Modern Workforce Skills and Knowledge Development in Computing Curricula

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Keywords: Entrepreneurship; Innovation; Professional Skills; Curriculum design; Learners’ Perspective; Business Plans.

Extended Abstract

Introduction

Today’s computing and engineering college graduates must be academically and professionally prepared to enter the dynamic modern workforce as productive workers (Joseph, 2013). This workforce promotes sound technical and analytical skills, lifelong skills and knowledge development, strong work ethics, problem solving skills, entrepreneurialism, creativity, innovative intelligence, self-management, teamwork, flexibility, business savvy, strong communication skills, and emotional intelligence (Byers \textit{et al}, 2013; Joseph, 2014; Weiss & Legrand, 2011). Moreover, the workforce is becoming increasingly dependent on contingent workers (Joseph & Payne, 2011; Joseph, 2013) with weaker work contracts. If computing and engineering programmes are to adequately educate and train their graduates for workplace readiness, most would need to be redesigned to include entrepreneurship, creativity, innovation, and teamwork to be compliant with the modern workplace (Altschuller, 2007; Byers \textit{et al}, 2013; Joseph, 2014; Katzenbach & Smith, 2003; Smith. & Imrie, 2007). Entrepreneurship education is an essential disciplinary vehicle for training technical students for the current workforce (Byers \textit{et al}, 2013; Ezeudu, 2013; Karoly, & Panis, 2004). Furthermore, current cooperative education/internship programmness are generally not sufficiently comprehensive to allow knowledge transfer between the theory-practice domains (Joseph & Payne, 2011).

To prepare students for the modern knowledge-based economy workforce, the university, industry, and government need to collaborate closely to educate and train students (Etzkowitz & Leydesdorff, 1997; Zheng, 2010). One solution is infusing entrepreneurship in computing and engineering curricula with government and active industry support. At present, very few computing programmes offer entrepreneurship courses (Byers \textit{et al}, 2013; Joseph, 2014). Moreover, most entrepreneurship courses offer little or no formal instruction in innovation and/or teamwork (Joseph, 2014). We secured

government funding and industry support to develop and offer four interdisciplinary computing courses that included entrepreneurship, innovation, and teamwork components (Altschuller, 2007; Byers et al., 2011; Katzenbach & Smith, 2003; Smith & Imbrie, 2007; Strober, 2011; Weiss & Legrand, 2011). This study highlights two of these courses to determine the extent to which students who completed the courses increased their skills, knowledge, behaviours, and attitudes in terms of the requisite modern workforce skill clusters (digital-age literacy, inventive thinking, effective communication, and high productivity) (Burkhardt et al., 2003).

Methods and Materials
The four courses were Technology Entrepreneurship, Financial Computing and Entrepreneurship, Modeling Financial Processes and Systems, and Entrepreneurial Health Informatics. Each course was supported by guest lecturers, industry mentors, instructor monitoring and support of teams, product/service development, and business plan creation. Each student team solved a team-identified financial or healthcare problem under the guidance of a mentor. Except for the first instance of the Technology Entrepreneurship course, the courses were taught using the project-based learning strategy to provide students with a sense of workplace realism replete with frequent deliverables and oral presentations. The mentors also provided the instructor with feedback on improving the courses’ workplace relevancy. Each team’s final deliverable included an algorithmic solution of its problem with a supporting business plan. The two courses used in this study are Technology Entrepreneurship and Modeling Financial Processes and Systems. The instruments used to evaluate the courses included pre-/post-class Student Assessment of Learning Gains (SALG) surveys. Of the six pre-class survey item categories and the 10 post-class survey item categories, four overlapped: understanding, skills, learning transfer, and attitudes. The open-ended versions of these four categories were mapped into the skill clusters of the knowledge-based economy workforce.

Results
From the mapping of the pre-/post-surveys’ open-ended questions to the knowledge-based economy workforce skill clusters, it was observed that students wanted to gain the most in digital-age literacy and the least in effective communication, while moderately for inventive thinking and high productivity with a 18.9% difference. However, the overall finding was that students’ actual gains relative to their expected gains were greatest in effective communication and lowest in high productivity: 300% and -69% respectively. The overall relative change in gains for digital-age literacy and inventive thinking were moderate: -7.9% and -16.7% respectively. When the pre-/post-survey questions pertaining to knowledge acquisition and learning transfer were examined, a relative change in gains of 114.3% and 1125% respectively were discovered for effective communication and a relative change in gains of -100% and -75% respectively were discovered for high productivity. Students also reported a strong relative change in gains of 48.9% for digital-age literacy under knowledge acquisition and a moderate change in gains of 20% for inventive thinking under learning transfer. On the post-survey question soliciting the courses’ impact on students’ learning/studying attitudes, 42% of the responses related to inventive thinking and 25% related to effective communication; digital-age literacy and high productivity-related responses were evenly divided.

Discussion and Conclusion
In general, students enrolled in the interdisciplinary computing entrepreneurship courses with high expectations for gains in digital-age literacy and low expectations for gains in effective communication skills, but they completed the courses with relative gains in effective communication exceeding 100%,
and in one instance, exceeding 1000% for the learning transfer question. Except for knowledge acquisition (understanding), the students’ survey responses pertaining to skills and learning transfer did not show any positive change in gains for digital-age literacy. However, the gains in expected skills and acquired skills were essentially the same. Moreover, the least actual gains were associated with high productivity. These findings imply that the mostly computing students expected to gain greater knowledge, skills and learning transfer in computing, with moderate gains in associated inventive thinking and high productivity skills. Instead, they experienced overwhelmingly high relative gains in effective communication, the modern workforce professional skills that are easily transferable between workplace contexts. This result is likely a consequence of the direct instruction of teamwork skills, team monitoring and support, and students’ interactions with mentors. Although high productivity was an objective of the courses and the instructional strategy was changed to project-based learning to facilitate increased interaction between team members, the teams and their mentors, and teams and the professor, the quality of some of the products/services that emerged could have improved if the teams had embraced the modern workforce behaviours of high productivity skills rather than the typical classroom project assignment model. However, some teams did produce products/services with market potential by the end of each course.

Acknowledgement

This material is based upon work supported by the National Science Foundation under Grant Number: 0942732.

References


