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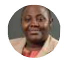
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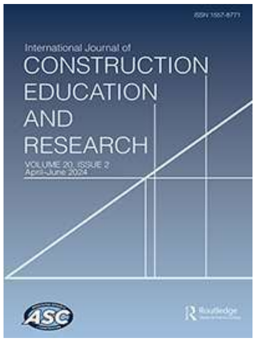

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Design and Evaluation of a Web Platform for Connecting Instructors and Practitioners – Instructors' Perspective

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ABSTRACT

Collaboration between instructors and practitioners is crucial for preparing the future workforce. By applying connectivism learning theory (CLT) and leveraging the affordances of information technology (IT) through Web 2.0, this paper introduces ConPEC, a web platform designed to bridge the gap between instructors and practitioners in the construction industry. This paper presents the design and user evaluation of ConPEC as guided by design principles and heuristics to ensure optimal usability and acceptance by end-users. Twenty (20) instructors in construction-related academic programs who are potential end-users were recruited for evaluation by interacting with ConPEC in a real-case scenario. Both objective and subjective measures were adopted to assess ConPEC's usability, instructors' perception, and their intention to use ConPEC. The results reveal the potential of ConPEC to enhance academic pedagogy by providing instructors with improved access to practitioners and fostering a blend of theory and practical knowledge required by the industry. The results also demonstrate the efficacy of the adopted method in developing information systems because users perceived ConPEC as useful, user-friendly, and likely to be adopted. This study highlights the application of CLT and IT to address skill disparities and align students with industry expectations, serving as a reference for similar initiatives.

KEYWORDS
Connectivism learning theory; instructors; practitioners; student development; web platform

Introduction

The workforce supply deficit is one of the prime challenges confronting the construction industry in the United States (Manesh et al., 2020; Pamidimukkala & Kermanshachi, 2021). This deficit is both numerical and qualitative in dimension (Christo-Baker et al., 2017). This means that both the quantity of personnel and the level of competencies required seem inadequate (Cappelli, 2015; Karimi et al., 2018; Zender et al., 2014). The workforce supply deficit has been described in various ways: skill gap, skill mismatch, and skill shortages but collectively regarded as the skill problem (Cappelli, 2015). Research and industry reports have shown that despite their credentials, new graduates from science, technology, engineering, and math (STEM) disciplines like construction engineering programs do not have

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an adequate blend of the skills and competence that the industry demands (National Academies of Sciences, Engineering, Medicine, NASEM, 2016). This challenge has resulted in several ripple effects on industry, academia, and graduates. Some challenges include low productivity and poor project performance (Karimi et al., 2018), dissatisfaction among employers, and the additional cost of training new employees (Detsimas et al., 2016; Suleman & Laranjeiro, 2018). In the same vein, many students feel unprepared for the realities of the industry (Pereira et al., 2019). Hence, to proactively address these challenges, modifications to the pedagogical framework of construction engineering education are required in preparing the future workforce to meet industry expectations (Manesh et al., 2020). For example, Abudayyeh et al. (2000) opined that every level of education ought to be enriched by incorporating diverse perspectives from the industry. Previous studies have also called for greater incorporation of complementary inputs from practitioners into classroom instructions (Jacobs et al., 2022; NASEM, 2016). However, the means to achieve this synergy remain a matter of inquiry (Peters & Lucietto, 2016).

Although several frameworks (such as industry advisory boards, technology transfer offices, industry liaison offices, and on-campus recruitment) exist for industry participation in academia (Abudayyeh et al., 2000; Bruneel et al., 2010), the focus on industry-academia interactions have been more on research and funding than the development of future professional workforce (Afonso et al., 2012; Chandrasekaran et al., 2015). These arrangements are institutional frameworks that have little or no direct impact on preparing the future professional workforce to meet industry expectations. Therefore, beyond the limits of the current institutional frameworks, future workforce development requires dynamic interaction between instructors and practitioners at the classroom and course levels to ensure practitioners' direct input in course instructions and students' greater interaction with the industry (Anderson & Mourgues, 2014). However, instructors' efforts to connect with practitioners for workforce development collaborations are being hampered by the difficulty in accessing willing practitioners. Many instructors rely on social media or personal networks (Gruzd et al., 2012), industry advisory boards, and professional organizations (Lu & Jacobs, 2022) to connect with practitioners. This could be prone to red tape, difficulty of/limited access to practitioners, lack of proper organization and coordination as well as misfit of practitioners' offerings (Kaymaz & Eryiğit, 2011; Lu & Jacobs, 2022; Peters & Lucietto, 2016). Also, instructors and institutions with limited industry contacts are disadvantaged.

While greater interaction between industry and academia has been noted as a potential means to address the skill problem in the construction industry, innovative means to achieve this interaction have been grossly lacking if not non-existent. Also, there seems to be no country or industry-wide arrangement/interface for industry and academia to collaborate for future workforce development. New possibilities of connection and networking are being pioneered by advances in computing technology. With the internet, diverse groups of people can be connected from anywhere and at any time (Wellman, 2004). The affordances of the internet and computing techniques to connect communities and aid learning, and collaborations have been widely explored in several contexts. For example, web platforms have been used to facilitate online teaching (Inada, 2023), technology transfer between industry and academia (Confalonieri & Janes, 2022), the connection of tutoring communities of practice (CoP) (Garrot-Lavoué, 2011), and connection of students with practitioners in other domains such as biotechnology (Khan & Gogos, 2013). Web platforms that connect instructors and practitioners for students' development seem lacking. Hence, web platforms could be leveraged to improve collaboration between instructors and practitioners. To achieve this, user testing of web platforms is an important procedure in the design of nascent user interfaces to assess usability, acceptance, and intention-to-use (Gould & Lewis, 1985). Prior studies have evaluated nascent web platforms using eye tracking metrics, system usability scale (SUS), verbal feedback, and technology acceptance model (TAM) questionnaire (Idrees et al., 2023; Johansson-Pajala et al., 2023; Salloum et al., 2019). Therefore, this paper describes the development and usability evaluation of a collaborative network for connecting instructors and practitioners for future workforce development.

This paper demonstrates an innovative application of information technology in fostering dynamic connections between instructors and practitioners to enhance student learning. The efficacy of design principles in the development of information systems that meet end-user requirements was also underscored. This study also contributes to connectivism learning theory by connecting industry and academia via a web platform for the development of students' disciplined perceptions and professional identity. This could serve as a benchmark for the design of similar platforms in other domains. The other sections of this paper are organized as follows: a literature review section on the need to connect industry and academia, existing efforts to connect industry and academia, user evaluation of web platforms, and theoretical underpinning. The methodology section describes the overview of the web platform, the design and development process, and user evaluation. The result section presents the outcomes of the web platform evaluation by potential end-users.

Literature review

The need to connect industry and academia

Industry and academia are two discrete entities with differing interests (Bozoglu, 2016; Niedergassel & Leker, 2011). For instance, industry is said to focus on the application of knowledge while academia focuses on teaching and research (Kaymaz & Eryiğit, 2011; Niedergassel & Leker, 2011). Also, the industry is known to prioritize exposing students to real-life challenges, but academia prioritizes students' technical, theoretical, and conceptual knowledge to prepare students to be professionals (Chandrasekaran et al., 2015). Though different, the two communities are two sides of a coin with complementary roles in developing the future professional workforce (Afonso et al., 2012; I. A. Rizvi & Aggarwal, 2005). Collaborative efforts between industry and academia are required to enhance students' analytical thinking to connect theory and practice as well as aid their transition to the workplace (Snell & Snell-Siddle, 2017). Practitioners can provide instructors with suggestions for new topics in their course offerings, help identify industry problems that need to be addressed, and provide feedback on how effective academic pedagogical efforts are in preparing students for the industry (Irizarry & Adams, 2006). Industry-academia collaborations also provide diverse opportunities for students to explore the practical aspects of their theoretical knowledge (Chandrasekaran et al., 2015; Lu & Jacobs, 2022). These collaborations offer students exposure to their communities of practice (CoP), current industry trends, and professional networks (Chandrasekaran et al., 2015; Lu & Jacobs, 2022). From their prior experience, practitioners can help students connect academic knowledge to practical relevance in the workplace. As practitioners share their experiences on how they acquire and apply their expertise, students could garner insights regarding career options and skills required in the industry. Students could also learn how success in the industry is dependent on soft skills such as communication and networking (Abudayyeh et al., 2000). The involvement of practitioners is crucial to preparing graduates who meet industry requirements by exposing them to the rigor and realism of the workplace (Bozoglu, 2016; Sharma & Sriraman, 2012). This facilitates experiential learning (Eiris Pereira & Gheisari, 2019), the development of professional identity (Cruess et al., 2015), and disciplined perception (Carbone et al., 2020) which are crucial for success in the industry. Innovative techniques to foster collaborations between instructors and practitioners are required to explore these benefits.

Existing efforts to connect industry and academia

Frameworks such as on-campus recruitment, technology transfer offices, and industrial liaison offices (Abudayyeh et al., 2000; Bruneel et al., 2010) serve as interfaces between industry and academia. However, the primary focus in these arrangements is not students' development or preparation for the industry. In addition, many students' interactions with industry are not guided by instructors (e.g., internships and co-ops), whereas previous studies (Anderson & Mourgues, 2014; Lu & Jacobs, 2022) have argued that student's interactions with industry under the guidance of instructors help to uphold the curriculum design for maximal benefit of students. Therefore, there is a need to foster industry-academia interactions between instructors and practitioners where students' development is the primary focus. To achieve this, studies (Iyer, 2014; I. A. Rizvi & Aggarwal, 2005) have advocated for an industry-academia interface for future workforce development. This interface has been defined as "an interactive and collaborative arrangement between academic institutions and business corporations for the achievement of certain mutually inclusive goals and objectives." Therefore, over the years, instructors have engaged practitioners through site visits, guest lectures (Abudayyeh et al., 2000), seminars, workshops (Blix Germundsson, 2020), laboratory sessions, and capstone projects (Edward Back & Sanders, 1998) for student development. These arrangements help to facilitate the direct contribution of practitioners in instructors' course offerings. Hence, instructors and practitioners are required to work as a team for maximum benefit to students (Anderson & Mourgues, 2014). However, these efforts are being hampered by poor coordination and limited access to practitioners who are willing to provide support (Chandrasekaran et al., 2015; Lu & Jacobs, 2022). Given the affordances of the Internet for effective networking and connection of individuals and communities (Vlachopoulos & Makri, 2019; Wellman, 2004), a web-based platform is proposed to address these shortcomings by improving instructors' access to practitioners. To explore this, user evaluation of a web platform is crucial to ensure its suitability and users' acceptance (Hartson & Pyla, 2012). This could help to improve a blend of theoretical knowledge and practical applications among construction engineering graduates.

User evaluation of web platforms

In addition to adherence to design principles, user evaluation of web platforms is a common practice. This is because the success of new information systems is highly dependent on users' acceptance (Davis, 1993). Therefore, it is crucial to assess end-user perception in terms of acceptance, satisfaction, and intention to use. The Technology Acceptance Model (TAM) by Davis (1985) is a common method to assess users' perceptions of new information systems. The model could explain about a 40% variance in usage intention (King & He, 2006). TAM explains the acceptance and rejection of new technologies by users as well as how the technology affects users' behavior (Revythi & Tselios, 2019). The fundamental constructs of TAM are perceived usefulness (PU) and perceived ease of use (PEOU) of a system being evaluated, attitude toward usage (ATT), and behavioral intention-to-use (BIU). The proponent of TAM defined PU as "the degree to which an individual believes that using a particular system would enhance his or her job performance" and PEOU as "the degree to which an individual believes that using a particular system would be free of physical and mental effort." The model has been used in diverse contexts to aid the understanding of human acceptance of technology. For example, patients' acceptance of telemedicine services (Kamal et al., 2020), students' acceptance of e-learning (Salloum et al., 2019), acceptance of mobile library applications (Rafique et al., 2020), acceptance of virtual reality (Sagnier et al., 2020), and adoption of fintech services (Hu et al., 2019). Due to its wide applications, various variants and extensions of TAM have been developed with the addition of new constructs (e.g., TAM 2 and TAM 3). Also, the system usability scale (SUS) by Brooke (1996) has been shown as an invaluable tool for the evaluation of web platforms. SUS is a commonly used, standardized method for evaluating perceived usability (Lewis, 2018). SUS is regarded as a measure of effectiveness, efficiency, satisfaction (Vlachogianni & Tselios, 2022), acceptance (Sihombing et al., 2020), and learnability (Lewis, 2018). SUS has ten (10) statements (5 positive and 5 negative statements) that are usually rated on a 5-point Likert scale (where 1=Strongly disagree, and 5=Strongly agree). SUS scores range from 0–100 and any system with a score between 70–100 is considered acceptable (Bangor et al., 2009). Because SUS is free, easy to use, and has adequate psychometric properties, it has been widely used in the evaluation of diverse web platforms (Pal & Vanijja, 2020). For example, e-health platforms (Idrees et al., 2023), mobile applications (Kaya et al., 2019), and several educational technology systems (Vlachogianni & Tselios, 2022).

To complement subjective measures as advocated by Bangor et al. (2009), eye-tracking metrics are objective measures to assess users' visual behavior in human-computer interaction (Joseph & Murugesh, 2020). Eye tracking measures are easy to use and noninvasive. Eye tracking has been noted to be a means to understand users cognitive load (Joseph & Murugesh, 2020), acceptance (Fu et al., 2022), as well as intention-to-use (Gelderblom et al., 2019). Eye tracking metrics are either fixation or saccades. Fixations represent static eye movement when focusing on a stimulus while saccades are continuous eye movements (Deng & Gu, 2021). These help to understand the pattern of users' interaction with interfaces, areas being given attention as well as those ignored (Gelderblom et al., 2019). Fixation metrics such as fixation count, fixation duration, and time to first fixate are the most used eye-tracking metrics (Joseph & Murugesh, 2020; Vasseur et al., 2019). These metrics can be represented pictorially using heat map and gaze plot (Fu et al., 2022; Wang et al., 2014). Fixations metrics help to understand the areas of the interface that users are focusing on, degree of focus as well as attention. Longer fixations on web platforms could be interpreted as confusion (Wang et al., 2014). However, in other contexts, it could represent attention or interest (Bojko, 2006). These metrics have been used to understand behavioral intention during online shopping (Deng & Gu, 2021), public acceptance of technology (Fu et al., 2022), and usability of e-health platforms (Idrees et al., 2023). Bojko (2006) opined that although eye-tracking metrics could provide insights into users' perception of interfaces, it could be limited hence the need to supplement the metrics with other measures for robust insights. In addition to obtaining quantitative measures of users' perception, prior studies have utilized qualitative measures such as post-task interviews to capture verbal feedback of users as well as suggested modifications (Idrees et al., 2023; Oyekunle et al., 2020). Studies have also advocated for supplementing SUS and eye tracking with other measures (Bangor et al., 2009; Bojko, 2006). Hence, verbal feedback through semi-structured interviews could be explored. Verbal feedback could help uncover underlying reasons behind users' subjective ratings of questionnaires as well as suggested modifications for iterative design (Gelderblom et al., 2019).

Theoretical underpinning

Connectivism Learning Theory (CLT) is one of the network learning theories that combines both social and technological dimensions of learning (Downes, 2005; Goldie, 2016; Siemens, 2005). CLT as propounded by Downes (2005) and Siemens (2005) has three components: Links, Nodes, and Network. In CLT, a node is an entity that can be connected to another. This could be a webpage, a person, or a book (Siemens, 2005). Link represents connections between various nodes. The foundation of CLT is the idea that learning occurs when connections are made between different nodes of information. Hence, students can learn better when academia is connected with industry. Networks represent two or more nodes that are connected to share resources (Goldie, 2016). According to Downes (2008), for a network to be successful, it should be characterized by diversity of opinion, connection of nodes, openness, and participants' independence. Hence, the proposed web platform is a collaborative network of instructors and practitioners. On the proposed web platform, instructors (and consequently students) are connected with practitioners to share resources and knowledge to enhance students' development. CLT viewed knowledge as distributed among networks of connections that emanate from experience and interactions between people, organizations, and communities (Goldie, 2016). In CLT, learning begins when learners connect to and participate in a learning community which exposes them to more knowledgeable members of the community (Goldie, 2016; Siemens, 2005). Therefore, learners are connected to resources provided by more knowledgeable members of the learning community (Downes, 2005). In the same vein, the proposed web platform seeks to improve students' exposure to their CoP by connecting instructors with practitioners. This exposure is to enable learners to learn from diverse members of their CoP for adequate preparedness for the workplace.

Although a single theory to describe learning in technologically enabled networks is unlikely to exist and CLT has been majorly applied in massive open online courses (MOOC) (Goldie, 2016), the vast perspective of CLT which is seen in its diverse principles enables its potential relevance in myriads scenarios. For example, these principles according to Siemens (2005) include "learning and knowledge rest in diversity of opinion," "learning is a process of connecting specialized nodes or information sources," "accurate, up-to-date knowledge (currency) is the aim of all connectivism learning activities" and "nurturing and maintaining connections are needed for continual learning." In addition, Kop and Hill (2008) argued that the proponents of CLT never suggest that CLT is constrained to an online environment (i.e., MOOC), rather online environments are applications that are vital to the development of CLT, and that the theory encapsulates broader learning environments. The authors further argued that a network is not only a digitally enabled artifact but according to the proponents of CLT, it refers to the connection between "internal and external physical environments" to facilitate learning. Therefore, CLT could underpin several technology-enabled learning in diverse scenarios such as the proposed web platform to connect instructors and practitioners for future workforce development. This study laid out the design and development of the web platform.

Leveraging the potential of information technologies, a web-based platform is proposed to achieve the desired connection and industry-academia interface for students' adequate preparedness for the workplace. Therefore, the nature of the proposed solution, that is, being a new information system, necessitates usability evaluation to determine end-users perception, acceptance as well and intention to use. As suggested by human factors principles in user interface design by Gould and Lewis (1985), actual behavioral assessment of how easy to learn, easy to use, and how useful a system is should be carried out in the early stage of the design process. Gould and Lewis (1985) advocated for user testing rather than system testing to assess how users can easily learn and use a new system. The authors opined that usability tests should be carried out where potential actual end-users are given real-scenario tasks to carry out and their perceptions and responses should be recorded and analyzed. Therefore, the Technology Acceptance Model (TAM) by Davis (1985) developed to empirically assess new end-user information systems is suitable to underpin the usability evaluation of the web-based platform in this study. The model showed that system design features and characteristics influence perceived ease of use and perceived usefulness, which culminate in actual usage. The TAM has been widely used for understanding users' acceptance and adoption behavior when it comes to new technologies and information systems (Marangunić & Granić, 2015). Therefore, this study also seeks to uncover end users' acceptance, satisfaction, and behavioral intention toward the proposed web platform.

Methodology

Overview

To improve the participation of construction communities of practice (CoP) in construction engineering education, there is a need to enhance communication, coordination, and collaboration between industry practitioners and construction engineering instructors. Therefore, a web-based collaborative network called "ConPEC" is proposed to achieve this. The name "ConPEC" was coined from "connecting professional and educational communities." This study adopts a methodical approach that involves a review of existing literature (section 2), design (section 3.2), and user evaluation (section 3.3) of a web platform to connect instructors and practitioners. An overview of the process adopted is shown in Figure 1 and explained in the subsequent sections.

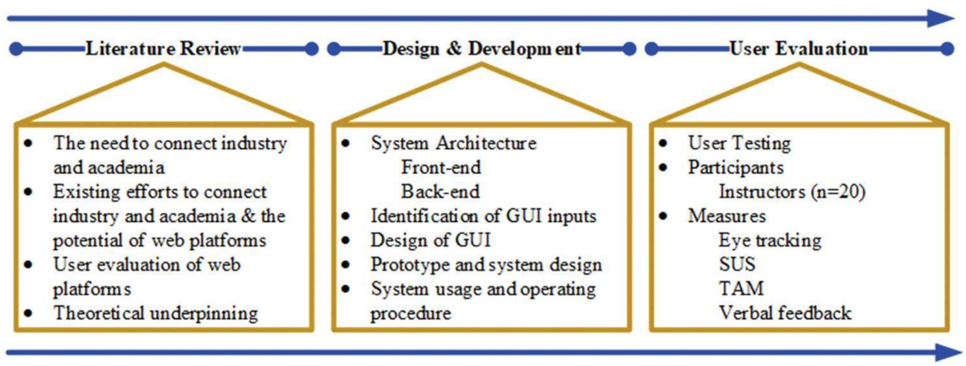

Figure 1. Overview of the process adopted.

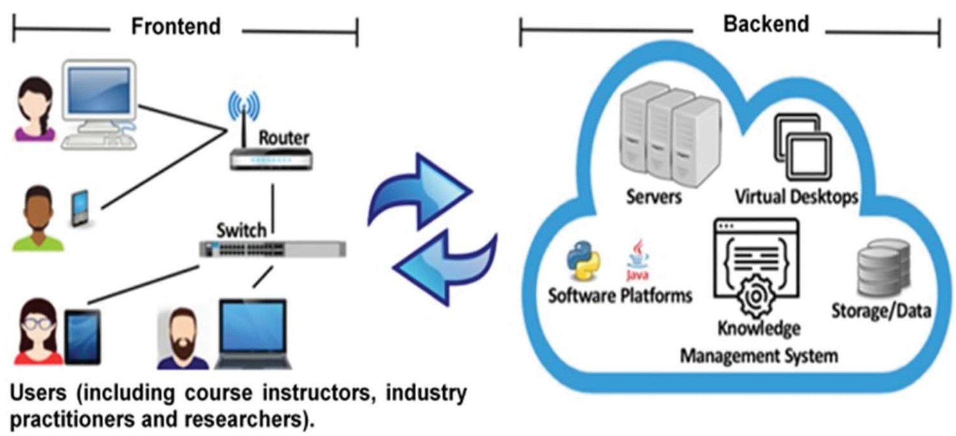

Figure 2. Overview of the proposed system.

Design and development of the web platform

This section outlines the sequence of the design process adopted in the development of ConPEC. The overview, components, system architecture as well as the system operating procedure are presented. ConPEC consists of the following modules, namely: front-end and back-end modules. The components and interaction between these modules are shown in Figure 2 and described in subsequent sections.

System architecture

The system architecture of ConPEC is shown in Figure 3. The system architecture consists of the client (i.e., front-end), the server, and databases (i.e., back-end) as well as the interaction between them. A client is a device, application, or software component that initiates requests to a server to obtain specific services, resources, or data. Clients are typically end-user devices such as personal computers, smartphones, or tablets. These devices have web browsers that send requests to web servers to retrieve web pages, images, videos, or other resources. A server is a system that responds to client requests by providing services, resources, or data. Servers are designed to be always active and accessible to clients,

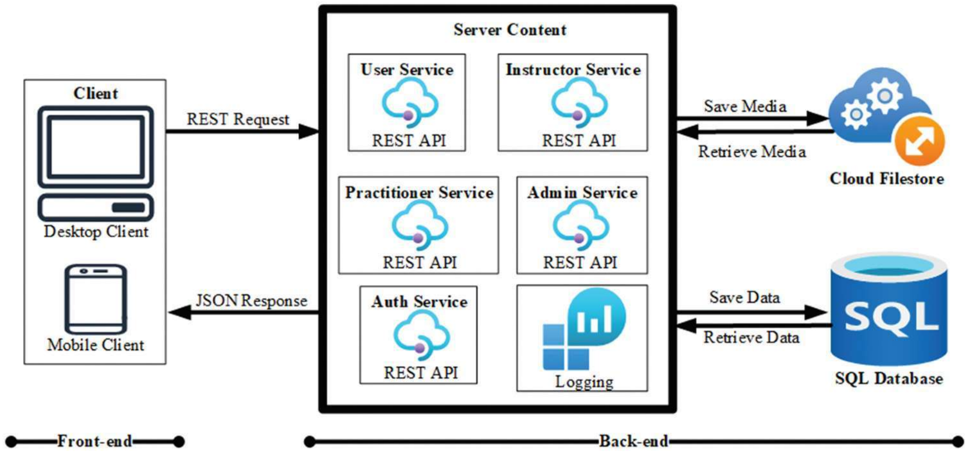

Figure 3. System architecture.

handling multiple requests simultaneously. They are responsible for processing requests from clients, performing computations, storing, and retrieving data, and sending back responses. The server hosts web applications and various services. The server also retrieves the requested web pages and resources from the database or Cloud Filestore and sends them back to the client for display. The server consists of diverse services for practitioners, instructors, users, admin, authentication as well as logging. Each service contains corresponding functions. For example, instructors' services contain functionalities that are related to instructors' roles in the proposed system. MariaDB, an open-source relational database management system that uses Structured Query Language (SQL) was adopted to manage and provide access to relational databases using SQL as the query language. MariaDB was chosen for managing the web application data. Cloud Filestore is used to save user-uploaded media content like pictures, videos, and documents. The same server is being used to manage the media content and the database. The process involved in the design and development of the front end as well as the composition of the backend is explained in the subsequent sections.

Front-end module

The inputs for the graphical user interface (GUI) of the proposed system were first determined and thereafter, the GUI was designed. The process followed is explained in the section below.

Step 1: Determination of Inputs for Graphical User Interface (GUI): User-centered design principles (Hartson & Pyla, 2012), as well as human factors principle in interface design (Gould & Lewis, 1985; Grimes et al., 1986) guided the process to determine inputs for GUI of ConPEC. To ensure adequate usability of a system, the principles advocated for early involvement of end-users, user testing, and iterative design. Therefore, the inputs for GUI of ConPEC were systematically determined via usage research (i.e., inquiry about and from potential end-users) which included data elicitation from end-users as well as data analysis. The usage research includes a literature review, survey, and focus group. Usage research helps to secure users' inputs, understand users' expectations as well as ensure their participation in the design process (Hartson & Pyla, 2012). After an in-depth review of existing literature, the outcome informed the development of a survey with well-structured closed-ended questions. The survey was administered to instructors in construction-related academic programs in the United States. The respondents were asked to rank on a scale of 1 to 5, different parameters they would consider while seeking practitioners to support their classroom instructions. A total of 301 respondents participated in the survey. The data from the survey was analyzed using the Mean Normalization Index (MNI) to identify the critical parameters. Parameters with MNI ≥ 0.5 were considered critical (Yusuf et al., 2024). Hence, these parameters constitute the GUI inputs that were incorporated in the design of the ConPEC user interface. The results of the survey were further validated with a focus group of six (6) instructors. The process and method adopted aligned with prior studies (Gould & Lewis, 1985; Hartson & Pyla, 2012) to ensure user-centered design and to understand end-users of proposed systems so that the design needs and GUI inputs can be determined. The GUI inputs identified from the survey and focus group (including other basic information such as the name and title of the practitioner as well as the name of the organization) are presented in Table 1. The GUI inputs represent the information that instructors would need to know and consider when selecting a suitable and/or preferred practitioner that could meet their course-support needs. Course-support needs of instructors are ways instructors want practitioners to contribute to their course offerings (Yusuf et al., 2024). These include practitioners serving as guest lecturers, facilitators of site visits, seminars, workshops, and laboratory sessions as well as mentors, sponsors, and judges for capstone or term projects. The usage research helps to ensure the early involvement of end-users in the design process through the identification of the GUI inputs. The design of the GUI and operating procedure of the web platform is explained in the next section.

Step 2: Design of GUI and Operating Procedure: To further ensure optimum usability, the ten (10) usability heuristics by Nielsen (1994) were adopted for the design of GUI on ConPEC. These usability heuristics are adjudged as rules of thumb that are widely used in enhancing the design of user interfaces (Gonzalez-Holland et al., 2017). These heuristics include correlation of design with the real world, adherence to standards, consistency in design, optimum control to users, recognition rather than recall, prompt feedback, use of users' domain language, as well as minimalist design. These heuristics help to adhere to Jakob's law of internet user experience (Nielsen, 2000a). The law explains that users spend most of their time on other web platforms and they already have predefined expectations

Table 1. Graphic User Interface (GUI) inputs

S/N	GUI Inputs
1	Name of practitioner
2	Title of practitioner
3	Position/role of practitioner
4	Area of specialization
5	Years of experience
6	Level of education
7	Name of organization
8	Location of Organization
9	Size of organization
10	Gender diversity of organization
11	Ethnic diversity of organization
12	Website of organization
13	Organization policies/support/resources for future workforce development

(i.e., mental model) of how a particular type of web platform should work. Hence, users prefer a web platform to work like other similar web platforms they already know. Failure to adhere to how other similar platforms work could be repulsive to users because it would increase their cognitive load by forcing them to adopt a new mental model to use the web platform. Given this, the design of the GUI of ConPEC as well as the operating procedure were guided by usability heuristics and Jakob's law to ensure that the design aligns with users' existing mental model.

Step 3: Prototype and System Design: Wireframes and mock-ups with several iterations were initially designed to serve as prototypes of the ConPEC interface. The interface and usage workflow were designed to be similar to other platforms (in terms of layout and navigation) that potential users are familiar with. This is to ensure that the look and feel as well as the operational procedure of the platform align with users' mental model which could enhance the ease of use of the platform as well as users' acceptance by reducing the learning curve. In the actual system design, the client (i.e., frontend) comprises the graphical user interface, which was designed using hypertext markup language (HTML), Cascading Style Sheets (CSS), and Vue framework. This makes the system lightweight with a short loading time to ensure that updates in HTML are synchronized with changes in JavaScript.

Back-end module

JavaScript programming language was used in the development of ConPEC. This is due to its speed, ease of use, rich interface, interoperability, and wide usage. Due to the structured nature of the data on the platform, Maria DB which is a relational database with advances over MySQL was chosen as the database management system. Node.js was used as a server because of its asynchronous nature and scalability. Node.js has the same language as front-end and back-end which makes applications easy to comprehend. It is quite more performant with less memory requirement than other languages such as Java. The client sends requests to the server using representational state transfer (REST) services which is an application programming interface (API) and responses from the server come in JavaScript Object Notation (JSON) format. Because of its flexibility, effectiveness, efficiency, allowance for caching, and lightweight nature, the REST web service was chosen in place of the Simple Object Access Protocol (SOAP).

System usage procedure/workflow of ConPEC

To use the web platform as a new user, instructors need to create an account by specifying their name, title, and e-mail, create a new password, and confirm the password. Keeping with Jakob's law, the process is typical of other web-based platforms that users are familiar with. Thereafter, users would be required to verify their e-mail addresses before their first login. After signing in for the first time, users will be required to complete their profile. Thereafter, they would be able to access other parts of the platform. For example, an instructor can request course support, and receive recommendations of some practitioners who can meet the request. Instructors can look at the details of each practitioner recommended to them and select the most preferred or most suitable. The procedure is shown in Figure 4. There are three (3) critical tasks to be performed by instructors during usage of the web platform. These include inputting course-support request details (e.g., class size, student academic program, student academic level, date, and time the course support is

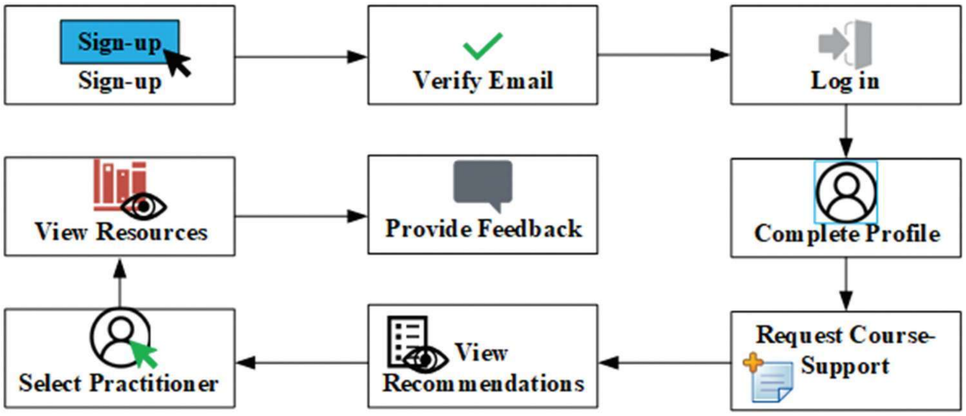

Figure 4. Usage procedure/workflow of the platform for instructors' interface.

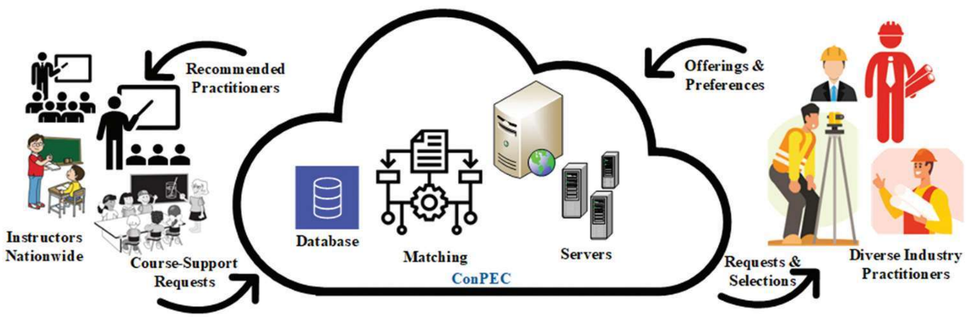

Figure 5. Overview of how ConPEC works.

needed), defining preferences regarding practitioners (i.e., the area of expertise, years of experience, gender, ethnicity, and age range of practitioners that instructors prefer) as well as viewing and selecting a practitioner from the recommendations.

Figure 5 gives an overview of how ConPEC operates. As shown on the left-hand side of Figure 5, instructors in construction education programs can post requests for course support on the platform. Practitioners on the other hand can indicate their preferences and offerings to meet instructors' requests by indicating their expertise, availability, and areas they are willing to provide input. Based on these inputs, ConPEC would match an instructor with a suitable practitioner who is both willing and able to provide the course support requested. The matching is done using the following parameters (i.e., instructors' requests and practitioners' offerings): type of course support, area of expertise, years of experience, level of education, gender, and ethnicity. Hence, instructors receive recommendations from the system showing practitioners who could meet their requests. As shown in Figure 4, an instructor can select out of the recommended practitioners, and selected practitioners would receive details of instructors' requests, hence both parties get connected to collaborate for student development. The system allows instructors to connect with practitioners to facilitate site visits, guest lectures, seminars, workshops, and laboratory sessions, as well as serve as mentors, sponsors, and judges for capstone or term/classroom projects.

Application scenario description.

The ConPEC platform is meant to serve instructors in construction-related academic programs in different higher educational institutions (HEIs) across the United States. These academic programs include building construction, construction science, construction engineering, and management. The web platform will be available to instructors from different HEIs and practitioners at no cost. ConPEC would connect individual instructors and practitioners who are registered on the web platform. The industry practitioners registered on the platform do not serve a particular HEI but are available to all instructors who request their expertise in providing course support needs. The web platform is not a teaching platform. Here is an example of a usage scenario: Prof. ABC in the construction management department at XYZ University wants to invite a guest speaker to speak with his students on the applications of laser scanning in the construction industry. Prof. ABC would have to sign up on the web platform and submit a request for a guest lecture. In the process of submitting the request, Prof. ABC would provide information about the topic, expectations from the guest speaker, date, venue, and time(s) of the event. Whether the guest lecture would be in-person or virtual would also be stated. Information about students' programs of study, academic level, prior knowledge, and learning outcomes will be provided. The Prof. would also specify other parameters such as the gender, years of experience, and areas of expertise of the guest lecturer that he prefers (if any). Based on these inputs, the platform will recommend from the pool of practitioners on the web platform those that could meet the request of Prof. ABC. Prof. ABC could check the details of each recommended practitioner by looking at their profiles and deciding on a preferred person. After a selection is made, the selected practitioner will be notified via e-mail to respond on ConPEC to the request. If the practitioner accepts the request, Prof. ABC and the practitioner will be connected. If the guest lecture is in person, the practitioner will visit XYZ University for the event. If it is a virtual session, Prof. ABC and the practitioner would arrange to use teleconferencing platforms such as Google Meet, Zoom, or Microsoft Teams for the guest lecture session. If the selected practitioner declines Prof. ABC's request, the professor will select another practitioner from the recommendations on the ConPEC platform.

User evaluation of ConPEC

Overview of evaluation methodology

For the eye tracking metrics, the components of the platform chosen as areas of interest (AOIs) were the specific GUI inputs that were identified in usage research through survey and focus group (see Table 1). AOIs represent the specific parts of the web platform interface that are of interest to the objective of the study (Zou & Ergan, 2019). This corresponds to the critical tasks where participants viewed details of a recommended practitioner and made a selection. The AOIs represent the information that instructors would need to know and consider when selecting a suitable and/or preferred practitioner that could meet their course support needs. In addition to eye tracking, SUS, and verbal feedback, only the fundamental constructs of TAM (i.e., PU, PEOU, ATT, and BIU) were adopted in this study, similar to prior studies (Teo et al., 2009; Shroff et al., 2011; Pal & Vanijja, 2020). This is because the web platform is nascent, and all participants had their first exposure to it during the study. Also, the evaluation of ConPEC seeks

Table 2. Participants demographics

Category	Frequency	Percentage
Gender		
Male	9	45
Female	11	55
Program		
BC	6	30
CEM	6	30
CEE	4	20
ARC	4	20
Job Title		
Professor	2	10
Associate Professor	7	35
Assistant Professor	6	30
Professor of Practice	4	30
Others	1	5
Years of Experience		
1–5 years	7	35
6–10 years	6	30
11–15 years	0	0
15+ years	7	35

to investigate whether potential end users will use the system, uncover what would influence users to use ConPEC and the extent to which end users would accept ConPEC. The sections below describe the details of the methods adopted to achieve these objectives.

Participants

Keeping with the suggestion by Gould and Lewis (1985), actual end-users of ConPEC were recruited for the usability evaluation. Twenty (20) participants took part in this study. Similar sample sizes have been used in prior studies (Cowen et al., 2002; Zardari et al., 2021). Also, Nielsen (2000b) showed that a sample size of fifteen (15) participants is suitable for usability evaluation. The participants (see Table 2) were instructors (faculty members) of different gender identities, years of experience, and from different construction-related academic programs (i.e., building construction (BC), civil and environmental engineering (CEE), construction engineering and management (CEM), as well as architecture (ARC)).

Experimental procedure and data collection

All the participants were introduced to the study and the experimental workflow. How ConPEC operates was shown and explained to the participants. Thereafter, each participant signed the informed consent form. Eye calibration of the participants was done, and they interacted with the web platform. The eye-tracking device used in this study is a screen-based type called Tobii Pro Nano which can be connected directly to a computer via a USB port. The device has a sampling frequency of 60 Hz and allows for flexibility regarding head movements and lighting conditions. The GUI inputs identified in section 3.2.2 and presented in Table 1 represent the AOIs for eye tracking. The participants were initially introduced to the web-based platform to understand the usage procedure/workflow as described in section 3.2.4. Following the procedure, the experiment involves a real-task scenario of the platform usage as suggested by Gould and Lewis (1985). All the participants interacted with the web platform on a computer with a screen resolution of 1920 pixels by 1080 pixels. The gaze sample of the participants was at least 75% similar to Chen et al. (2019). After the participants completed the session, their feedback and perceptions were

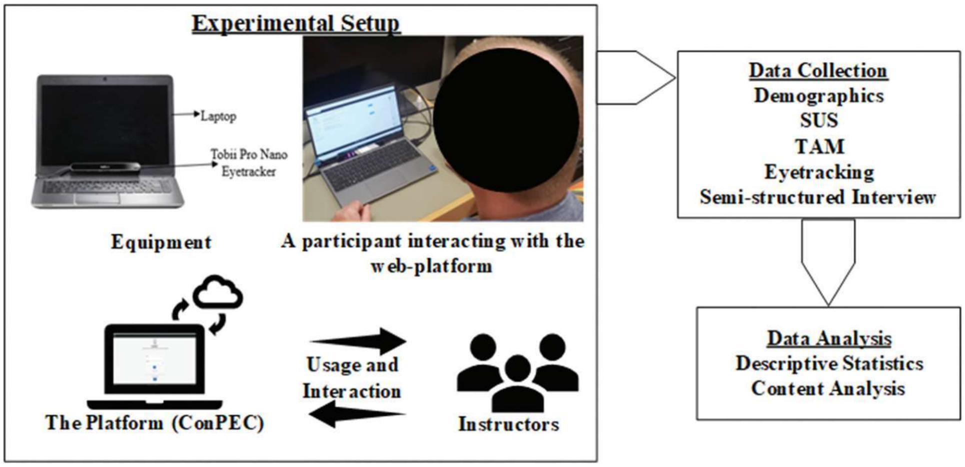

Figure 6. Overview of evaluation methodology.

captured with SUS and TAM questionnaires and semi-structured interviews. The questionnaires were rated on a scale of 1 to 5 (1- strongly disagree, 5- strongly agree). A demographic questionnaire was used to collect the participants' demographics. The experiment sessions with the participants were conducted under similar conditions with an average duration of 1 hour and 25 minutes per participant. An overview of the methodology adopted is shown in Figure 6. Analysis of the data collected is described in the following section.

Data analysis

Eye tracking: Eye tracking was used to assess whether the participants focused on the GUI inputs identified in the usage research. The participants' visual perception of the ConPEC interface and gaze behavior were explored using a heat map and gaze plot. Eye tracking metrics (i.e., fixation duration, fixation count, and time to first fixate) for the AOIs on the web page where participants viewed details of practitioners and made a decision were pictorially plotted into heat map and gaze plot using the Tobii Pro Lab software. This helped to refine the functionality and usability of the web platform by highlighting the GUI inputs that instructors wanted and what was designed.

SUS and TAM questionnaire: The data elicited via questionnaires were analyzed using descriptive statistics. Cronbach Alpha values of 0.81, 0.81, 0.86, 0.83, and 0.85 for SUS, PEOU, PU, ATT, and BIU constructs respectively underscored the internal consistency of the data collection instrument (Taber, 2018). Mean scores of participants' ratings of the statements in the questionnaires were calculated. Using Spearman's correlation, correlation analyses between intention-to-use and other constructs such as PEOU, PU, ATT, and positive statements in SUS were employed to investigate participants' behavioral intention-to-use ConPEC. A similar approach has been adopted by prior studies (Alharbi & Drew, 2014; Mohamed et al., 2011). The sample size is adjudged adequate for correlation analysis because according to (Bujang & Baharum, 2016), a sample size of 19 can detect a correlation coefficient of 0.60. The SUS scores for each participant were calculated, and the SUS scores were averaged to derive the overall SUS score. The analysis was done using Microsoft Excel (v.2403) and Statistical Package for the Social Sciences (v.20).

Semi-structured interview: The verbal feedback of the participants was captured through a semi-structured interview session after interacting with the platform. The participants were asked questions regarding possible modifications to be made to the interface of each page of ConPEC and workflow. They were also asked how they think ConPEC would help meet their course-support needs, the type of course support they would like to use ConPEC for in the future, concerns they have about using ConPEC, and what would make them continue to use ConPEC. Depending on responses to these questions, participants were further probed for better clarifications. The session was audio recorded. The recordings were transcribed, de-identified, and coded. Similar codes were grouped into themes. The analysis was done using Dedoose, a software for qualitative analysis. An inter-rater reliability test was conducted by two researchers to ensure the reliability of the codes. About 97.74% agreement was achieved between the two coders and the Cohen-kappa coefficient was 0.43 which indicates moderate agreement.

Results

The results of the usability evaluation are presented in this section. The first section presented some interface components of the platform, and the other parts of the section presented the results of the user evaluation by instructors.

Presentation of ConPEC interface

A few screenshots of the web platform interface are shown in Figures 7–10. In Figure 7, part "a" reveals the user registration page, part "b" shows the login page, and part "c" represents the feedback page where users can submit comments to the web platform administrator.

Figure 8 shows a sample home page of an instructor after signing in. The home page shows the navigational tabs and course-support requests submitted by the instructor. Clicking on "View Recommendation" as shown in Figure 8 would lead to Figure 9 which is the recommendation page where instructors view different practitioners that the platform recommends to them. If an instructor clicks on "View Details" as shown in Figure 9, this will lead to Figure 10 showing the AOIs that instructors need to consider before selecting a practitioner to meet their course-support needs. Figure 10 contains the GUI inputs identified from the survey and focus group revealing the information that instructors desire to know about a practitioner in deciding to connect with the practitioner to provide a course-support.

Usability evaluation results

Heat map

The heat map provides a pictorial representation of the degree of visual attention that is given to each constituent of the webpage. The heat map (Figure 11) is plotted based on absolute fixation count during a critical task which was when participants viewed the detail of a recommended practitioner before selection. The red portion indicates areas with the highest number of fixations. This is followed by yellow and

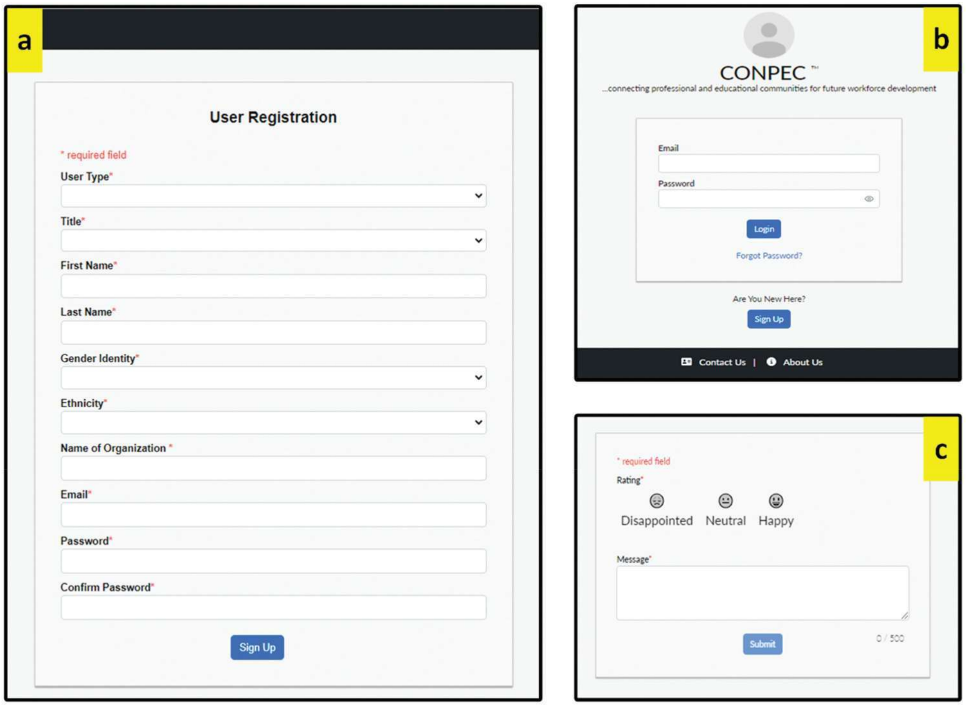

Figure 7. Screenshots of ConPEC interface. (a) User registration page, (b) Login page, and (c) Feedback page.

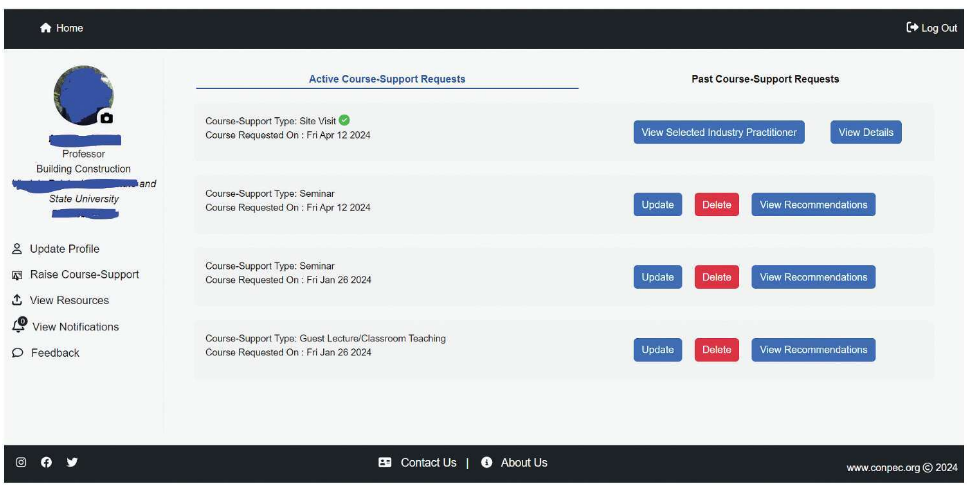

Figure 8. Screenshot of ConPEC interface (Home page).

green respectively. Areas of the webpage with no fixation have no color. As shown by the red portions of the heat map, Figure 11 reveals that only the area of the webpage containing the AOIs has a high number of fixations compared to other

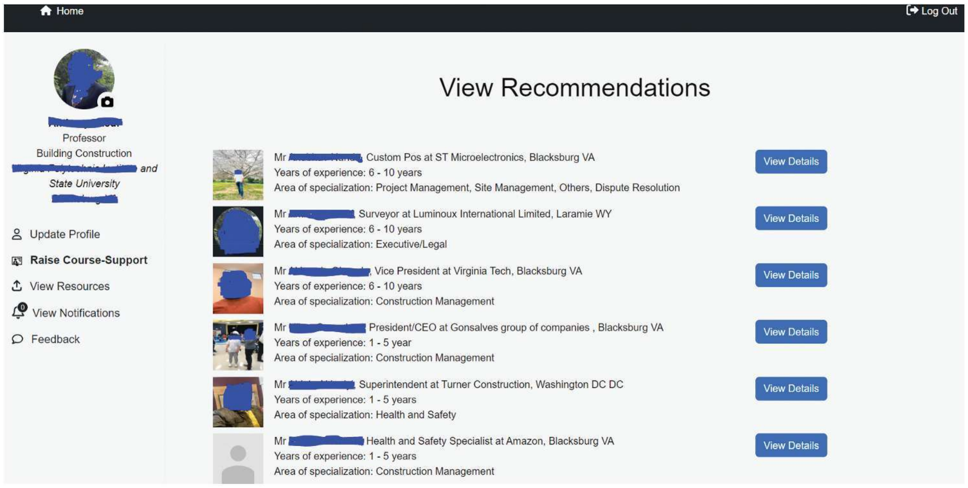

Figure 9. Screenshot of ConPEC interface (Recommendation page).

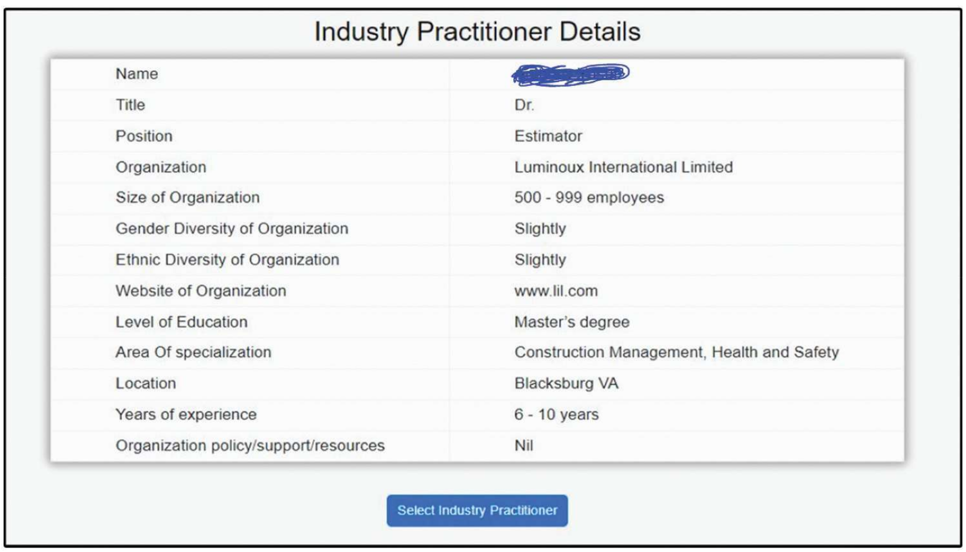

Figure 10. Industry practitioner details showing the AOIs.

parts of the webpage. This showed that participants' visual attention was on the AOIs.

Gaze plot

Gaze plot also provides a graphical representation of the amount of visual attention allocated to different components of the web page. The gaze plot shown in Figure 12 is based on fixation duration during a critical task which was when participants viewed details of a recommended practitioner before selection. The positions of the bubbles represent the points on the web page where the participants fixated. The

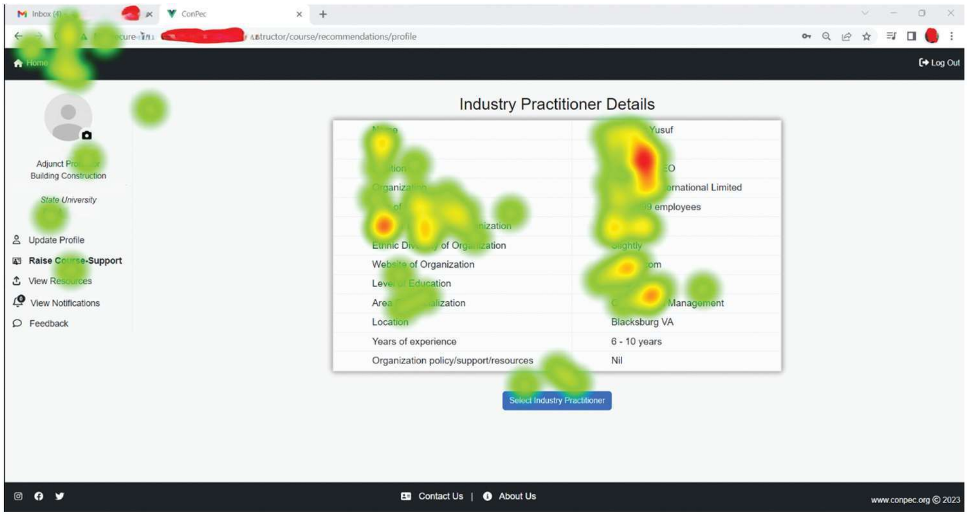

Figure 11. A sample of the heat map.

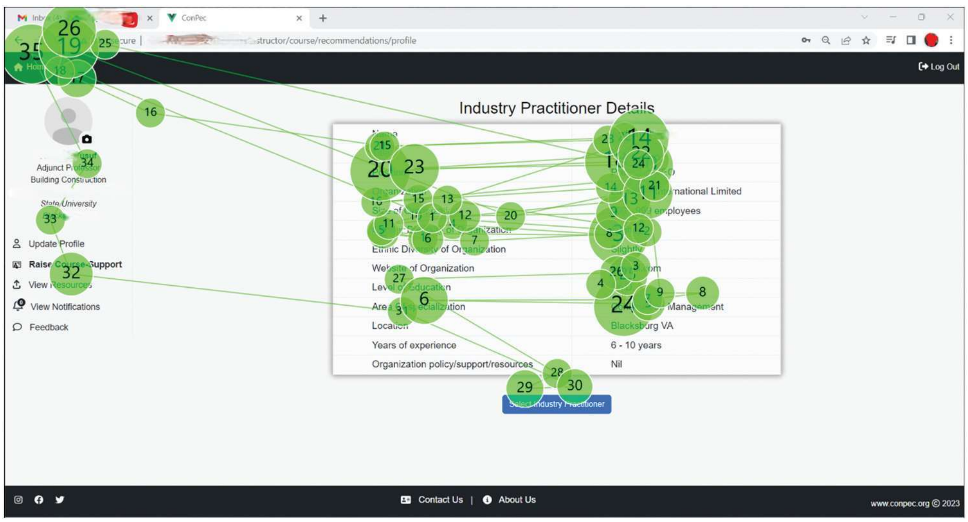

Figure 12. A sample of the gaze plot.

bigger the bubble, the longer the fixation duration of the participant on a particular point on the webpage. The number within the circles represents the order of the fixation. The lower the number in the circle the shorter the time to first fixate on the AOIs. From the numbers within the circles, the gaze plot shows that the AOIs drew the attention of the participants because the small numbers (such as 1 to 15) show that the early fixations of the participants were on the AOIs. This shows that the participants did not only have a longer fixation duration on the AOIs but also had a shorter time to first fixate on the AOIs compared to other parts of the webpage that received fixation from the participants.

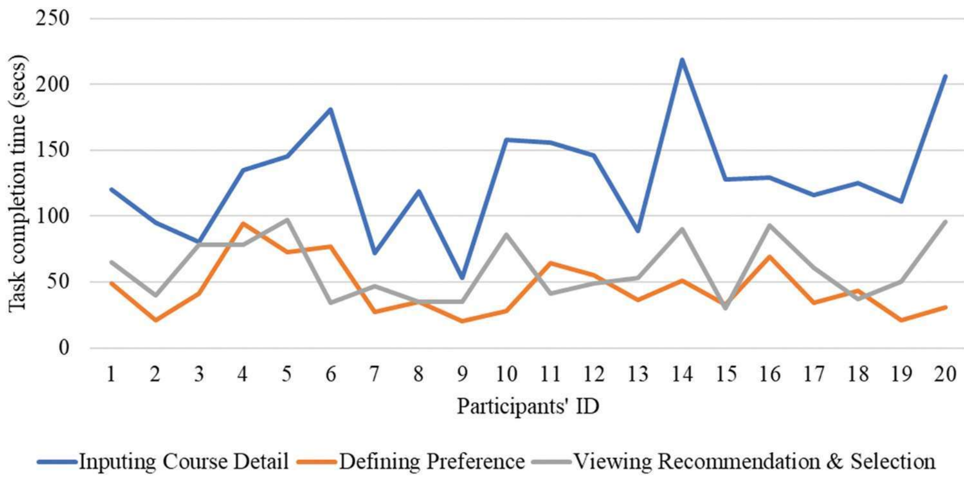

Figure 13. Task completion time of critical activities.

Task completion time

The time completion times of the critical activities that instructors perform while using the web platform are shown in Figure 13. The total average duration for the three tasks that instructors had to perform to get connected with suitable practitioners who could meet their course-support needs was about 234 seconds (less than 4 minutes). Half of the participants had the total duration for the three activities to be less than the average for the entire participants. The activity with the highest completion time for all the participants was "Inputting Course Detail." The average completion time for this critical activity was about 129 seconds. This activity took longer for all the participants than the other two critical activities. This is followed by "Viewing recommendation and making Selection" which took about 60 seconds on average for all participants. Out of the twenty (20) participants, fourteen (14) participants took a longer time to complete this activity compared to "Defining Preference" which was the activity with the shortest duration. This activity took about 45 seconds on average.

System usability scale (SUS)

All the positive statements had mean scores ≥ 3.70, which is considerably high. This indicates that the participants had a high level of agreement with the statements. The negative statements had low mean scores which were ≤ 1.35, hence the participants had low agreement with the statements (Table 3). From these ratings, the participants largely agreed to the ease of use, ease of learning to use, acceptance, and confidence in ConPEC as a tool to connect them with practitioners. The statements (except one) had standard deviations of less than one (1), which shows that the opinions of the participants regarding the statements were very similar. The mean SUS score from all participants was 89%.

Technology acceptance model (TAM)

All the statements in the TAM questionnaire for PEOU, PU, ATT, and BIU constructs had mean scores ≥ 3.80. This reveals that the participants agreed with the statements. The statement items for BIU are shown in Table 4 while those of PEOU, PU, and ATT are

Table 3. System Usability Scale

S/N	Statements	MS	SD
	Positive Statements		
1	I thought the platform was easy to use	4.80	0.410
2	I would imagine that most people would learn to use this platform very quickly	4.70	0.571
3	I felt very confident using the platform	4.55	0.605
4	I found the various functions of this platform well integrated	3.95	0.999
5	I think that I would like to use this platform frequently	3.70	1.081
	Negative Statements		
6	I thought there were too much inconsistency in this platform	1.35	0.671
7	I needed to learn a lot of things before I could get going with this platform	1.25	0.716
8	I found the platform unnecessarily complex	1.20	0.523
9	I found the platform very cumbersome to use	1.20	0.523
10	I think that I would need the support of a technical person to be able to use this platform	1.10	0.308

Table 4. Behavioral intention-to-use

Statements	Mean Score
ConPEC is worthy of being used to connect with practitioners to provide course-support	4.75
I intend to frequently use ConPEC in connecting with practitioners to provide course-support	3.80
I intend to refer to ConPEC as often as possible in connecting with practitioners to provide course support	4.10

Table 5. Correlation between behavioral intention-to-use and other constructs

	Intention-to-use	
Constructs	Correlation coefficient	*p*-value
PEOU	.664**	0.001410955
PU	.502*	0.024193006
ATT	.737**	0.000209082
SUS	0.358	0.121

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

shown in Table 5. The results of the correlation analysis between Intention-to-use and PEOU, PU, ATT, and SUS are also shown in Table 5. The results show strong positive correlations and statistically significant relationships between Intention-to-use and PEOU, PU, and ATT. However, a weak correlation was observed between the Intention-to-use and SUS construct.

To uncover what would influence end users' intention-to-use ConPEC, further correlation analyses were conducted between intention-to-use and statement items in the constructs above. Table 6 shows the results of the analysis.

As shown in Table 6, for the PEOU construct, only the statement item "I would find the platform to be flexible to interact with" had a strong positive correlation with behavioral intention-to-use and the relationship was significant at $p < .01$. For the PU construct, two statement items, namely: "Using the platform would make it easier to connect with practitioners to provide course support" and "I would find the platform useful in connecting with practitioners to provide course support" had strong positive correlations with behavioral-intention-to-use and the relationships were significant at $p < .01$. Under the ATT construct, three of the statement items had strong positive correlations with behavioral intention-to-use and the relationships were significant at $p < .01$. These statement items are: "I believe that ConPEC could help in connecting with practitioners to meet my course-support

Table 6. Correlation analysis between intention-to-use and other constructs' statement items

Constructs	Intention-to-use	
PEOU	**ρ**	***p*-value**
Learning to operate the platform would be easy for me	0.183	0.4397005
I would find it easy to get the platform to do what I want it to do.	0.163	0.4921824
My interaction with the platform would be clear and understandable.	0.201	0.3956234
I would find the platform to be flexible to interact with.	**.782****	**0.0000456**
It would be easy for me to become skillful at using the platform	0.222	0.3466315
I would find the platform easy to use	0.321	0.1679965
PU		
Using the platform in my job would enable me to quickly connect with practitioners to provide course-support.	0.366	0.1122641
Using the platform would improve my job performance.	0.419	0.0656236
Using the platform in my job would increase my productivity.	0.334	0.1504566
Using the platform would enhance the effectiveness of connecting with practitioners to provide course-support.	0.427	0.0604999
Using the platform would make it easier to connect with practitioners to provide course-support.	**.579****	**0.0074386**
I would find the platform useful in connecting with practitioners to provide course-support.	**.590****	**0.0062217**
ATT		
Using ConPEC is a good idea.	0.440	0.0521772
I feel positive toward using ConPEC	0.407	0.0753027
I believe that ConPEC could help in connecting with practitioners to meet my course-support needs.	**.647****	**0.0020416**
I favor the use of ConPEC for connecting with practitioners to meet my course-support needs.	**.631****	**0.0028752**
I think it is a good idea for instructors to use ConPEC to connect with practitioners to provide course-support needs.	**.775****	**0.0000593**
SUS		
I think that I would like to use this platform frequently	**.543***	**0.0133881**
I thought the platform was easy to use	0.143	0.5474953
I found the various functions in this platform were well integrated.	0.173	0.4656681
I would imagine that most people would learn to use this platform very quickly.	0.287	0.2203509
I felt very confident using the platform.	0.148	0.5326106

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

needs," "I favor the use of ConPEC for connecting with practitioners to meet my course-support needs," and "I think it is a good idea for instructors to use ConPEC to connect with practitioners to provide course-support needs." For SUS, the only positive statement with a strong positive correlation with behavioral intention-to-use was "I think that I would like to use this platform frequently." The relationship was significant at $p < .05$.

Verbal feedback

The participants provided qualitative feedback on their perception of ConPEC and how to enhance its usability. This includes features and/or functions to add, remove or modify. The suggested improvements were holistically considered, and this is intended to guide the design iteration of the web platform. The results are presented under five (5) sections as described below. The codes and theme summary are shown in Figure 14.

Usability: The participants commented on the usability of ConPEC in diverse ways. For example, ConPEC was considered very easy to use and easy to learn: "*. . .I thought it was all very clean and easy to understand*". In terms of usefulness, the participants were unanimous in describing ConPEC as " *... a product that would be very helpful and needed.*" The participants also described their experience with ConPEC as very exciting: *"I think I am excited to see this work done and I feel it's something that is maybe long overdue, especially in our interactive society." ". . .I think it's an exciting platform"*. The participants likewise

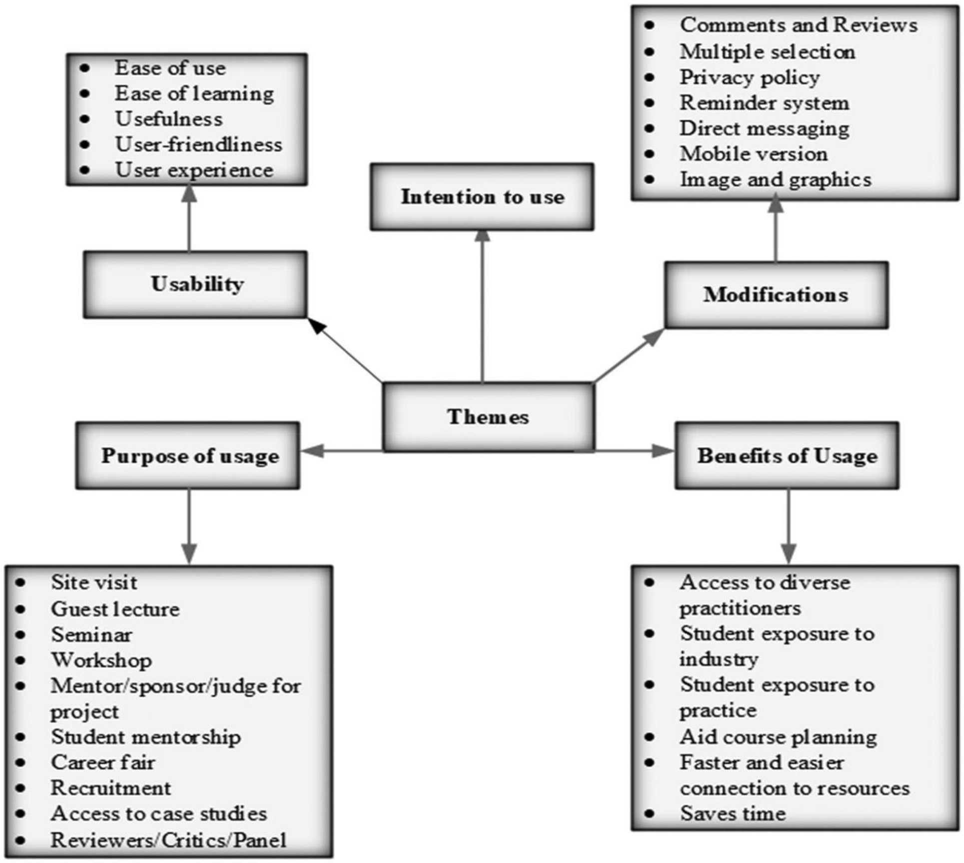

Figure 14. Themes and sub-themes from semi-structured interviews.

considered ConPEC to be user-friendly and useful in getting their job done: "*. . .It's very user friendly*" "*So, overall, this is great. This is phenomenal. I think that it's a medium that could be very helpful.*" The ease and speed with which ConPEC connect participants with industry practitioners was emphasized given that instructors earlier had to go through a somewhat laborious and time-consuming process of sending out multiple e-mails to engaged with practitioners in their classes: "*It takes like 5 minutes to request somebody and it's very efficient because it goes out to everybody that meets the qualifications and then you can select through based on somebody's geographic location*".

Intention-to-use: The participants expressed their intention to use ConPEC as a tool to connect with practitioners for participation in student development: "*. . . I would use it a lot anyway because it's very efficient . . .* " The participants attributed their intention-to-use ConPEC to its usability, such as ease of use, usefulness, and user friendliness "*. . .I think it would be a really good tool, like I said, easy to use, easy to navigate . . . It was very user friendly and made sense. So, I think it would be very well used*". "*I plan to invite some guest lecturers next semester so if this will be released. I will definitely use this*". The participants opined that acceptance of ConPEC by industry practitioners would also enhance 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.*" Only one participant opined that he might not use ConPEC frequently because of his robust network of industry practitioners.

Purpose of usage: The participants likewise described the purpose for which they would use ConPEC. These include all the course-support needs of instructors such as getting guest lecturers, scheduling site visits, engaging facilitators for seminars, and workshops, as well as mentors, sponsors, and judges for student projects: *"Yeah, I engage guest lecturers and mentors in all my classes. So, I would say anything anybody teaches, they could use this."* In addition to these, the participants noted their intention to use ConPEC to arrange for critics, reviewers, and alumni panels during student presentations, connect individual students with mentors in the industry, arrange for demonstrations and career fairs, bring case studies into the classroom as well as for recruitment activities.

Benefits of usage: The purpose for which the participants intend to put ConPEC as well as their intention to use the web platform were attributed to the platform's diverse benefits to students and instructors. The participants noted that ConPEC would enable them to expose their students to diverse practitioners, with different experience and perspectives, especially in areas where they do not have expertise or personal network. "*. . .I see a ton of value, like I said, for people who are starting off who don't have networks. . .*," and *"smaller schools that don't have robust industry boards . . . , "And these people hopefully will be instrumental in and helping me teach areas that I'm not an expert"*. The participants emphasized the benefits of exposing students to practical experience, insights, and examples that practitioners bring into the classroom: *"Because I do want my students to know things outside of the classroom."* The participants also noted that ConPEC would help plan their classes, saving time, streamlining and making the process of connecting with practitioners faster, giving them access to a diverse pool of practitioners as well as helping them to boost their network and relationship with the industry: *"And I would love to have something like this at the beginning of the semester so that I can plan my schedule,"". . .I think that it could potentially save a lot of time," "It could streamline the process and make it faster and easier for me to invite practitioners for course-support."*

Modification: To further enhance the usefulness and usability of ConPEC, the participants provided some suggestions which include modifications and additional features. These include having more information about the practitioners as well as their organizations so that instructors could easily choose from the list of practitioners recommended to them: *"I think if they've participated in the past you could have some type of like comments or reviews on that person's participation"*. Also, suggestions regarding additional fields and more functionalities in supplying course information were provided. These include multiple selections of student academic level, program of study, date, and time: *"But when I was making a selection, I was not able to select multiple."* Additional fields suggested are course title, course code as well as including graduate students in the list of student academic level: *"I guess you could include that with a course title." "I would add graduate students into that."* The participants also recommended that there should be a privacy statement/policy on how the information of users will be handled: *"I would think about some kind of privacy statement or something"*. Additional functions suggested by participants were a reminder system for upcoming events and direct messaging to enhance personal engagement: *"A reminder saying your event is coming up, that would also be good"*, *"It'd be very helpful if there was some sort of chat function on the interface"*, *". . .I think that the platform should make that personal engagement as easy and seamless as possible"*. The participants also recommended that the web platform should be made accessible on mobile devices: *"Can you use it on a mobile device?," "is that modified for a phone viewing?."* Other suggestions include interface change to make the platform more visually appealing by introducing more colors and images: *"It might be nice to have a few images or something," ". . ..and maybe even get some more of the images or graphics along the side so that it's not so plain"*.

Discussion

Since the advent of COVID-19, there has been a surge in the usage of information technologies to connect communities and individuals. As the networking propensity of society continues to increase, this must be leveraged in connecting instructors with practitioners who are willing to support pedagogical efforts in preparing the future professional workforce. CLT provides a theoretical underpinning for learning in technologically enabled networks (Goldie, 2016), hence alongside design principles, this was leveraged to design ConPEC which is a collaborative network of instructors and practitioners. Therefore, ConPEC serves as a technology-enabled industry-academia interface for instructors and practitioners to collaborate in preparing the future professional workforce. ConPEC provides an automated means that is industry- and purpose-specific for instructors and practitioners to connect. This is potent to address the lack of coordination and limited access to practitioners that are currently being experienced in the existing traditional means being used by instructors to connect with practitioners (Lu & Jacobs, 2022). Similarly, ConPEC would be useful for new faculties and instructors without strong industry relations. The technology-enriched interface provided by ConPEC is required to strengthen and facilitate existing industry-academia collaborations in preparing the future professional workforce. Such an industry-academia interface can ensure that industry does not only depend on the output of academia but is also a participant in preparing students for the workplace (I. A. Rizvi & Aggarwal, 2005). This has been noted as critical due to the dynamic nature of the construction industry which has resulted in ever-evolving trends of skills and competence required of construction engineering graduates (Tayeh & Issa, 2021).

The efficacy of the principles and theory adopted in the design of ConPEC is evident in the outcome of the usability evaluation by potential end-users of the platform. For instance, the participants opined that ConPEC works in a similar pattern with other web platforms they are used to which made it very easy for them to use and learn to use. This underscores the efficacy of Jakob's law of internet user experience. The eye tracking results showed that the participants' visual attention was on the AOIs. This is revealed by the gaze plot and heat map showing longer fixation duration and shorter time to first fixate on the AOIs. That is, the attention of the participants was quickly captured on the AOIs and once captured, their attention was held as they considered the AOIs to decide on selecting a practitioner. Hence, the participants focused on the GUI inputs which represent the details of the practitioners they need to consider before selecting from the recommendation. Since each of the AOIs does not require specific action (such as clicking or selecting) but is to be wholistically considered to decide whether to select a practitioner, fixation means that the participants considered the AOIs in selecting a practitioner (Bojko, 2006; Just & Carpenter, 1976). This is similar to W. H. Rizvi (2020) who also reveals that fixation on a stimulus shows that the attention of participants is captured. The eye tracking results show that the GUI inputs identified in the usage research which constitute the AOIs were also the parameters that the users focused on to decide on the practitioners to choose. This demonstrates the effectiveness of usage research in eliciting important design information from users of information systems. The findings also reinforced the efficacy of human factor principles in user interface design as well as user-centered design principles in ensuring that information systems meet the needs and expectations of end-users.

The usability of the web platform is further reinforced by the task completion time of the critical activities that instructors had to perform on the web platform to get connected with suitable practitioners who could meet their course-support needs. The time required was less than four (4) minutes. This was further underscored during the semi-structured interview by the participants when they compared their current approach (of sending multiple e-mails to diverse practitioners) with the ease and speed with which ConPEC connects them with practitioners. In the same vein, the usability rating of the web platform by the participants was considerably high. The average SUS score of 89% is considered acceptable on the acceptability range and falls in the "B" grade scale described as "excellent" according to Bangor et al. (2009). The SUS score is a multivariant score that reveals the acceptance (Sihombing et al., 2020), usefulness, ease of use, ease of learning, and user experience (Lewis, 2018; Vlachogianni & Tselios, 2022). Therefore, the end-users considered ConPEC to be very useful, easy to use and learn. The usage was effortless, and the usage experience was satisfactory in getting the platform to do what it was required to do.

In addition to the SUS score, the above-average ratings given to all the statement items in the TAM questionnaire for PEOU, PU, ATT, and BIU constructs reveal that the participants had very positive attitudes toward the web platform, and they intended to use it. This is further underscored by the correlation analyses which show that PEOU, PU, and ATT had strong positive correlations with participants' behavioral intention to use ConPEC. Further analyses reveal the statement items in each construct that are responsible for the strong positive relationship. The statement items specifically show what would influence participants' behavioral intention to use ConPEC. This includes the flexibility, usefulness, and easier access to practitioners afforded by ConPEC. This was underscored by the verbal feedback from the participants. Also, the participants favored the use of ConPEC, believed that ConPEC helps connect with practitioners, and considered the usage of ConPEC a good idea. Lastly, the participants indicated that they would frequently use ConPEC. This was also reinforced by the verbal feedback. Therefore, as opined by Revythi and Tselios (2019) the success of new information systems is highly dependent on users' acceptance, it is safe to say that ConPEC would receive acceptance by instructors upon deployment. The results point out the importance of early user involvement as well as the incorporation of user input in the design of user interfaces as advocated by user-centered design principles and human factor principles in user interface design. This approach has been noted to ensure that information systems are useful, easy to use, easy to learn, pleasant to use, and have features that end-users would need in their work (Gould & Lewis, 1985; Hartson & Pyla, 2012)., The design modifications suggested by the users also provide means to further improve the usability of the platform.

Conclusion, limitations, and future work

The current disparities between the competence requirements of the construction industry and the offerings of construction engineering graduates have resulted in an increased focus on future workforce development in industry-academia interactions.

To address this challenge, the participation of practitioners is required in preparing the future professional workforce. However, the current access to industry practitioners is primarily via one-on-one contacts and personal relationships which leaves institutions or instructors, and consequently students, without such contacts or relationships disadvantaged. To advance existing efforts as well as improve instructors' access to practitioners in preparing students for an ever-dynamic industry, this paper adopts connectivism learning theory to leverage the potential of information technology in achieving the much-needed industry-academia interface for future professional workforce development. The web platform (ConPEC) presented in this paper has the potential to address the current challenges in the dynamic industry-academia collaborations such as instructors' lack of/limited access to practitioners, low participation of practitioners in construction engineering education as well as disadvantages faced by small institutions (including instructors and students) with limited industry network. This could ultimately improve the competencies of new construction engineering graduates who are already noted to fall short of industry expectations.

As shown by the results of the usability evaluation, the web platform has the potential to address students' and instructors' marginal and unequal access to the construction CoP which would ultimately improve student learning. This study contributes to connectivism learning theory by leveraging information technology to increase the exposure of students in construction-related programs to their CoP through a collaborative network of instructors and practitioners. Also, the study contributes to interface design principles such as human factor principles in user interface design, user-centered design principle, usability heuristics, and Jakob's law of internet user experience by demonstrating the potential of these principles to guide the design of information systems that are useful and user-friendly which could facilitate users' acceptance. In addition, this paper demonstrates the application of these theories and principles in a web platform aimed at connecting instructors and practitioners for student-centered collaborations. The study also demonstrates the potential and application of information technology in fostering these collaborations. This study could serve as a benchmark and reference for the application of information technologies, connectivism learning theory, and design principles in improving student development in other domains.

Further work that would be done includes the iteration of the design based on participants' suggestions and the final deployment of the platform. Also, further work would focus on developing matching algorithms and machine learning frameworks to facilitate more dynamic and equitable matching of instructors with practitioners. In addition, a summative assessment would be conducted to assess the impact of the web platform on the disciplined perception and professional identity development of construction engineering students. Similar evaluation of the web platform by practitioners could also be the focus of future research efforts.

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