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Instructors' Considerations When Collaborating with Practitioners for Future Workforce Development

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Abstract: A paradigm shift toward workforce development is essential to ensure that the future workforce meets the expectations of the architecture, engineering, and construction (AEC) industry. Both industry and academic communities play different, but essential and complementary roles, which suggests a need for stronger industry–academia collaborations. These could be achieved by connecting instructors with practitioners through web-based collaborative platforms. However, user requirements for facilitating such collaborations on web-based platforms are yet to be formalized. As a precursor, this study investigates the factors which instructors in AEC-related academic programs would consider when collaborating with AEC practitioners to complement their pedagogical efforts. Understanding these factors could aid the development of web-based networking platforms that could facilitate greater interactions between industry and academia in preparing students for the workplace. To ensure triangulation, a mixed method approach was adopted, and data analysis was conducted from individual differences perspective based on demographic characteristics. Instructors' considerations are influenced by students' preferences and bias, students' career and development, ease of organizing course-support activities, student learning outcomes, curriculum structure, and ethnic and gender diversity. The results showed both demographic similarities and differences in the considerations of instructors. The results of this study could serve as inputs for the design of a web-based collaborative network of instructors and practitioners. This study contributes to expanding literature on collaborations between industry and academia for future workforce development. The study also offers insights that could enhance these collaborations for maximal benefits to students. **DOI: 10.1061/JCEECD.EIENG-2043.**

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Introduction

The architecture, engineering and construction (AEC) industry is rapidly changing, facing new challenges, and increasing levels of complexities (Tayeh and Issa 2021). These have made the AEC workforce ever evolving, with new skill and competence requirements over the decades (Ahmed et al. 2014). Academia is expected to produce graduates that are workplace-ready, and able to confront the current challenges of the workplace (Chandrasekaran et al. 2015). To meet this expectation, academia needs to achieve a balance between theoretical knowledge and practical skills (Afonso et al. 2012; Bozoglu 2016), and keep pace with the dynamics in the industry (Tayeh and Issa 2021). However, it appears that academia is in constant struggle to meet these expectations (Back and Sanders 1998; Chandrasekaran et al. 2015). This has resulted in skill gaps and mismatches between industry needs and academic offerings (Afonso et al. 2012). This is reflected by the displeasure of employers because their skills and competencies requirements are not being met by new hires (Christo-Baker et al. 2017; Suleman and Laranjeiro 2018), a reality that has been corroborated by industry reports (ICW 2012; NASEM 2016).

To address these challenges, greater interaction between industry and academia in preparing the future workforce has been proposed (Chandrasekaran et al. 2015; Zheng et al. 2019). This is to ensure that the pedagogical efforts in academia are complemented by the practical knowledge, insights, and inputs from practitioners (Sutherland et al. 2005; Afonso et al. 2012). This is particularly important for AEC-related disciplines because they are applied science and practice-based (Abudayyeh et al. 2000). Hence, through collaborations with practitioners, instructors have devised several avenues to complement classroom teaching with practical insight, rigor, and realism (Sharma and Sriraman 2012; Lu and Jacobs 2022). However, achieving these industry–academia collaborations is being plagued by several challenges (Ahn et al. 2012; NASEM 2016). These include difficulty of access to practitioners, instructors' lack of contact (Chandrasekaran et al. 2015) and lack of well-coordinated industry–academia interfaces for workforce development (Rizvi and Aggarwal 2005). In addition, many instructors rely on personal contact, professional organizations, and industry advisory boards to get practitioners to support their classroom efforts (Lu and Jacobs 2022). These could be limiting

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especially for new instructors and smaller institutions without robust industry network and for female instructors who face particular challenge in this area (Tartari and Salter 2015). To address these challenges, a web-based collaborative network is potent to enhance instructors' access to diverse practitioners. For instance, pathful.com is a web platform for promoting work-based learning and ensuring career readiness and employability skills in K–16 by connecting industry with the classroom (Pathful 2024). To develop such a web platform and ensure its usefulness, ease of use, and user acceptance, design principles suggest a user-centered approach (Hartson and Pyla 2012). This involves user research to understand users' considerations in such context. The results of user research could provide a basis to deduce the design needs and graphical user interface (GUI) inputs to guide the design process (Gould and Lewis 1985). However, this information seems unavailable in extant literature. Hence, an assessment of potential users' (e.g., instructors and industry practitioners) considerations is deemed necessary to enhance student development through industry–academia collaborations.

In addition, the considerations of instructors when collaborating with practitioners have not received adequate attention (Peters and Lucietto 2016). These considerations are important in ensuring that two different, but complementary entities work together for the same cause. Therefore, understanding instructors' considerations when collaborating with practitioners for future workforce development is important for the effective integration of the two communities (Kaymaz and Eryiğit 2011; Cho et al. 2019). To develop a web-based platform that could enhance collaborations between instructors and practitioners, this study makes an initial attempt to investigate the different course-support needs of instructors and the factors that instructors would consider when seeking practitioners to meet their course-support needs. This is examined from the perspective of demographic differences. This study contributes to scarce literature on industry–academia collaborations for workforce development and the role of demographic differences in these collaborations. This paper is structured as follows: a literature review on the importance of and challenges in industry–academia workforce development collaborations, instructors' consideration in industry–academia workforce development collaborations and theoretical underpinning. These are followed by the methodology of the study. The methodology section presents a highlight of the mixed method approach adopted, including data collection and analysis procedure. The methodology section is followed by the results section where the outcomes of the data analysis according to the study objectives were presented. This is followed by discussion of the results, and conclusion section, respectively.

Background

Importance of Industry–Academia Workforce Development Collaborations

For academia to meet AEC industry expectations of new graduates, collaborations with industry are required (Zheng et al. 2019) to help students internalize their learning, identify with the norm and culture of their profession, and begin to think, act, and feel like professionals (Cruess et al. 2015; Tan et al. 2017). These interactions with their communities of practice (CoP) help to form students' perspectives and develop their professional identity which are crucial for success in the industry (Cruess et al. 2015; Carbone et al. 2020). These also expose students to experiential and work-integrated learning which enable students to connect classroom teaching with workplace scenarios (Chandrasekaran et al. 2015). In addition, practitioners' practical insights can complement the theories taught in classrooms (Sutherland et al. 2005; Afonso et al. 2012), and students' knowledge of technologies and industry practices can also be enhanced. Industry could assist academia in updating and refocusing education based on new trends and projections (Chandrasekaran et al. 2015). These collaborations have been identified as a means to circumvent the current skill gaps and mismatches between industry and academia in workforce development (NASEM 2016; Chandrasekaran et al. 2015).

There are diverse forms of industry–academia collaborations such as internship, summer and co-op jobs, on-campus recruitment, industry advisory board, and continuous professional education (Abudayyeh et al. 2000; Bruneel et al. 2010; Chandrasekaran et al. 2015). However, this study focuses on instructors' collaborations with practitioners that directly complement pedagogical efforts through meeting instructors' course-support needs (Table 1). These are important for student development because students' interactions with industry that is guided by instructors' help to uphold academic curriculum (Anderson and Mourgues 2014; Lu and Jacobs 2022).

Table 1. Instructors' course-support needs

Instructor course-support needs	Sources
Guest lecture	Abudayyeh et al. (2000), Chandrasekaran et al. (2015), and Lu and Jacobs (2022)
Site visit	Abudayyeh et al. (2000), Gunhan (2015), and Carbone et al. (2020)
Seminar	Abudayyeh et al. (2000) and Lu and Jacobs (2022)
Laboratory session	Nikolic et al. (2011), Liu and Berumen (2016), and Bozoglu (2016)
Judge/mentor/sponsor for term/capstone project	Back and Sanders (1998) and Anderson and Mourgues (2014)
Workshop	Chandrasekaran et al. (2015), Ofori-Boadu et al. (2017), and Lu and Jacobs (2022)

Challenges in Industry–Academia Workforce Development Collaborations

Although industry–academia collaboration in workforce development is beneficial, establishing such interaction is challenging. The challenges include time conflict, difficulties in coordination (Abudayyeh et al. 2000; Eiris and Gheisari 2018; Lu and Jacobs 2022), and cultural differences between industry and academia (Chang and Dozier 1995; Chandrasekaran et al. 2015). This is shown in their different working practices and mutual lack of understanding of expectations (Bruneel et al. 2010). Therefore, engaging practitioners requires instructors to bridge institutional gaps, and navigate an unfamiliar terrain with dissimilar norms and expectations (Tartari and Salter 2015) which could be challenging to surmount. Kaymaz and Eryiğit (2011) noted that prior unfavorable experience, poor communication, lack of awareness, red tape, and apathy of both parties sometimes hinder industry–academia collaborations. Also, industry–academia collaborations are being plagued by reluctance of practitioners (Sharma and Sriraman 2012) and disparities and misfit between instructors' requirements and practitioners' offerings (Peters and Lucietto 2016). Also, instructor's lack of contact, differences in focus and interest, and lack of enthusiasm are recurring challenges (Chandrasekaran et al. 2015).

Therefore, understanding instructors' considerations in workforce development collaborations could help alleviate these challenges.

Instructors' Consideration in Industry–Academia Workforce Development Collaborations

Researchers (Abudayyeh et al. 2000; Eiris Pereira and Gheisari 2019) have opined that students' learning outcomes are central to instructors' considerations in workforce development collaborations with practitioners. However, the nuances and interplay of factors that surround instructors' decisions to collaborate with practitioners for workforce development have not been adequately examined. For example, Tartari and Salter (2015) showed that female instructors collaborate less with the industry and in different ways compared with their male colleagues of the same status. The study revealed that female instructors who work in male-dominated disciplines (such as construction and engineering) may have less social capital and spend more time and effort to engage with the industry. The level of diversity in a particular discipline or field would affect how female instructors and those from traditionally minoritized groups engage with practitioners because of lack of peers in the industry (Tartari and Salter 2015). This is critical in AEC education because the AEC industry is male dominated, and still struggling with both ethnic and gender diversity (Price 2010; Karakhan et al. 2021), hence, this could affect how female instructors and those from traditionally minoritized groups engage with practitioners. Similarly, Bozeman et al. (2013) noted that personal attributes considerations such as age, ethnicity, and gender affect how individual academics collaborate with the industry. The study further identified size, location/proximity, and racial diversity of organizations as factors influencing collaboration patterns. These factors are important for consideration given the growing effort to address the labor shortage in industry through a more diverse workforce (Karakhan et al. 2021; Choi et al. 2022).

In addition, because industry–academia collaborations for future workforce development are student-centered, students' preferences and bias might be important considerations for instructors. For instance, Egalite et al. (2015) showed that students perform better with instructors of the same ethnicity who could serve as their role models and mentors. This was buttressed by Price (2010) who showed that students' learning experience and outcome and their persistence in STEM could be influenced by the gender and ethnicity of the instructor, with better performance with instructors of students' own race. In the same vein, Joye and Wilson (2015) reported that students have greater rapport with female professors than male professors. The study also reported that students perceived younger professors better than older professors. On the other hand, Clayson (2020) noted that students perceived they would learn the most from older instructors, but younger ones would be more helpful. Also, the study reported that students often preferred male instructors over female ones. These might be important considerations for instructors in bringing practitioners into the classroom, especially for AEC education where there is a need to bridge the diversity gap (Price 2010; Choi et al. 2022).

Also, certain scholars have documented the accounts of instructors in engaging with practitioners in workforce development collaborations. For example, Gunhan (2015) provided an account of how site visits were used to complement classroom teaching of a construction management course. Anderson and Mourgues (2014) also provided an account of how a capstone project was executed to prepare students for the industry. The accounts show that the instructors considered safety requirements, location of the jobsite, and organization policy/support/resources. In the context of scheduling a guest lecture, Dalakas (2016) considered areas of expertise and website content of organization when arranging for a guest lecture. Other considerations identified from literature include the type of project executed by the practitioner's organization (Farrow and McCabe 2012; Carbone et al. 2020; Civjan 2020), practitioner's years of experience (Zou et al. 2019; Lu and Jacobs 2022), number of students that can be accommodated during site visit (Carbone et al. 2020; Civjan 2020), project stage, project overview, and limit/extent of access to the site allowed (Civjan 2020). These factors are summarized in Table 2.

Theoretical Underpinning

Several theories have underpinned the need for industry–academia collaboration in future workforce development. Professional vision theory (Goodwin 1995), theory of disciplined perception (Stevens and Hall 1998), and professional identity development theory (Cruess et al. 2015) are a few examples. These theories find expression in the concept of communities of practice (CoP) by Wenger (1999). The theories reveal that as students interact with their CoP, they learn the shared repertoire of their professions, hence the need to connect industry and academia. By leveraging advances in computing, improved interaction could be achieved through web-based platforms, which can open doors for connecting instructors with a diverse pool of practitioners. However, in the design of web-based platforms, human factors principles for user interface design (Gould and Lewis 1985) and user-centered design principles (Hartson and Pyla 2012) stipulate that end-users should be understood, and their inputs should inform system design. Hence, the need to assess the considerations of instructors when collaborating with practitioners for future workforce development. Prior studies have adopted a similar approach (Van Velsen et al. 2009; Holgersson and Karlsson 2014).

Individual differences theories showed that people differ in their attitudes, behaviors, and preferences, and these differences emanate from demographic factors (Boag and Tiliopoulos 2011; Carver and Scheier 2012). These demographic factors (such as gender and ethnicity) are important to better understand research findings and the extent of generalizability (Beins 2009; American Psychological Association 2020). This would also uphold the *universalism* assumption which proposes that the same phenomena of interest may differ across participants of varying demographics (Beins 2009). Therefore, this study assesses the considerations of instructors in industry–academia workforce development collaborations from demographic differences perspective. This will help to understand universals and variations that exist among and within the study populations (Hammer 2011). Previous related studies (Tartari and Salter 2015; Agyekum et al. 2022) have adopted a similar approach. Therefore, this led to asking the following research questions: (1) What are the factors instructors would consider in industry–academia workforce development collaborations? (2) How do these factors vary across demographic characteristics of instructors?

Methodology

Overview of Methodology

To ensure triangulation, a mixed methods approach using a survey and focus group was adopted for this study (Almalki 2016). This mixed method approach has been recommended for research in the construction domain (Love et al. 2002). Primary data were collected through an online survey. The considerations of instructors in workforce development collaborations with academia as gathered from extant literature (presented in Table 2) were used to develop a

Table 2. Instructors' considerations in workforce development collaborations

Instructors' considerations in workforce development collaborations	Sources
Practitioner-related factors	
Gender	Price (2010) and Bozeman et al. (2013)
Age	Joye and Wilson (2015) and Clayson (2020)
Race/ethnicity	Bozeman et al. (2013) and Egalite et al. (2015)
Years of experience	Eiris and Gheisari (2018) and Lu and Jacobs (2022)
Area of expertise	Dalakas (2016) and Lu and Jacobs (2022)
Physical disability(ies)	Manley and Graft-Johnson (2013)
Practitioner's organization-related factors	
Name of the organization	Dalakas (2016)
Location or proximity	Bozeman et al. (2013) and Gunhan (2015)
Size of the organization	Bozeman et al. (2013)
Types of projects executed	Farrow and McCabe (2012) and Carbone et al. (2020)
Website content	Dalakas (2016)
Ethnic diversity	Bozeman et al. (2013) and Tartari and Salter (2015)
Gender diversity	Tartari and Salter (2015)
Organization policy/support/resources	Anderson and Mourgues (2014) and Gunhan (2015)
Specific course-support related factors	
Types of course-support willing to provide	Nangia and Pramanik (2011)
Types of physical disabilities that can be accommodated on site	Elleven et al. (2006) and Olayiwola et al. (2020)
Number of students that can be accommodated on site	Carbone et al. (2020) and Civjan (2020)
Limit/extent of access to site allowed	Civjan (2020)
Project stage	Gunhan (2015) and Eiris Pereira and Gheisari (2019)
General overview of the project (e.g., client, cost, and size)	Civjan (2020)
Safety concerns/requirements during site visits	Gunhan (2015) and Carbone et al. (2020)
Availability of senior personnel during site visit	Civjan (2020) and Gunhan (2015)
Size of the course-support team (e.g., guest lecturing team) the practitioner is willing to provide	Zou et al. (2019)

survey with well-structured and closed-ended questions. The survey was divided into two parts. The first part contains questions on respondents' demographics, whereas the second part contains questions on the specific objective of the study. Instructors were asked to identify their course-support needs (Table 1) that practitioners can meet. They were allowed to select as many as possible and provide other course-support needs not listed in the survey. Respondents were also asked to assess the level of importance of the factors they would consider when seeking practitioners that can meet their course-support needs. A five-point Likert scale (i.e., 1: Not Important, and 5: Very Important) was used. The twenty-six (26) factors were divided into three categories which include practitioner-related factors, practitioner's organization-related factors and specific course-support related factors. Participants had the option to provide open comments regarding other factors they would consider which were not captured in the list provided.

Content and face validity of the data collection instrument were carried out. The survey was evaluated by three professors of at least five (5) years of faculty experience. The survey was also evaluated by an external evaluator who suggested the inclusion of *country of study* and *level of education* as part of the factors. Thereafter, a pilot survey was conducted to ensure internal validity. The pilot survey was conducted online and twenty (20) instructors in different AEC-related academic programs across institutions in the United States participated. The participants were also asked to provide qualitative feedback on each question (if any) to improve the survey. The major improvements include changing location of respondents from regions to specific states, addition of a factor: *types of technologies adopted*. A Cronbach Alpha of 0.89 further underscored the internal consistency of the survey (Peat et al. 2020). The survey was further evaluated by an external evaluator before it was finally launched online through QuestionPro. At the end of the survey, instructors who were interested in the focus group were asked to provide their contact information. A focus group was adopted to validate the results of the survey, uncover underlying reasons behind the survey results, and gain in-depth understanding of the study phenomena (Krueger 2014). The study was approved by the Institutional Review Board at Virginia Tech (IRB# 22-379). Fig. 1 shows the overview of the methodology adopted.

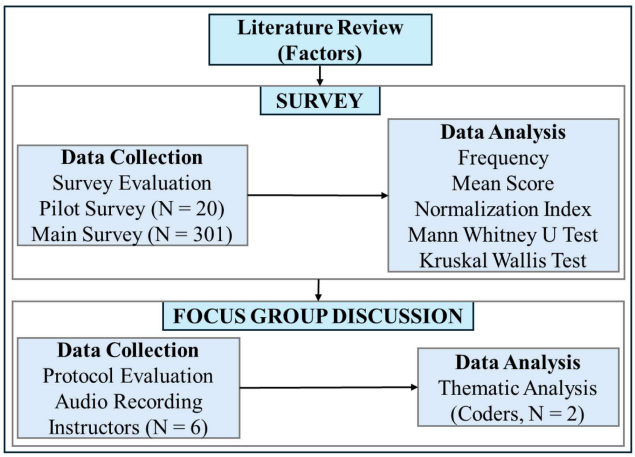

Fig. 1. Overview of methodology.

Data Collection

Survey

The survey was administered to instructors in AEC-related academic programs across the United States between November 2022

and February 2023. The survey was distributed through the listservs of the Associated School of Construction and American Society of Civil Engineers Construction Research Council containing 949 and 463 contacts, respectively. Personalized emails containing the link to the survey were also sent to instructors. Social media platforms were also used to reach respondents. About 1,509 participants viewed the survey, of which only 301 completed the survey with valid responses for analysis. This represents a response rate of 19.95%.

Focus Group

Nine (9) instructors among those who participated in the survey and indicated their interest to 0be involved in the focus group were purposively selected and contacted. This was to ensure adequate representation of the diverse nature of AEC education, covering different types of institution, AEC-related academic programs, and years of faculty experience. Six (6) out of the nine (9) instructors contacted participated in the focus group. The participants include full professor, professor of practice, associate professors, and assistant professors from different AEC-related academic programs and from both predominantly white institutions (PWI) and minority serving institutions [i.e., historically black institutions (HBI) and Hispanic serving institutions (HIS)]. A sample size of six (6) to eight (8) participants is considered adequate for a focus group session (Creswell 2017). The questions for the focus group were developed based on objectives of the study and results of the survey to provide answers to the research questions as informed by the theoretical underpinning. The questions were examined by three instructors with at least five years of faculty experience. The questions were also evaluated twice by an external evaluator. The focus group was conducted online using an institutional Zoom account. The talking points and consent information were sent to the participants more than 24 h before the focus group session. All the participants gave their informed consent to participate in the study. The survey results were visually presented to the participants. Thereafter, the participants were asked open-ended questions relating to the completeness of the survey results (i.e., lists of instructors' course-support needs and factors), and why some factors were ranked high, and others were ranked low. The participants were also asked to share their experience in relation to the questions. The session lasted for about 60 min and was audio and video recorded. The recordings were de-identified, transcribed, and analyzed.

Data Analysis

Descriptive and inferential statistics such as Mann-Whitney U, Kruskal Wallis, mean score (MS), frequency distribution and percentage were used for the analysis. After the MS of the factors were computed, mean normalization index (MNI) was employed to identify the critical factors. MNI reveals the relative importance of factors under a given consideration (Nnaji and Awolusi 2021). MNI ranges from 0–1. Factors with MNI ≥ 0.5 were considered critical factors that instructors would consider when seeking practitioners to meet their course support needs. This is similar to previous studies (Adabre and Chan 2019; Nnaji and Awolusi 2021). The MS and MNI were computed with the aid of Microsoft Excel.

Shapiro-Wilk Test (SPW) showed that the data varied considerably from a normal distribution. Hence, nonparametric tests: Mann-Whitney U and Kruskal-Wallis tests were suitable for examining differences in the opinions given by the group of respondents. The Mann-Whitney U test was used to compare two groups of respondents, whereas the Kruskal-Wallis test was used to compare more than two groups. A p-value < 0.05 was considered significant. The post hoc test was conducted where a significant difference was observed. The analyses were carried out using Statistical Package for Social Sciences, version 20.

Thematic analysis was employed for the focus group data using NVivo 11 which is a software for qualitative analysis. Related themes were analyzed and categorized using inductive coding (Braun and Clarke 2006). The analysis was done through an iterative process of reading the transcribed data, generating, and refining codes and themes. Relevant data were collated into codes, and related codes were collated into themes. To ensure the reliability of the codes, an inter-rater reliability test was conducted by two different researchers (n = 2) using the Cohen-kappa coefficient which ranges from 0–1 (Nowell et al. 2017). Trustworthiness was secured by discussing differences in coding approaches until coders reached agreement. The reliability test revealed 97.30% of agreement and Cohen-kappa coefficient of 0.66 which shows that the two coders strongly agree.

Results

Survey

Participants' Demographics

Table 3 presents participants' demographics. The demographics show a considerably large number of instructors who were from a wide range of AEC-related academic programs with adequate experience to provide useful data for the study.

Course-Support Needs of Instructors

According to the responses, the results are shown in Fig. 2. About 90.37% of the participants chose guest lecture/classroom teaching, which indicates that instructors really value bringing practitioners into the classroom to discuss technical topics from their experience. Also, 81.06% of the participants selected site visits which reveal the interest of instructors in exposing students to the workplace and work practices. Judge/mentor/sponsor for term project/capstone was chosen by 61.03% of the participants. This shows a vital way whereby instructors expose students to realism and rigor of the workplace. Seminar, workshop, and lab session were selected by 50.83%, 38.54%, and 24.25% of the participants, respectively. These course-supports, which by nature usually involve intensive discussion or training on certain subject matters received lower selection by instructors which could suggest that these are being achieved in other curriculum arrangements handled by instructors. There were no differences in the frequency rankings of the course-support needs based on gender and ethnicity of instructors. Other course-support needs that the participants provided include content development (i.e., case studies), training for industry software and student competition team coaching.

Considerations of Instructors in Workforce Development Collaborations

The results in Table 4 show that *Area of expertise* had the highest mean score (MS) of 4.28, while *physical disability(ies)* had the lowest mean score of 1.35. Both factors were under practitioner-related factors. Out of the 26 factors, only 15 were considered critical factors because their MNI was ≥0.5. Table 4 shows the MS, MNI, and ranking of the factors. Other factors provided by the respondents that they would consider when seeking practitioners to meet their course-support needs were *political connections that support the department*, *alumnus of our program*, *ability to offer clear and engaging interaction*, *day and time of availability*, *previous experience in course-support*, *course topics*, *internship*

Table 3. Demographics of surveyed instructors

Category	Frequency
Type of institution	
Predominantly White institution	204
Historical Black institution	12
Hispanic serving institution	44
Others	41
Department of institution	
Architectural science	23
Building construction	18
Building and construction technology	10
Civil engineering	44
Civil and environmental engineering	71
Construction engineering	8
Construction management	69
Construction technology	6
Construction science	9
Construction engineering and management	8
Real estate and construction management	3
Geomatics	2
Others	30
Race/ethnicity	
American Indian or Alaska native	1
Asian	36
Black or African American	25
Hispanic or Latinx	20
Native Hawaiian or other Pacific Islander	0
White/Caucasian	204
Multiracial	4
Others	11
Gender	
Male	215
Female	83
Nonbinary	0
Others	3
Job title	
Professor	78
Adjunct professor	16
Associate professor	67
Assistant professor	87
Professor of practice	8
Senior professor of practice	1
Assistant professor of practice	3
Lecturer	26
Instructor	4
Others	11
Cumulative faculty experience	
1–5 years	82
6–10 years	56
1115 years	42
Above 15 years	121

and/or full-time employment opportunities, *interest of students*, *regional/national/global reach of an organization*, and *duration of the support activity.*

Comparison of Instructors' Considerations in Workforce Development Collaboration based on Demographic Differences

Drawing from the theoretical underpinning of the study, the participants' responses to the extent to which the factors are important were compared across demographic differences: type of institution, gender, ethnicity, and years of faculty experience. This section reveals the similarities and differences within each demographic group.

Types of Institution

Regarding the types of institution, significant differences ($p < 0.05$) were found in the responses of the respondents with respect to five factors: country of study, name of organization, website content, organizational policies/support/resources, and availability of senior personnel during the site visit. The results show that instructors from HBI attached the greatest importance to these factors, followed by instructors from HSI, except for name of organization and organizational policies/support/resources which instructors from PWI ranked higher than those from HSI. For country of study, website content and organizational policies/support/resources significant differences were observed in the responses of instructors from PWI and HBI. Instructors from PWI and HSI only differ significantly ($p < 0.05$) in the level of importance attached to availability of senior personnel during the site visit. Significant differences were also found between responses of instructors from HBI and HSI regarding name of organization and website content.

Gender

Only the responses of male and female instructors were compared because no participant was nonbinary. Significant differences ($p < 0.05$) were observed in the responses of the male and female instructors for 11 factors. These include gender, ethnicity, area of expertise, and country of study which are practitioner-related factors. Also, location, ethnic and gender diversity of practitioner's organization which are practitioner's organization-related factors; type of course-support practitioner is willing to provide, type of physical disabilities that can be accommodated on site, number of students that can be accommodated during site visit, and limit of access to site allowed. Among the 11 factors with significant differences between male and female instructors, female instructors ascribed greater importance to all these factors than male instructors except for country of study which male instructors ascribed higher importance to.

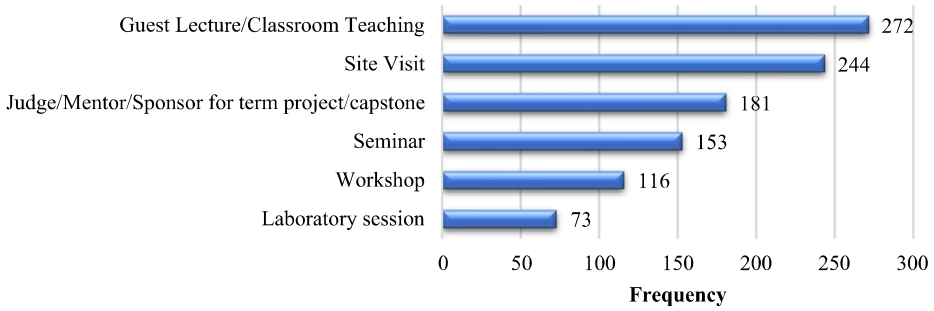

Fig. 2. Instructor's course-support needs.

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Table 4. Considerations of instructors in workforce development collaborations

Instructors' considerations in industry–academia collaborations	Mean score	S.D.	MNI	Group ranking	Overall rank
Practitioner-related factors					
Area of expertise	4.28	0.866	1.00[a]	1	1
Years of experience	3.64	1.057	0.78[a]	2	5
Level of education	2.80	1.107	0.50[a]	3	15
Country of study	2.03	1.191	0.23	4	21
Ethnicity	1.92	1.339	0.20	5	22
Gender	1.90	1.293	0.19	6	23
Age	1.79	1.068	0.15	7	25
Physical disabilities	1.35	0.821	0.00	8	26
Practitioner's organization-related factors					
Type of project	3.75	1.029	0.82[a]	1	4
Location	3.43	1.174	0.71[a]	2	8
Types of technologies adopted	3.25	1.218	0.65[a]	3	12
Organization policy/support/resources	2.74	1.200	0.48	4	16
Gender diversity	2.47	1.290	0.38	5	17
Ethnic diversity	2.46	1.282	0.38	6	18
Size	2.16	1.084	0.28	7	19
Name of organization	2.10	1.173	0.26	8	20
Website content	1.80	1.115	0.15	9	24
Specific-course support related factors					
Safety concerns or requirements during site visits	3.89	1.204	0.87[a]	1	2
Types of course support willing to provide	3.83	1.062	0.85[a]	2	3
Number of students that can be accommodated on site	3.61	1.079	0.77[a]	3	6
Limit of access to site allowed	3.51	1.076	0.74[a]	4	7
General overview of the project	3.42	1.064	0.71[a]	5	9
Availability of senior project personnel during site visit	3.37	1.126	0.69[a]	6	10
Project stage	3.25	1.084	0.65[a]	7	11
Size of course support team	3.08	1.159	0.59[a]	8	13
Types of physical disabilities that can be accommodated on site	2.97	1.271	0.55[a]	9	14

[a]MNI ≥ 0.5.

Years of Faculty Experience

For six factors, there were significant differences ($p < 0.05$) in the responses of the instructors based on their years of faculty experience. These factors are practitioner's years of experience, website content, ethnic diversity, types of technologies adopted, types of course-support willing to provide, and safety concerns/requirements during site visits. Instructors with 1–5 years of experience ascribed greater importance to all these factors except for types of course-support practitioner is willing to provide which instructors with 11–15 years of experience attached higher importance to. For practitioner's years of experience and ethnic diversity of practitioner's organization, instructors with 1–5 years of experience and those with above 15 years of experience differ significantly ($p < 0.05$) in their responses. For website content, instructors with 1–5 years of experience and those with 11–15 years of experience also differ significantly in their responses. For types of technologies adopted, a significant difference was found between the responses of instructors with 1–5 years of experience and those with 6–10 years of experience. For safety concerns/requirements during site visits, responses from instructors with 1–5 years of experience and those with 11–15 years of experience also differ significantly.

Ethnicity

Asians, Black/African American, Hispanic/Latinx, and White/Caucasian were the only ethnic groups compared because other ethnic groups (Multiracial, Native Hawaiian or other Pacific Islander, and American Indian or Alaska Native) have negligible numbers. Significant differences ($p < 0.05$) were observed in the level of importance attached to ethnicity of practitioners, country of study, website content of practitioner's organization, type of technologies adopted by practitioner's organization, safety concern/requirements during the site visits, and size of course-support team required. Black or African American instructors ascribed higher importance to ethnicity of practitioners, country of study, and website content of practitioner's organization than all other ethnic groups. Asian instructors attached higher importance to types of technologies adopted, safety concerns/requirements during site visits, and size of course-support team than other ethnic groups. Regarding website content of practitioner's organization, significant differences were found between the responses of Hispanic/Latinx, Black/African American, Asians, and White/Caucasian. For types of technologies adopted, safety concerns/requirements during site visits, and size of course-support team, Asians, and White/Caucasian instructors differ significantly in their responses.

Focus Group

Six (6) themes were generated from the qualitative analysis. These themes summarized instructors' considerations when collaborating with practitioners for future workforce development. The themes are shown in Fig. 3 below which include students' preferences and bias, students' career and development, ease of organizing course-support activities, student learning outcomes, curriculum structure, and ethnic and gender diversity. The findings in this section are presented according to the different sections of the survey results.

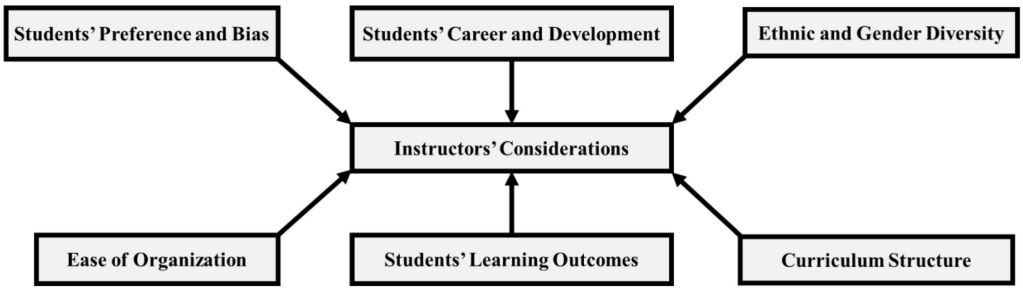

Fig. 3. Themes generated and relationship with factors and course-support needs.

Course-Support Needs of Instructors

The participants unanimously agreed with the rankings of the instructors' course-support needs in the survey results because it matches their expectations and experiences. Ease of organizing course-support activities, students' preference, and curriculum structure were provided as the reasons that influenced the rankings of these course-support needs. The top-ranking course-support needs, such as guest lectures, site visits, and judge/mentor/sponsor for capstone/term projects, were considered to be preferred by students, easy to organize and get practitioners to provide: "depend on the amount of time that's required for planning these activities and students' reception of those activities as well I think that's why they ranked very high" "for the top ranked items we have sort of like flexibility to include them into our curriculum."

The low-ranking course-support needs of instructors in the survey results, such as seminars, workshops, and laboratory sessions, were considered already structured, i.e., rarely needing industry support. The participants noted that they rely on their industry advisory board to give feedback on areas of improvement and provide the top-rank course-support needs: "with the Advisory Board . . . . we are getting continuous feedback from industry about . . . how we should improve our curriculum." Real case scenarios of software application and career development interaction with students were provided as additional course-support needs.

Practitioners-Related Factors

The participants also unanimously agreed to the ranking of the top three factors in the survey results: area of expertise, years of experience, and level of education, which hinged on students' learning outcomes. However, low ranking factors such as gender and ethnicity of the practitioner were considered differently by the participants. The participants noted that these factors are important to ensure diverse experience and exposure for students, encourage minority practitioners and students, and satisfy the preferences and bias of students. For example: "I am in a PWI, I try to expose students to people from different ethnicities because I want my minority students, to understand that they can also be in this position in the future." "I come from an HBCU . . . we try to include as many ethnicities as possible . . . but I still feel that they (students) connect well to a person from their group." However, despite instructors' efforts to expose students to diverse practitioners, lack of diversity in the AEC industry hinders these efforts: "we don't have diversity in our industry . . . I think that's why probably we are not even thinking about." Although the open and freethinking nature of academia was acknowledged, the impact of unconscious bias in instructors' considerations was also noted: "we might have a little bit of unconscious bias in our minds not thinking thoroughly about it."

The instructors expressed their efforts on exposing students to different practitioners from different organizations to achieve learning objectives and afford students with diverse experience and exposure for all-round development: "we try to get people from different areas of industry intentionally . . . so the students are likewise exposed to a lot of different things." The participants likewise noted that they try to achieve a balance between age and years of experience of practitioners because students prefer practitioners with relatable experience, hence having practitioners with several years of experience is not necessarily a priority: "students can relate with younger or people with less experience . . . .compared to somebody sitting in the executive level and may not necessarily be spending a lot of time in the junior starting level." An additional factor relating to whether a practitioner is an alumnus of the instructors' institution was provided. This was considered significant because connecting alumni to students gets students excited and driven.

Practitioners' Organization-Related Factors

The participants agreed with the top-ranking of *type of project executed by practitioner's organization* because of the need to align course-supports with student learning outcomes and to expose students to practitioners with diverse industry experiences: "we are not inviting residential builders; they have a different approach in construction . . . we are targeting general contractors or specialty contractors." The participants, however, were surprised by the low-ranking of size, gender and ethnic diversity of the practitioner's organization. The size of the practitioner's organization was considered important because of potential job opportunities for students: "If we invite really small companies, then what are the odds that they're going to hire from our graduates?" Also, the gender and ethnic diversity of practitioner's organization and their disposition to diversity, equity, and inclusion were noted to be important given the current drive to promote diversity in the AEC industry: "I think it is disappointing that diversity (gender and ethnic) rank low . . . . They (students) go work at an internship, and they come back, and they say, I don't want to work for this company or they move after 2 years, because . . . they realize they're not people who look like them or there're no mentors within the company, or they've actually experienced discriminations on the job site." Beliefs and causes supported by practitioner's organization such as disposition to sustainability and corporate social responsibilities were provided as additional factors.

Specific Course-Support Related Factors

The participants were indifferent regarding the ranking of the factors. This is because they agreed that the factors are important as

evident in their high mean scores. Instructors tried to ensure students are exposed to practitioners from various organizations to bring expertise different from what students are already familiar with. Beyond learning outcomes, instructors contribute to the career development of students by inviting practitioners that could encourage students to go beyond their bachelor's degree and get their professional license: "I tried to bring someone who will encourage them to get their professional license." Instructors achieve this by bringing recent graduates who could inspire students with their stories: "I'm looking for a recent grad who can speak to my students." The participants shared their experiences and other factors they would consider: "I am trying to make sure these collaborations will not be a burden for the person or for us . . . and for the students." The main challenges the instructors mentioned in their experience were regarding site visits: "you have to fill out a lot of paperwork." "I need to get hardhats and vests and . . . sometimes we have to divide them into two sections." The instructors mentioned that the topics they are trying to teach and students' academic level might influence how these factors are considered: "I think it depends on the topic of the course as well" "when it is subjected to junior . . . .senior level students, they take it more seriously."

Discussion

Course-Support Needs

Although research efforts on and accounts of site visits seem to be more prevalent in literature, guest lecture/classroom teaching was identified as the most prominent course-support need of instructors. This is perhaps because of the barriers that earlier studies (Eiris and Gheisari 2018; Eiris Pereira and Gheisari 2019) have identified to be associated with site visits which instructors also echoed during the focus group. These barriers include time conflict, paperwork requirements, and logistics constraints associated with taking students out of the classroom. The result of this study agrees with Irizarry and Adams (2006) who identified classroom teaching as the most used teaching techniques in construction education. Also, the flexibility offered through virtual guest lectures and ease of organizing the course-support activity could have made the course-support a favorite choice of instructors (Zou et al. 2019). Although the instructors mentioned that the site visit could be difficult to organize, students' desire to get on the field, and interact with their CoP through experiential learning could have made the site visit to be ranked highly. Also, site visits are now being considered as integral parts of construction education (Carbone et al. 2020). The high ranking of sponsor/mentor/judge for capstone or term project could be because capstone courses are common in engineering curricula (Anderson and Mourgues 2014) and are usually required of senior students prior to graduation. The result shows that course-support needs that are easy to organize (both for instructors and practitioners) in terms of time and efforts involved and those that fascinate students are the focus of instructors in industry–academia workforce development collaborations. The result reveals the unique nature of industry–academia workforce development collaborations which involve three stakeholders: practitioners, instructors, and students. This differentiates workforce development collaboration from other industry–academia collaborations that are primarily bilateral (i.e., involving instructors and practitioners only, for example, research funding and consultation). Also, no differences were observed in the ranking of the course-support needs of instructors based on gender and ethnicity. The results differ from the findings of Tartari and Salter (2015) who highlighted that female and minority instructors collaborate with industry in different ways compared with their colleagues. This difference could have been influenced by other considerations relating to achieving student learning outcomes which is central to industry–academia workforce development collaborations. These results could serve as inputs for the interface design of a web-based platform to connect instructors with practitioners.

Considerations of Instructors in Industry–Academia Workforce Development Collaborations

Out of the 26 factors, only 15 were considered critical factors (with MNI ≥ 0.5). Three of the critical factors are practitioner-related, three are practitioner organization-related, and nine are specific course-support related. However, for practitioner-related factors, although the survey results reveal that ethnicity, gender, and age of practitioners were ranked low, the participants in the focus group opined that these factors are important in their considerations given the efforts to promote diversity in the AEC industry, satisfy students' preferences, and ensure diverse experience and exposure for students. The differences in the two results could have been influenced by unconscious bias which was noted during the focus group and lack of diversity in the AEC industry which hinders instructors' access to minority practitioners. Also, the results of the survey could have been skewed by the larger proportion of instructors who were White/Caucasians and from predominantly white institutions where certain factors such as gender and ethnicity might be considered differently. The results also show that instructors find students to connect well with younger professionals with little experience than those already at the top of their career. This is because practitioners at the peak of their career might not share current information or experience about junior starting level. This shows that instructors do not require practitioners to have several years of experience but prioritize practitioners with little but relatable experience that students can relate with. The results of this study agree with Joye and Wilson (2015) and Clayson (2020) who also reported that students perceived younger instructors better than older ones. In the focus group, the instructors from HBI emphasized that gender and ethnicity are important considerations to them because of the preferences of their students who are predominantly Blacks. This result contributes to the findings of Price (2010) and Egalite et al. (2015) who noted that students' learning experience is better with own-race instructors, especially for Black students. This result reveals how students' preferences and bias, student's career prospect and development influences instructors' collaborations with practitioners in preparing the future workforce.

Also, the result of the survey shows that website content and size of practitioner's organization are not considered important. However, the results of the focus group reveal the exact opposite. The size of practitioners' organization was considered important because instructors also consider the career prospects for their students and the capacity of the organization to hire from their graduates. The finding agrees with Bozeman et al. (2013) who highlighted that the size of organizations matters in industry–academia collaborations. The website content is regarded as the primary way to learn about the organization before invitation to the classroom. Similarly, the ethnic and gender diversity of a practitioner's organization ranked low in the survey results, but the instructors considered this disappointing during the focus group given the ongoing effort to promote diversity in the AEC industry. During the focus group, the instructors opined that these factors are important considerations for them given that students now speak to

the lack of diversity and discriminations they have experienced in their interaction with the industry.

As suggested by the theoretical underpinning, the results show similarities and variations in the responses of instructors across demographic classifications. For instance, based on the type of institution, the responses of the instructors differ in a few instances which could have resulted from instructors' prior experience, differences in institutional frameworks, and considerations of students' preferences and bias. Although the results show that both male and female instructors do not differ in their course-support needs that practitioners can meet, the results show that they differ significantly in the consideration of 11 factors of which female instructors ascribed greater importance to 10 of these factors. The result shows that female instructors highly regard factors relating to gender and ethnic diversity when collaborating with practitioners compared with their male counterparts. Differences were also observed in the responses of the instructors based on their ethnicity. These findings agree with Tartari and Salter (2015) who showed that lack of adequate representation of female and minority peers in industry sectors (such as the AEC) would influence the interaction of female and minority instructors with practitioners. Differences were observed in instructors' responses based on their years of faculty experience. Surprisingly, instructors with 1–5 years of experience gave higher ranking to practitioner's years of experience, website content, ethnic diversity, types of technologies adopted, and safety concerns/requirements during site visits. These differences could be attributed to differences in their experience levels. Prior experience in interacting with practitioners by instructors with higher years of faculty experience could have influenced how these instructors perceived the factors. These results strengthen the universalism assumption (Beins 2009) and align with individual differences theories (Boag and Tiliopoulos 2011; Carver and Scheier 2012) which advocate that participants from various demographic groups might differ in the same phenomena, hence the need to examine demographic differences.

The outcome of the focus group revealed that some of the low-ranking factors in the survey result were considered important when instructors collaborate with practitioners to foster students' preparedness for industry. The differences in the survey and focus group results could be attributed to the limitations of survey, such as lack of access to underlying reasons for respondents' opinions, personal and social desirability biases in responses (Kelley et al. 2003). In addition, unconscious bias, and previous experience of instructors in not getting access to diverse practitioners could have influenced how they perceived the factors. This could also be because of instructors' consideration of students' bias, preferences, and career prospects while engaging with practitioners. The results also showed that instructors' considerations are influenced by student perceptions, bias, and interest. The results of this study further reinforce the need to adopt mixed methods in AEC-related research and ensuring triangulation to facilitate in-depth comprehension of phenomena as suggested by Love et al. (2002). The universals and variations in the results across different demographics reveal the multifaceted nature of industry–academia workforce development collaborations.

This study could serve as user research for the development of a web platform to give instructors improved access to practitioners. This approach aligns with previous studies (Van Velsen et al. 2009; Holgersson and Karlsson 2014) in developing web platforms that are user centered. The study also agrees with user-centered design strategies to enhance usability and user experience in interface design (Gould and Lewis 1985; Hartson and Pyla 2012). The results of this study could help to infer end-users' design needs and GUI inputs to aid the design process. For example, the course-support needs identified in this study represent the different collaboration types that should be available and supported on such a web platform. Also, the study revealed that instructors would consider practitioners' gender, years of experience, and size of their organizations. Hence, these could represent inputs for the user interface design and information that should be made available to instructors on such a web platform (i.e., functions and features). In addition, the critical factors identified could guide the designation of required and optional fields on the user interface. The demographic variations identified could help in adapting the user interface of such a web-based platform to diverse categories of instructors.

Conclusions, Limitations, and Future Research

Workforce development through industry–academia collaborations has been considered important to meeting industry requirements. However, studies in this domain are scarce. Hence, this study investigates the considerations of instructors when collaborating with practitioners for workforce development. The understanding of instructors' considerations provided in this study could be leveraged to improve the integration of industry and academia, address skill gaps and mismatches between industry requirements and academic offerings by fostering better interaction between the two communities. The findings reveal that the course-support needs of instructors and their considerations when seeking practitioners to meet those needs are influenced by students' preferences and bias, students' career and development, ease of organizing course-support activities, student learning outcomes, curriculum structure, and ethnic and gender diversity. In the context of AEC education, the study contributes to individual differences theories and strengthens the universalism assumption which advocates that the same phenomena of interest may differ across participants' demographics. This was achieved by showing that both similarities and differences exist in the factors instructors would consider in industry–academia workforce development collaborations based on their demographic characteristics (such as gender, ethnicity, years of faculty experience, and type of institution). The findings could also be used by relevant stakeholders to achieve maximal benefits for students in these collaborations. This study also opens discussion on how instructors' considerations and collaboration patterns are influenced by students' career prospects, bias, and preferences.

Further studies would be conducted to investigate the considerations of practitioners when collaborating with instructors. Future research should address some of the limitations of this study. These limitations include: First, this study was conducted in the United States with AEC industry as the focus. Conditions in other countries and industry sectors might be different. Second, no participant from HSI was involved in the focus group, so their qualitative feedback was not captured. Also, institutional-related factors that could influence how instructors collaborate with practitioners for workforce development could be investigated. Further studies are required to also examine the roles and perception of students in industry–academia workforce development collaborations and the extent to which students' perceptions influence instructors' considerations while engaging with the industry. In addition, other collaborations between industry and academia to develop future workforce that are not directly tied to individual instructors but at institution or department levels could also be the focus of further studies.

Data Availability Statement

Some or all data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request.

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