EMPLOYERS’ PERCEPTIONS OF TECHNOLOGY COMPETENCY AND GRADUATES’ READINESS: A MULTI-DISCIPLINARY, QUALITATIVE ANALYSIS IN THE SOUTHEASTERN UNITED STATES

M. Maghiar1, X. Song2, C. Brown1
1Georgia Southern University (UNITED STATES)
2Central Michigan University (UNITED STATES)

Abstract
As technology is pervasive in all aspects of life, students’ technology competency becomes essential in all disciplines of higher education. To fully prepare college graduates to function competently and productively in their career, it is important to examine employers’ views of technology competency and our graduates’ readiness. Obtaining employers’ perspectives not only engages employers in building skills of their potential employees, but also fills in a gap between academic program outcomes and workplace competencies or expectations. Using a qualitative approach by interviewing employers in South-eastern United States across a range of fields, the authors described the major functions and dimensions of technology competency, compared similarities and differences across the disciplines, and integrated the results to inform theory and pedagogy. The main purpose of this research was to investigate how well new graduates from selected disciplines can transfer technological skills, how they learned and/or used these skills during their program of study. Technology skills may be required in the performance of their first jobs as they transition from classroom to employment so that curricular changes or revisions can be made if needed to improve outcomes. Over this manuscript, investigators also introduced how a multi-disciplinary approach, which involved faculty from different backgrounds (Civil Engineering and Construction, Education and International Trade) through the Scholarship of Teaching and Learning (SoTL) —Faculty Learning Communities (FLCs), was used to explore perceptions of technology competency. Using the semi-structured interview protocol, the investigators interviewed four participants as company technology supervisors, two school principals and two other business managers. Results showed that all participants were dependent on the use of technology, but the degree of sophistication varied widely. While the participants reported their new hires were able to use foundational technology, the actual usage varied among the disciplines and their discipline-specific technology knowledge was often limited. Overall, the study recommends that use of discipline-specific software should be incorporated into curriculum with more depth. Institutes of higher education (IHE) need to continue fostering students’ soft-skills such as teamwork and self-efficacy, so graduates will be better prepared in the workplace. As a different facet of this investigation, experiences and strategies regarding collaboration and learning experiences of the SoTL project will be shared and an in-depth understanding of technology competency defined by employers through the results of the study will be presented. The paper will comment on the value of collaboration and the faculty learning community in nurturing the SoTL research culture. The results will demonstrate major functions and dimensions of technology competency across and within the disciplines. The study is providing valuable information to the investigators for use in strengthening, improving or revising educational curricula and/or pedagogical strategies to improve outcomes of the educational process involving technology skills pertaining to the respective fields.

Keywords: technology, competency, readiness, software, soft-skills.

1 INTRODUCTION
Programs in our work places design buildings, analyze potential structural problems, and suggest materials for construction. Technology runs business, keeps track of money and inventory, facilitates “meetings” with people from all over the world by way of virtual “meeting rooms” and provides us with information that allows for business decisions and tracks international markets. As technology is pervasive in all walks of life and almost every field of human endeavor, students’ technology competency becomes essential in all disciplinary areas in higher education [1].

Because of the dependence on technology in the professional world, higher education must prepare students to be able to use both basic and specific technologies required for job performance in their selected professional pursuits after graduation. However, there is a growing concern about the extent
that students’ educational preparation may not be keeping pace with the demands and expectations of corporations and companies who will employ college graduates. Research is needed to examine how well graduates are prepared to be able to transfer/transport classroom learning to workplace applications and experiences.

1.1 Construction and Civil Engineering field

BIM (Building Information Modeling) represents now a major aspect in the future of the construction industry, and it is clear that higher education will play a major part assisting to prepare graduates with the relevant skills required in the industry. However the major question educators in this field need to address is that current structure of education we experience today through curriculum in place is sufficient enough to provide the industry with BIM-ready skills, or at least reasonably BIM skilled graduates today though and, if not, what challenges may higher education face? These questions are essential and are needed to be addressed by all educators in construction and civil engineering programs.

One of the first challenges in the university and college environments is to increase awareness of BIM amongst the existing teaching staff within institutions. If BIM is to be developed and integrated into undergraduate courses then members of staff who may not be directly impacted by BIM still need to be made aware of it and understand why institutions are pushing forward in the direction of BIM. Additionally, this more specialized and individual professional learning will more than likely be required by staff to ensure that all those involved in the delivery of BIM are competent and understand what they are advocating. This is an area where maybe the government needs to work together with higher education institutions and agree upon a clear plan which can then be deployed and conveyed to all higher education universities and colleges teaching in the built environment curriculums [2]. Even though the topics of BIM are quite unique and they may stay at the core of technology competence expected from graduates prepared in academic environment, it may be that the technical skills acquired to professionally address and analyze solutions to construction operations in this industry to be limited when judged through the lens of BIM only.

One of the issue which concerns educators is how BIM is integrated across the construction and civil engineering curriculum. Construction students should at least leave university with an awareness of what BIM actually is and what it means to them; not only as an individual but also as a part in the overall spectrum of the industry. The difficulty will be in ensuring that the differing disciplines who are studying in their fields of expertise gain the appropriate amount of skills which are needed, beyond that of an initial cognizance. This is something which needs to be continually developed and accessed as BIM in the industry naturally develops, education should follow the case and adapt its processes to ensure that the graduates are leaving with the right skills [2].

Another issue in teaching BIM is dealing with the complexity of some BIM concepts. It is paramount that the skills and theory that are to be taught do not confuse students more than when they started. When something is hard to define it can also be difficult to teach, an aspect which BIM can be guilty of sometimes. Teaching needs to be clear that BIM goes beyond that of the 3D model, with efficient information sharing a critical factor which needs to be adopted and understood [2].

With all difficulties and challenges lying ahead, teaching possibilities in the BIM arena are growing over the entire Civil Engineering and Construction Management (CE and CM) curriculum within nation’s Universities. The way in which BIM can be taught and the impact BIM could have on teaching is always an important consideration with great implications on the technology related courses. Clearly there is a broad spectrum of possibilities encasing the following aspects:

- the technology used in the course offering and the approach adopted
- the application(s) to enhance understanding of the process in which BIM is embedded
- the all-embracing pedagogy [3]

In addition, specific CM and CE courses may be cross-listed in the curriculum and they may have the potential of introducing students to modeling topics of interest within the taught curriculum in an attempt to expand the overall BIM and CIM (Civil Information Modeling) adoption in departments’ curriculum framework. These topics are of particular interest for academic instructors working closely with industry because they are challenged to certain recommendations the industry would like to get across the curriculum before hiring graduates:

- updating skills of the respective faculty to support the delivery of the desired learning outcomes
efficient framework for learning to variety of students
keeping the pace with the development of BIM in construction and software industry
increasing student employability
moving the classroom topics closely related to industry field-specific problems [3]

The specific objectives envisioned by Maghiar and Fu [3] for a potential standard framework to expand BIM and CIM adoption within taught curriculum are revolving around growth of BIM and CIM implementation and understanding of this trend in industry setting:

• focus on training and elevate the learning; also research aspects of BIM and CIM and their implementation in industry
• mutual promotion of BIM and CIM (expand the trend to more trade-specific markets)
• establish open medium for communication, consequently sharing knowledge, experience, case studies, opinions, etc.
• collaboration for joint activities and research projects with industry
• research matters for teaching and learning in the BIM and CIM arena
• challenge to create standard practices for BIM and CIM incorporation across curriculum

Therefore, as the industry continues to implement BIM or CIM and gear itself to improve productivity and safety of all operations, the demand for CE and CM graduates will not only be disciplinary competences but also some level of BIM knowledge and capability that will continue to increase. Also, students are becoming increasingly aware of the importance of BIM as further enhancing their employability skills in an emerging construction and civil engineering market and, along with accreditation, this is important in their choice of an appropriate curriculum.

1.2 Education and International Trade fields

Technology is considered as one of the two cross-cutting themes in teacher education [1]. Teachers should not only manage the use of technology in the classroom for learning to improve instructional practice and maximize student learning, but also use technology to communicate and collaborate with students, parents, teachers, administrators, and global community productively ([4],[5]). Various theoretical frameworks have been adopted in developing and evaluating pre-service or in-service teachers’ technology competency by accreditation bodies and state department of education ([6], [1]). However, it is not clear how teachers’ technology competency is defined by school board officials and school administrators.

Employers are also concerned that the portability of skills from the classroom to the workplace is lacking and utilizing technology in the workplace is requiring extensive orientation and “on-the-job” training (OJT) much of which should have been taught in the classroom. While it is recognized and acknowledged that it is not possible to learn to use every specific application that students in business, industry, or education, employers are noticing—and being verbal about—the lack of basic technology literacy such as the use of spreadsheets, databases, and information systems which can reduce the time spent in orienting new employees to the specifics of utilizing the programs needed in day-to-day job performance [7]. Extended orientation means more time and manpower is spent by the company or agency that hires new graduates and an extended learning curve means that the new employee’s full productivity is delayed as well. This situation means increased time and money invested by the company/agency and is becoming increasingly costly for the employing companies/agencies. This could affect the ability of a new graduate to obtain employment in his/her chosen field. Employers clearly are looking for graduates that are “work ready” and able to use and build on basic computer skills needed to perform in a competitive world market.

Higher education needs to respond to these concerns and perhaps form partnerships with the institutions and companies that hire new graduates to work together more collaboratively to solve this problem. To that end, the purpose of this proposed project is primarily to interview a variety of the employers in companies/agencies (e.g., Civil Engineering and Construction, International Trade, and Education) that hire graduates to assess how technology is used in their company/agency, how well graduates from a variety of programs generally and Georgia Southern University specifically are prepared to move quickly into a productive, independently operating employee, and where the gaps are. This will help educators like the authors of this manuscript to make curricular changes or revisions
so that what we are expecting as educational outcomes will meet the preparedness needs of both new graduates entering the job market and the needs of the businesses that are hiring new graduates. To fully prepare college graduates to function competently and productively in their career, it is important to examine employers’ views of technology competency, especially in current work settings in which employees are often expected to keep abreast of substantial technological innovations. Obtaining employers’ perspectives not only engages employers in the conversation of building the skills of their potential employees, but also fills in a gap between academic program outcomes and workplace expectations. It helps to enhance knowledge transfer from classroom to workplace.

The study will adopt a multi-disciplinary approach, which involves multiple disciplines in juxtaposition (e.g., Civil Engineering and Construction, International Trade, and Education) in exploring technology competency. Information and perceptions collected from multiple disciplines are likely to advance understandings of technology competency beyond the scope of a single discipline [8]. As specific theories, approaches and practices may be standard for one discipline but novel in other fields, integrating theories and knowledge in a multi-disciplinary manner provides a unique, informative angle to investigate technology competency. Understanding employers’ expectations of the use of technology in the workplace will assist in devising strategies for improved application and transfer of student knowledge as a new employee.

2 METHODOLOGY

The investigators interviewed a total of eight employers from a variety of company/agency types. They interviewed company representatives/ supervisors at companies/agencies that depend on the use of technology in the workplace for job performance that newly hired graduates are expected to use in their positions. The list of companies/agencies were obtained from each of the investigators involved in the study and represented companies that each investigator had familiarity with either through prior association, company reputation, or through known companies/agencies that hired graduates from the types of programs represented by the three investigators.

Participants in this investigation were contacted by phone or electronic means and asked if they would be willing to participate in the study. The study was explained in detail including the decision not to participate and any questions about the study will be answered at that time. Willingness to participate constitutes consent. A copy of the consent form was provided through either electronic transmission or through mail if the participating representative/supervisor of the company/agency wishes to have this for their records. An appointment, which were either by phone or face-to-face, were made to gather the study data. No incentives were provided for participation in the study. Each company/agency were identified only by company type. The data gathered were audio-recorded.

The investigators gained some insight into how well graduates from a variety of educational programs generally and Georgia Southern University graduates in particular are equipped to enter the workplace and to gather data that can help with making curricular changes or adjustments that could potentially improve educational outcomes for the programs investigated especially in light of the concerns and criticisms currently reported in the literature. While the investigators may find similar results as those currently encountered in the literature review across disciplinary areas, it is the investigators’ hope that both educators and employers could potentially find solutions for improved outcomes for all parties involved. The results additionally could provide incentives for the formation of education/employer partnerships that could provide a winning situation for all concerned: educational programs which prepare students, the businesses and agencies who hire these new graduates, and the new graduates who will be hired. Both the representatives/supervisors of the companies/agencies that participate in the study as well as other educational programs or employing institutions seeking similar solutions might use the information from the study to dialogue about possible solutions to similar problems.

Each company/agency representative/supervisor was contacted and a time and place for each interview was arranged. Each investigator was then responsible for contacting and interviewing the representative/supervisor of the company/agency for which each has submitted company/agency names included on the list of participating companies. The semi-structured interview had taken place either by conference phone or in a face-to-face situation and a list of open-ended questions outlined on an Interview Guide (crafted and refined by all investigators) was asked. The Interview Guide was designed to allow for the collection of data specifically concerning graduates of similar educational programs from outside of Georgia Southern University and, specifically, Georgia Southern University graduates. The questions were providing guidance for the interview, but were also allowing for follow-up on any statements/information that may arise during the course of the interview. It was expected that each interview may take approximately 1 to 1¼ hours to complete. The investigators made plans as the interviews to be audio-recorded in order to retain the exact nature of the information obtained during the
course of each interview. As well, the investigators may take notes to allow for follow-up of information provided during the course of each interview. The recorded interviews were transcribed and the data was analyzed as outlined below. The expectation regarding the appointments to conduct and complete the interviews was to take 2-3 months depending on the ability of each company/agency’s representative or supervisor to schedule time for the interview, however the total duration to collect all this data in the three fields mentioned above (after approval of the Institutional Review Board) was exceeded one full-term academic year. This fact was recognized as one of the challenges to coordinate a multi-disciplinary qualitative endeavor of this magnitude in three different fields of study.

3 RESULTS OF THE STUDY

The following chapters are offering introspection into details of the results for all qualitative interviews and the data classification followed by overall examination and synthesis of data obtained.

3.1 Participants’ interviews

The synthesis of the interviews and their attributive data is exemplified in the qualitative analysis compiled into the large table below. This data also includes details on specific employers’ responses for the questionnaire applied in each case.

Authors have planned to analyze the data qualitatively in a modified form to see how well the findings match those reported in current publications and as the basis for potential curricular changes or revisions to enhance/improve educational outcomes. Researchers have looked specifically for perceived strengths, weaknesses, opportunities (either missed or captured by either the newly hired graduate or the company/agency that has hired the graduate) which may enhance job preparedness or threats that could/may retard the newly hired graduate’s ability to meet expectations for the use of the technology in the performance of the position s/he was hired to fulfill within the expected time frame of the company/agency.

3.1.1 Qualitative data and response analysis

The purpose of authors’ proposed project was primarily to interview a variety of the employers in companies/agencies (e.g., Civil Engineering, International Trade, and Education) that hire graduates to assess how technology is used in their company/agency and how well graduates from a variety of programs generally in SE United Stated and Georgia Southern University specifically are prepared to move quickly into a productive, independently operating employee, and where the gaps are. This will help the authors (as educators) to make informed curricular changes or revisions so that what are expecting as educational outcomes will meet the preparedness needs of both new graduates entering the job market and the needs of the businesses that are hiring new graduates.

3.1.2 Identified themes and codes for the qualitative analysis

The following themes were identified and coded from the interviews with all potential employers:

- Participants’ background
- Technology uses/names in the profession
- Purposes of technology uses
- Technology competency
- Principle for technology use
- Strengths and weaknesses: New hires/applicants
- New vs. Experienced GSU graduates
- Timeline to be productive
- Training
- Interfering factors to become effective employees
- Cost
- Suggestions for post-secondary education

The resulted data is placed in the Table 1 below. Each participant was assigned also an unidentifiable numeration code placed in the header of this Table (e.g., Participant Ed1, EN1, Trade1, etc.)
<table>
<thead>
<tr>
<th>Themes/Topics</th>
<th>Participant E-I</th>
<th>Participant G-I</th>
<th>Participant D-I</th>
<th>Participant E-II</th>
<th>Participant D-II</th>
<th>Participant E-III</th>
<th>Participant D-III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional background</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Participate in the strategic planning and decision-making processes</td>
<td>2. Engage in team-based projects and collaborative work</td>
<td>3. Lead and manage projects, teams, and resources</td>
<td>4. Participate in the development and implementation of professional development initiatives</td>
<td>5. Engage in coaching and mentoring activities</td>
<td>6. Participate in the design and delivery of professional development programs</td>
<td>7. Engage in research and scholarly activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology competencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Ability to use and manipulate various software tools and applications</td>
<td>2. Ability to troubleshoot and resolve technical issues</td>
<td>3. Ability to design and develop technical solutions</td>
<td>4. Ability to analyze and interpret data</td>
<td>5. Ability to communicate technical concepts effectively</td>
<td>6. Ability to work collaboratively with team members</td>
<td>7. Ability to lead and manage technical projects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purposes of technology use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. To support decision-making processes</td>
<td>2. To enhance communication and collaboration</td>
<td>3. To facilitate research and scholarly activities</td>
<td>4. To support professional development initiatives</td>
<td>5. To support the design and delivery of professional development programs</td>
<td>6. To support coaching and mentoring activities</td>
<td>7. To support the development and implementation of professional development initiatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology implications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Ability to use and manipulate various software tools and applications</td>
<td>2. Ability to troubleshoot and resolve technical issues</td>
<td>3. Ability to design and develop technical solutions</td>
<td>4. Ability to analyze and interpret data</td>
<td>5. Ability to communicate technical concepts effectively</td>
<td>6. Ability to work collaboratively with team members</td>
<td>7. Ability to lead and manage technical projects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strengths and weaknesses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenges and opportunities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Difficulty in keeping up with new technologies and trends</td>
<td>2. Lack of time to develop new skills</td>
<td>3. Difficulty in finding opportunities for professional development</td>
<td>4. Difficulty in finding opportunities for leadership positions</td>
<td>5. Difficulty in finding opportunities for project management</td>
<td>6. Difficulty in finding opportunities for research and scholarly activities</td>
<td>7. Difficulty in finding opportunities for coaching and mentoring activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future directions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Table 1. Study participants with identified themes/codes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4 CONCLUSIONS

The purpose of the proposed research project was to find out how well college graduates from different disciplines are prepared to enter the workplace as new employees; especially in the ability to use basic technology effectively in the performance of their job. Current literature, a good portion of which has been published either outside the U.S. or has emanated from technical schools/colleges, shares concerns about the ability of new graduates of post-secondary educational programs to use basic technological programs effectively. The use of basic technology skills is referred to as a “hard” skills. However, the ability of new graduates to be “self-starters”, especially during their orientation and/or probationary period, set learning goals, work out a plan of how to gain the necessary skills, and monitor their own progress is lacking. These skills are referred to as “soft” skills. This factor increases the new employee’s orientation time, increases company expense, and results in lost productivity.

While our research study was focusing on the effective transfer/portability of basic computer skills from higher education to the workplace, factors which may impact this process were also addressed. This investigation has the potential to improve outcomes for both employing companies/agencies and the educational programs that produce the graduates who are hired by the companies/agencies. The qualitative analysis of the interviews conducted with potential employers in these areas have helped the authors to identify five common issues/concerns that could produce results and impact the existing curriculum in the investigated fields of study as they are carefully and periodically revised. Those five common “adaptive” elements to be incorporated in the general curriculums are:

1. There are two types of technology competency: workplace competency and technical competency
2. There are two purposes in technology skills transfer: “to work” and “to communicate”
3. Employers are generally providing training about 6 months and it is perceived as costly
4. Technology is a “strength” compared with other skills, in general
5. The need of higher education is to focus on technical competency

ACKNOWLEDGEMENTS

All the contributors in this study would like to acknowledge the assistance, encouragement and support (non-financial) received from the Centre for Teaching Excellence (CTE). This centre provides support for teaching and learning through face-to-face, online, and blended classroom environments. The CTE supports faculty with research-based pedagogical and technological resources for designing, implementing, assessing, and researching effective and innovative instructional strategies as well as learning technologies that foster academic excellence at Georgia Southern University. This SoTL-FLC research was stemmed from one of the past round-table initiatives to conduct this type of projects which benefit interdisciplinary faculty collaborations and in some cases bridge the collaborations with industry.

REFERENCES

[6] Kirschner, Paul; Selinger, Michelle, "The state of affairs of teacher education with respect to information and communications technology", *Technology, Pedagogy and Education*, vol. 12, No. 1, pp. 5-17, 2003
