Ratings

S/N	SUS Statements	Mean	Std. Deviation
1	I thought the platform was easy to use	5.00	0.000
2	I would imagine that most people would learn to use this platform very quickly	4.89	0.333
3	I felt very confident using the platform	4.78	0.441
4	I found the various functions in this platform well integrated	4.00	1.118
5	I think I would like to use this platform frequently	3.67	1.225
6	I thought there were too much inconsistency in this platform	1.22	0.441
7	I found the platform unnecessarily complex	1.11	0.333
8	I found the platform very cumbersome to use	1.11	0.333
9	I needed to learn a lot of things before I could get going with this platform	1.11	0.333
10	I think that I would need the support of a technical person to be able to use this platform	1.00	0.000

Table 2. Trust Scale Ratings

S/N	Statements	Mean	Std. Deviation
1	The platform behaves in an underhanded manner	1.00	0.000
2	The platform is deceptive	1.11	0.333
3	The platform will have harmful or injurious outcome	1.22	0.667
4	I am suspicious of the platform's intent, action, or output	1.67	2.000
5	I am wary of the platform	1.67	2.000
6	The platform provides security	5.00	1.871
7	The platform has integrity	5.78	1.302
8	The platform is reliable	6.00	1.225
9	I am confident in the platform	6.11	0.782
10	The platform is dependable	6.33	1.000
11	I can trust the platform	6.44	1.014
12	I am familiar with the platform	6.44	0.882

Semi-Structured Interview. All the participants opined that they would use the platform to get course-support in nearly all the courses they teach. The participants were also unanimous in considering the platform easy to use, simple and straightforward:

- "*I will definitely try this out…after it is deployed…I would definitely use this; it is easy to use.*"
- "*…I think it's simple and straightforward." "…… I think it's very easy to use*".

The benefits of the platform for students and instructors were noted. The participants opined that through improved access to practitioners afforded by the platform, students will be able to better interact with practitioners:

- "*…we really need it, I think students need more interaction with the people they're actually going to be working with…*", "*….it gives the students the benefit of somebody who has direct experience, which I don't have….*" "*I think it will be very helpful because I know a lot of students want to gain more exposure to the industry. They want to learn from the experience the practitioners bring to the class. So, this will be very helpful. I plan to invite some guest lecturers next semester so if this will be released. I will definitely use it….*"

The participants noted their willingness to use the platform because it enables them to easily connect with a diverse pool of practitioners, facilitates bringing practitioners with varieties of experience and expertise into the classroom as well as ease their efforts in reaching practitioners and preparing for their classes:

- "*…it's easy to use. It gives me a choice of what I can ask for, and then it provides kind of instant results, and I can make my plans for my class based on what I get…*" "*…I would totally use this platform…because it's a big need.*"

The suggested modifications provided by the participants include the inclusion of graphics and images, improved navigation, addition of graduate students to student academic level, and ensuring personalization of interaction via the platform through chat functions to ensure that all interactions take place within the platform:

- "*I think that the platform should be able to be more personalized in terms of the request to the specific practitioner*".

Also, the participants noted the need to allow for some flexibility by allowing range selection in some options:

- "*…If you didn't have a specific date, I think it would be helpful to have an option that said, like flexible or like these are the options you can choose from rather than I need you at this date and at this time*".

The participants however opined that acceptance of the platform by industry practitioners will further incentivize their continual usage of the platform:

- "*…From our perspective…this is a great resource for us. We like it, but not sure about the industry*".

CONCLUSION, LIMITATIONS AND FUTURE WORK

After the design of a web-based platform following the process prescribed by human factors principles in user interface design and user-centered design principles, it is expected that the usability of the platform will be acceptable. However, the ultimate success of information systems depends on user acceptance. Therefore, using quantitative and qualitative measures, this study assessed the usability and users' acceptance of a web-based platform for connecting

instructors and practitioners for workforce development collaborations. The results show users acceptance of the platform as a tool to collaborate with practitioners. Despite early involvement of users in the design process and high usability rating of the platform, the results of the usability evaluation reveal some usability issues that should be addressed through an iterative design process to further enhance the platform. This study contributes to human factors principles in user interface design and user-centered design principles by demonstrating that the design of web-based platforms guided by these principles result in user acceptance and high usability rating. The study also serves as a guide for the development and evaluation of similar platforms. However, the study is limited in that only subjective measures were adopted, and the participants only interacted with the platform within a short time. Future research could address these limitations and focus on practitioners' evaluation of the platform.

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