

Mobile Device Utilization in Classes by Faculty of ASC-Member and ACCE-Accredited Construction Programs

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Mobile devices are ubiquitous in society today, as well as the construction industry. Segments of academia have found mobile device utilization in classes to be beneficial, yet the examples (and associated benefits) of how mobile devices are utilized in construction management curricula are few. The purpose of this research was to discern how, why, and to what extent mobile devices are utilized in classes by faculty of ASC-member and ACCE-accredited construction programs. Survey findings from 61 construction faculty members showed that (1) approximately 1/3 of construction faculty utilize mobile devices in their classes, (2) the top three “apps” utilized by construction faculty align with the top three apps utilized in industry, (3) the top reasons that faculty do not utilize mobile devices in their classes include a perceived lack of applicability and a lack of experience/expertise, and (4) 85 percent of faculty that do not currently utilize mobile devices in their classes would either possibly or definitely like to in the future. Future research to discern why differences of mobile device utilization per geographic region exist, and ways to increase mobile device utilization by construction faculty are posed.

Key Words: Mobile Technology, Construction Education, Survey Research, Mobile applications

Introduction

The construction industry is getting smarter. Jobsites today are radically different than even ten years ago, with technological advances such as GPS-connected heavy machinery, drone imaging, and the widespread adoption of business-ready mobile devices (Plangrid and FMI, 2018). Technology alone is seen as a way for contractors to differentiate themselves from competitors in the construction marketplace, as evidenced by frequent industry publications from sources such as Engineering News Record attesting to the value that technology brings. Mobile technology usage specifically in construction has seen substantial growth, and this trend continues to rise (Kamara et al., 2002, Ahn et al., 2012, JBKnowledge, 2017). JBKnowledge (2017) reported that over 80 percent of the 2,690 respondents surveyed for their 6th Annual Construction Technology Report felt that having mobile device capabilities is either very important or important. This upsurge is due to construction firms realizing how mobile technologies can simplify and automate the capturing of information in the field and communicate that information back to company management systems (Cline and Davis, 2013). The top three mobile applications utilized by contractors for these communication purposes are Procore, Bluebeam, and Plangrid (JBKnowledge, 2017).

Mobile devices, such as smart phones and tablets, are omnipresent in today’s society, especially in college-aged individuals. A recent survey completed by the Pew Research Center (2018) found that approximately 94% of Americans between the ages of 18 and 29 own a smartphone. Technology through mobile devices has become a standard part of daily life for college students, fundamentally changing the way that they communicate, gather information, allocate time and attention, and potentially how they learn (Chen et al., 2015). As such, construction firms assume (and even expect) university students that move into internship or new-hire positions are familiar with the latest technological innovations, as well as look to their newer employees to lead the adoption of technological change within their firms (Cline and Davis, 2013).

As stated by Ferdousi and Bari (2015), "The infusion of mobile technology into undergraduate courses can revolutionize the processes of learning and teaching by changing the educational environment." The integration of mobile devices in the classroom has enormous potential due to its popularity, ubiquity, and availability of various relevant apps (Yang et al 2015); yet, to date, the number of faculty that integrate mobile technologies into their coursework has shown to be relatively low, approximately 20 percent based on one study of a university with a

significant mobile technology support infrastructure (Chen et al., 2015). Conversely, nearly 75 percent of undergraduate students utilize mobile devices for academic purposes (Bomhold, 2013, Chen et al., 2015) such as looking up lecture topics during class, using discipline-specific apps to access knowledge, and using apps to access course textbooks both during and outside of class (Chen et al., 2015).

The existing literature provides only two examples of how mobile devices have been integrated into Associated Schools of Construction (ASC) member and American Council for Construction Education (ACCE) construction courses. Cline and Davis (2013) describe the integration of iPads into a freshmen-level construction materials and methods laboratory course. They found that incorporation of the iPads (1) facilitated communications between the learner and the instructor, (2) increased the student's construction safety knowledge, (3) increased the student's communication and problem-solving skills, all while providing the students with experience utilizing technology that they will be required to use in industry (Cline and Davis, 2013). Reyes et al. (2015) describe the incorporation of iPads into an undergraduate blueprint reading course, and found that students were more efficient in completing a class exercise when able to familiarize themselves with a hard set of blueprints ahead of working with the blueprints on a mobile device.

The authors sought to determine if mobile device usage has gained traction in undergraduate construction-related courses, as the opportunity to do so appears vast, and the value significant. The balance of this paper describes a survey of faculty teaching in ASC-member and ACCE-accredited construction programs regarding the integration of mobile devices into their programs and classes. The survey instrument design and distribution are explained in detail, along with analysis of the survey results. Limitations of the study and future research thoughts are also provided.

Research Objective and Methodology

The main objective of the study was to determine if, how, and to what extent mobile devices are being utilized in classes by faculty of ASC-member and ACCE-accredited construction programs. The research methodology consisted of a survey comprised of both open and closed-ended questions including general demographic information, such as rank and university affiliation, more detailed questions to discern the respondent's usage of mobile devices, and their opinions regarding mobile device integration. The survey instrument developed and administered by the authors included skip-logic programming to guide survey respondents to different questions depending on how the respondents answered the yes/no question "Do you personally utilize mobile devices in your classes?" Respondents answered 13 questions if they responded "No", and 19 questions if the respondent answered "Yes." Additionally, the survey instrument included the following definition for mobile devices: "A portable (i.e., hand-held) device, such as a smart phone or tablet device that functions through the use of applications (i.e., apps)." Survey takers were asked to consider this definition when completing the survey.

The survey was developed by the authors in Qualtrics, and disseminated to all faculty currently listed on the websites of ASC member and ACCE accredited programs (a total of 695 individuals) via an emailed web link on March 8th, 2018. An email was also sent to all faculty listed on the ASC member listserv (a total of 812 individuals) on March 8th, 2018. Inherently, there was some crossover between these two lists. The survey was distributed a second time to all of these individuals on March 21st, 2018. Moreover, the preliminary survey results were presented at the ASC annual conference in Minneapolis, Minnesota on April 20th, 2018 during the graduate student poster session. The poster itself included a QR code that linked to the survey instrument. The survey was closed at the end of April, 2018.

Survey Results

The authors received 61 complete survey responses, an 8.8 percent response rate (out of 695), or 7.5 percent response rate (out of 812). The respondents included 27 Assistant Professors, 17 Associate Professors, three Full Professors, two Adjunct Instructor, eight School Heads/ Department Chairs, and four respondents that categorized themselves as "Other", which included visiting faculty, retired faculty, and not disclosed. 53 of the 61 respondents (87 percent) teach in construction management (CM) programs, three teach in civil/construction engineering programs (five percent), and five teach in both CM and construction/civil engineering programs (eight percent).

The complete survey results were analyzed based on three categories of questions: (1) general usage of mobile devices (answered by all survey respondents), (2) responses from survey respondents that do not currently utilize mobile devices in their classes, and (3) responses from survey respondents that do currently utilize mobile devices in their classes. The following sections are broken out as such. The general usage of mobile devices section provides comparison between survey respondents that do utilize mobile devices in their classes, and those that do not.

General usage of mobile devices

Survey takers were asked to answer the following question “Does your department/program utilize mobile devices in classes?” Responses to this question were evenly split, with 27 respondents (i.e., 44 percent) answering yes, their department/program does utilize mobile devices in classes, and 27 respondents answering no. Seven respondents were not sure whether or not their departments/programs utilized mobile devices in classes. Table 1 provides a breakdown of responses to the question “Do you personally utilize mobile devices in your classes?” based on survey respondent rank. As shown, 22 of the 61 respondents (36 percent) answered yes, that they do utilize mobile devices in their classes, and 39 of the 61 (64 percent) respondents answered no. Additionally, the two largest groups of respondents, Assistant Professors and Associate Professors, each had 29 percent of respondents (8 out of 27 Assistant Professors, 5 out of 17 Associate Professors) respond that they integrate mobile devices into their classes. Lastly, further analysis of the responses showed that 20 of the 53 respondents that teach solely in CM management programs (38 percent) answered yes, that they do utilize mobile devices in their classes, and 33 of 53 respondents (62 percent) answered no.

Table 1.

Breakdown of survey responses to the question “Do you personally utilize mobile devices in your classes?” based on respondent rank

Rank/Major	Do Utilize (n=22)	Do Not Utilize (n=39)	Totals (n=61)
Assistant Professor	8	19	27
Associate Professor	5	12	17
Full Professor	2	1	3
Lecturer/Adjunct	1	1	1
School head/ chair	3	5	7
Other	3	1	6

Figure 1 provides a breakdown of mobile device utilization in classes based on the ASC region of each survey respondent. As shown, more respondents from Regions 4, 6, 7, and 8, the central and western states, utilize mobile devices in their classes, than respondents from Regions 1, 2, 3, and 5, the eastern, midwest, and southern states.

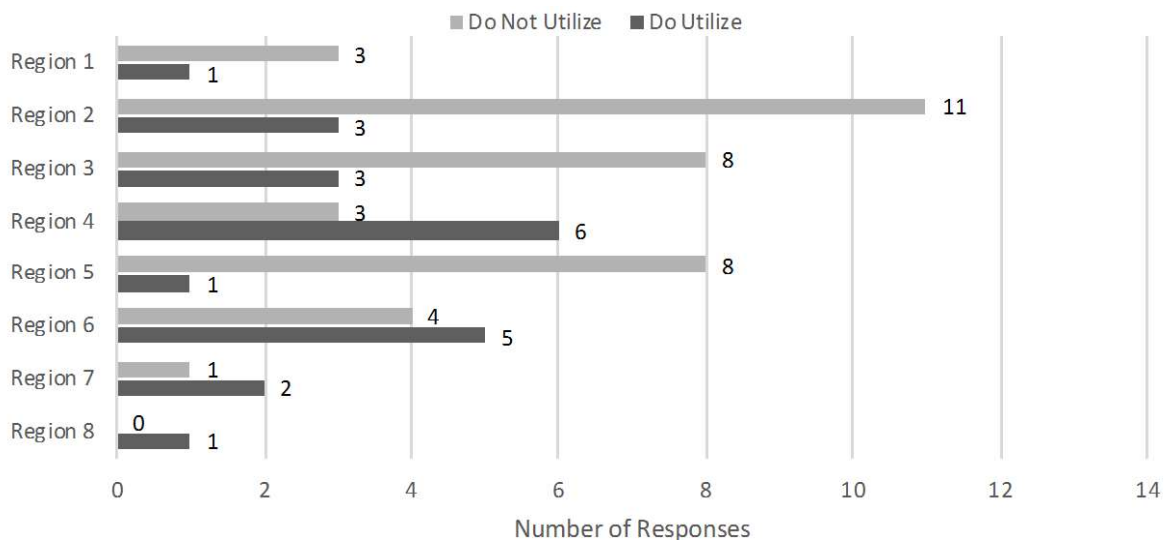


Figure 1: Breakout of survey respondent mobile device utilization based on ASC region

Figure 2 provides a breakdown of the typical CM subjects taught by the survey respondents, split into two groups based on survey respondent utilization of mobile devices in their classes. As shown, only two CM subjects, field operations and accounting, had more survey respondents that do integrate mobile devices into their courses than those that do not. “Other” responses included an assortment of classes such as quality control, environmental systems, concrete construction, building codes, leadership, collaborative practices with architecture, alternative project delivery methods, research methods, and communication.

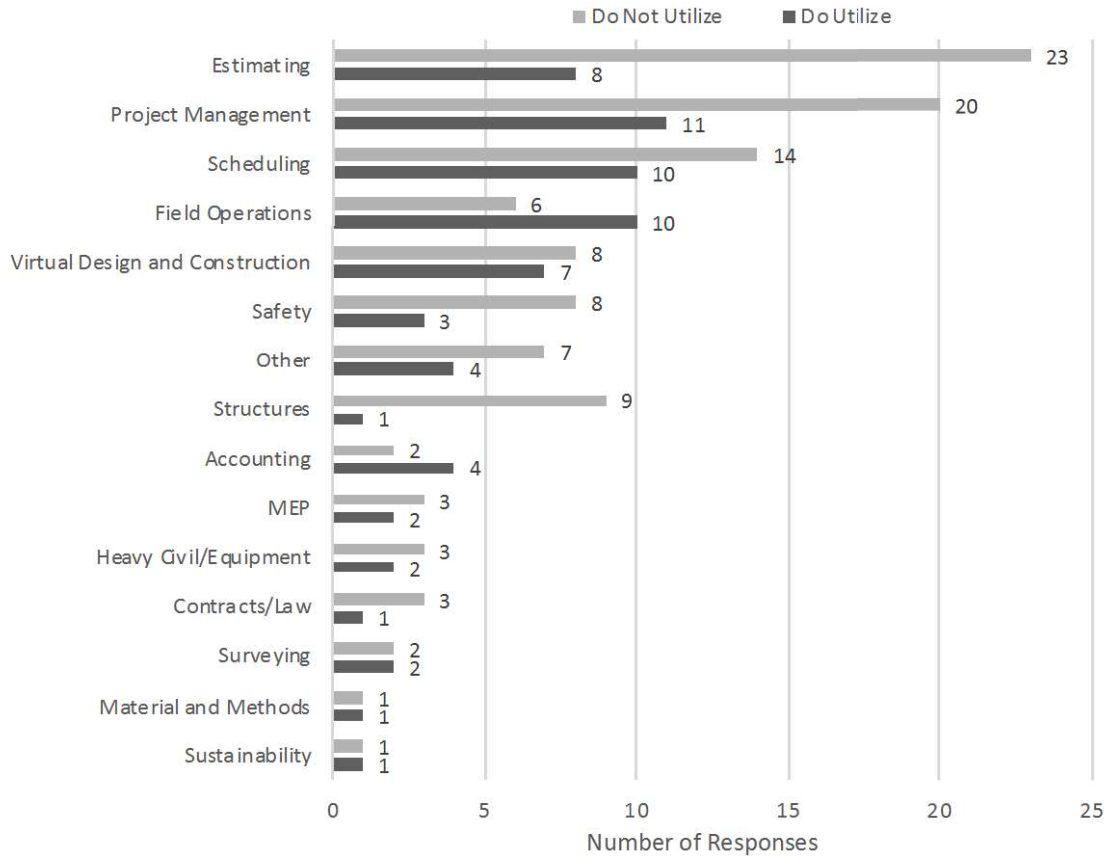


Figure 2: Breakdown of courses taught by survey respondents based on mobile device utilization

Summary of responses from survey respondents that do not currently utilize mobile devices in their classes

Figure 3 summarizes the survey responses to the question “Why do you personally not use mobile devices in your classes?” As shown, the top reason that survey respondents stated was mobile devices were not applicable to their coursework, followed by lack of expertise/experience with mobile devices, technology support, and other. Other included responses such as “Not everyone has a mobile device with the necessary applications.”, “Tried in the past [with] lots of inconsistency.”, and “No time to design activities.”

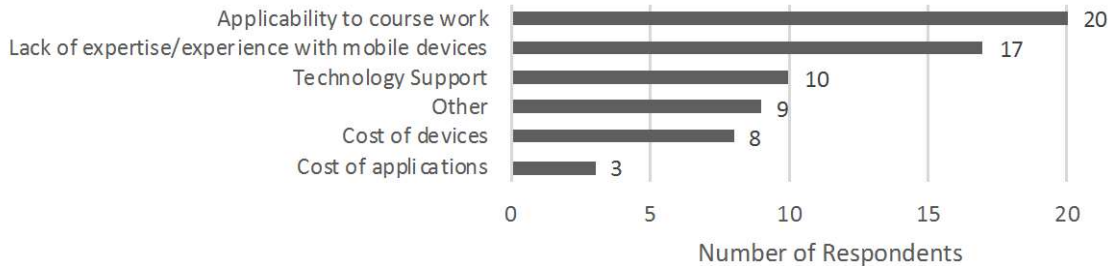


Figure 3: Survey respondent answers regarding why they personally do not use mobile devices in their classes

Figure 4 summarizes the responses regarding two survey questions: “Have you tried to incorporate mobile devices in the past?” and “Would you like to incorporate mobile devices in your classes in the future?” A majority of the respondents, 79 percent, had not previously attempted to incorporate mobile devices into their classes. As well, a majority of respondents, 85 percent, either possibly or definitely (i.e., yes) would like to incorporate mobile devices into their classes in the future.

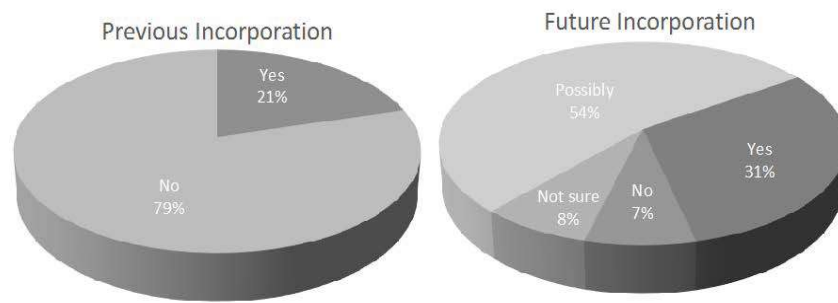


Figure 4: Comparison of previous incorporation of mobile devices into classes vs. future desire to incorporate mobile devices into classes

Survey respondents that do currently utilize mobile devices in their classes

Figure 5 provides a summary of responses regarding what classes the survey respondents integrate mobile devices into. As shown, a majority of the respondents incorporate mobile devices into project management, field operations, plan management/project document coordination, and other classes, with other referring to capstone and internship, introduction to construction management, electrical and mechanical construction, communication, heavy construction equipment, and “in context of studio education.”

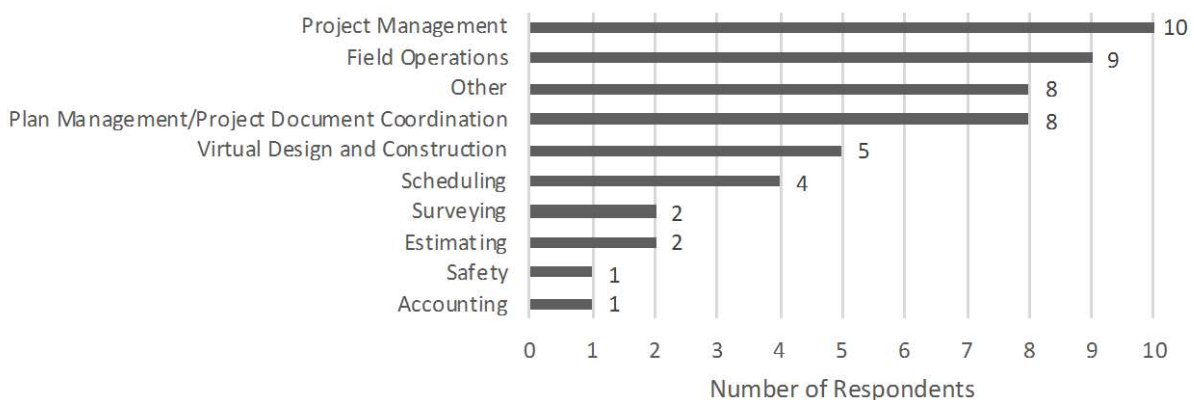


Figure 5: Classes in which survey respondents utilize mobile devices

Figure 6 provides a listing of the mobile applications (i.e., apps) that are utilized by the survey respondents. Procore was found to be the most highly used app, followed closely by Bluebeam Revu, other, and Plangrid. Other apps noted by the respondents included Augment, Youtube, Magnet Construct, NoteVault, Keypoint Interactive, TopHat, Google Drive, Google Docs, Dropbox, and Dewalt Mobile Pro.

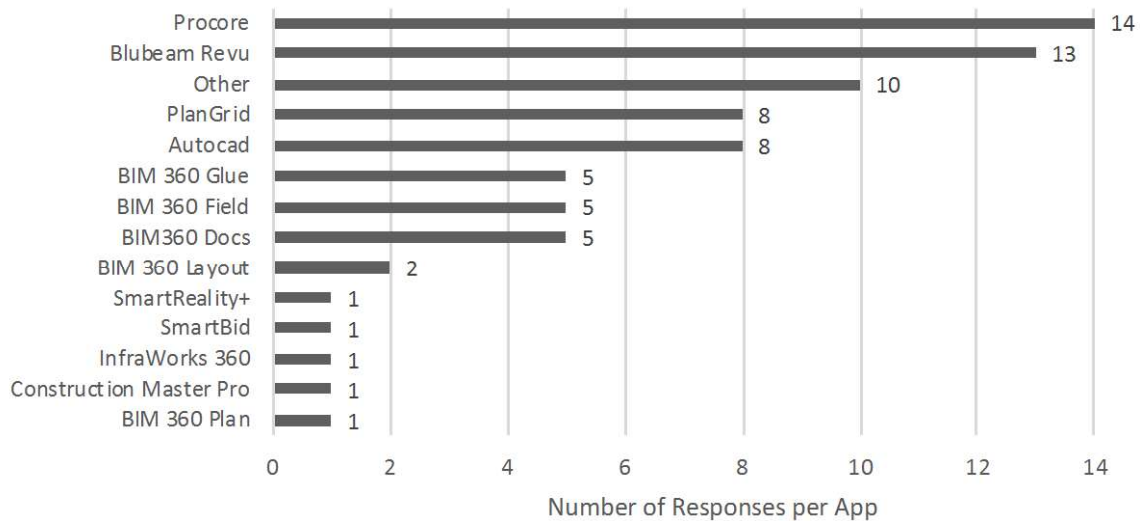


Figure 6: Survey respondent answers regarding what apps they utilize in their classes

Lastly, Figure 7 provides a breakdown of survey responses regarding the length of time (in years) that the survey respondents have incorporated mobile devices into their classes. As shown, a majority of respondents, 41 percent have incorporated mobile devices for over three years. The balance of the survey respondents were approximately evenly split, from less than one year prior to the survey, to two to three years prior to the survey.

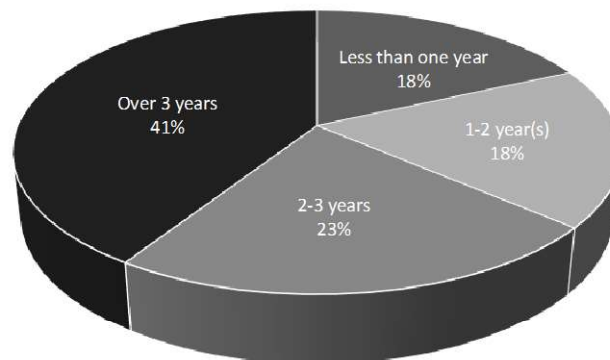


Figure 7: Responses regarding length of mobile device usage in classes

Discussion of Survey Results

The survey results provide several key findings regarding mobile device utilization in construction-related curricula in the United States. The authors contend that the results are generalizable for construction programs within ASC member and ACCE accredited CM programs, as the total sample size ($n=61$) is greater than the standard benchmark for statistical validity ($n>30$). The authors would also contend that these results cannot be generalized for construction programs outside of the United States, as only one survey response came from a faculty member at a foreign program.

First, approximately 1/3 of faculty members utilize mobile devices in their classes, as the total sample showed 36 percent utilization, and the two largest groups of respondents (i.e., Assistant Professors and Associate Professors)

showed 29 percent utilization. These utilization rates are higher than the 20 percent utilization rate found by Chen et al. (2015), but much lower than the percentage of contractors (approximately 80 percent) that feel having a mobile strategy in their organizations is important. This result shows that construction academics should strive to utilize mobile devices into their classes at a higher rate than what is currently being done. This finding is supported by the 85 percent of survey respondents that do not currently utilize mobile devices in their classes, but either possibly or definitely would like to in the future.

The top two reasons that the survey respondents stated as to why they do not currently utilize mobile devices in their classes included (1) mobile devices not being applicable to the coursework, and (2) having a lack of experience/expertise with mobile devices. The authors contend that these are both highly valid reasons to not utilize mobile devices, but both also signify opportunities for construction academics and researchers. It is possible that construction faculty do not perceive that mobile devices are applicable to their coursework because they have a lack of experience with mobile devices. The opportunities here include (1) faculty to personally improve their knowledgebase into mobile device/app capabilities, as it is paramount that construction faculty stay up to date with industry trends to ensure that coursework is applicable to the construction industry, and (2) additional case study dissemination regarding how mobile devices are leveraged in construction classes, building on the work published in Cline and Davis (2013) and Reyes et al. (2015). This sentiment was echoed by one survey respondent that currently does not utilize mobile devices, that commented “If there was a “pre-packaged” lesson plan detailing what exactly is needed and how to effectively teach the lesson, it would help make incorporating mobile devices easier.” Also, a majority of faculty (41 percent) that do utilize mobile devices have so for over three years, hence published examples of successful mobile device integration would provide great benefit to the construction academy.

Three of the top stated apps utilized by faculty, Procore, Bluebeam, and Plangrid, align with the three top applications currently utilized by industry. Moreover, three of the top stated course topics where mobile devices are currently utilize include project management, field operations, and plan management/project document coordination (which could be considered a subset of project management and/or field operations). These results show that some faculty that teach in these topic areas have found ways to successfully integrate the most industry-relevant apps into their courses. A significant number of faculty teach project management do not utilize mobile devices, as shown in Figure 2. These faculty have vast opportunity to leverage apps, which the authors assert could greatly improve the student’s experience in the courses, and flatten the student’s learning curves when entering industry as interns and new-hires.

Conclusions, Limitations, and Future Research

The main objective of the study was to determine if, how, and to what extent mobile devices are being utilized in classes by faculty of ASC-member and ACCE-accredited construction programs. A survey of 61 faculty from ASC member and ACCE accredited construction programs showed that approximately 1/3 of construction faculty in the United States utilize mobile devices in their classes. These faculty leverage the most common industry apps to teach project management and field operations coursework. The main reasons that faculty do not currently utilize mobile devices include a perceived lack of applicability of apps to their coursework, and a lack of expertise with mobile devices. A majority of faculty that do not currently utilize mobile devices would either possibly or definitely like to do so in the future. The research and findings are limited to United States-based construction programs, and may not be generalizable to programs outside of the United States.

As stated by JBKnowledge (2017), “The iPad is the new hammer!” This sentiment, along with the results of this study, clearly show that mobile device utilization in industry, as well as the classroom, should continue to be fostered. The authors would suggest that any faculty member that teaches construction-related coursework experiment with incorporating mobile devices into their courses. Future research into mobile device utilization should seek to (1) discern why mobile device utilization differs between geographical regions in the United States (as shown in Figure 1), (2) why mobile device have been utilized by some faculty for many years, yet there are many faculty that still do not utilize mobile devices, or even attempted to, and (3) case studies developed that describe in detail how mobile devices have successfully been utilized in construction curricula.

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