Cultivating Applied Technology Competencies in the Apparel and Textiles Curriculum: Development and Assessment of Course Materials and Teaching Strategies*

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Background. According to a study conducted by the Society for Human Resource Management on future workforce changes in the U.S. (SHRM, 2016), education level requirements will continue to increase, as will the number of jobs with specific technical requirements. Moreover, graduates are entering a workforce that expects them to be capable of learning and implementing new technologies on a regular basis (Wilen-Daugenti, 2009). Therefore, they must be competent in technology as applied to the workplace and not just to leisure activities (Guiliano, 2015). Likewise, graduates of apparel and textile programs are expected to be skilled in the technologies used within the industry. Specific to the apparel industry workplace, virtual/3D technologies have recently experienced tremendous growth and levels of firm adoption (Arribas & Alfaro, 2018), particularly due to the COVID-19 pandemic, which restricted most, if not all face-to-face workplace interaction globally (Gonzalo et al., 2020; Subashini et al., 2020).

The literature on technology in the workplace indicates that the usefulness of applied technologies (i.e., those technologies that are relevant to accomplishing work-related tasks) depends in large part on the users themselves. For example, Penaranda, Mejia, Romero, and Molina (2010) found that lack of employee commitment to using an applied technology system, along with the learning curve related to it, were the primary barriers to adoption and/or full integration. Likewise, a key reason for the "adoption gap" is lack of technological readiness among employees (Hodges et al., 2020; Mossinkoff & Stockert, 2008). However, the extent to which lack of commitment and readiness on the part of employees impacts firm technology adoption can be addressed before an employee is even hired, by ensuring that this readiness is part of undergraduate curricula within institutions of higher education. Consequently, an understanding of virtual/3D technology is critical for ensuring that students have the knowledge and skills necessary to lead the industry into the future.

Purpose. The purpose of this paper is to report on the products, results, and outcomes of a three-year project funded by a Collaborative CG2 United States Department of Agriculture (USDA) Higher Education Challenge Grant that addresses the need for future professionals with competencies in virtual/3D technologies. The two primary goals of the project were (1) to foster awareness of the importance of applied virtual/3D technology competencies for professional development among diverse undergraduate student populations and (2) to cultivate the applied virtual/3D technology competencies necessary for their workplace success as graduates. For the

purposes of the project, competency in applied virtual/3D technology pertains to the knowledge, skills, and abilities to use technology effectively for performing and supporting organizational processes, specifically critical decision-making, collaboration and teamwork, and project management and leadership (Ibáñez et al., 2010). Additional competencies addressed by the project were creative problem-solving and spatial visualization (Baytar, 2018; Park et al., 2011).

Project Phases and Outcomes. The project involved faculty at three U.S. universities and occurred in three phases. Phase I involved both primary and secondary data collection and analysis. A total of fifteen interviews were conducted with apparel industry professionals and focused on the role of virtual/3D technologies within the industry overall and specifically within their firms. Participants were also asked to share their perceptions of the knowledge and skills needed by students relative to industry-specific virtual/3D technologies. In addition, during this phase, a survey was distributed to faculty in apparel and textile programs. The survey focused on the types of virtual/3D technologies that faculty teach, the specific courses they teach, and the issues and challenges that they face in terms of virtual/3D technology. In addition, during Phase I, a pre- and post-test survey instrument was designed for use in assessing project outcomes.

Findings from the primary and secondary data were then used to inform Phase II of the project, which involved the development and testing of teaching strategies and learning activities for use within existing apparel and textile program courses. Activities were developed to address one or more of the five competencies outlined in the literature, along with compilations of readings, videos, and other resources that would be useful for faculty looking to teach virtual/3D technology in their courses. Virtual modules (v-modules) were then developed that integrate the course materials and resources. A total of five v-modules were created, each designed for use by faculty in teaching virtual/3D technologies. In addition, during Phase II, the pre- and post-test survey designed in Phase I was tested to ensure the reliability of developed measures.

Phase III involved the completion of the course materials, resource collections, and five v-modules. Each v-module targets one of five competencies defined in the literature on virtual/3D technology learning and includes materials designed to address specific courses or content areas within the apparel and textile curriculum, including textiles, sourcing/supply chain management, merchandising, buying and promotion, and design/product development. Activities were tested at the three universities in existing undergraduate courses.

Results. A total of 338 complete and matched pre- and post-test data from three universities were analyzed to examine the effectiveness of the activities for increasing self-efficacy. The EFA resulted in 16 items out of 27 being retained after excluding items that were either cross-loaded or with low factor loadings (below 0.4). As a result, three factors were identified: *skill/knowledge self-efficacy*, *attitude self-efficacy*, and *comprehensive self-efficacy*. Results of the CFA indicated good model-data fit of the three dimensions of the self-efficacy structure (GFI=0.91, NFI=0.95, CFI=0.96, and TLI=0.95). All factors had reliabilities above 0.70. Average variance extracted (AVE) values above 0.50 were used to establish convergent validity. The activities were found to be effective in enhancing students' self-efficacy in the context of virtual/3D technology for all three categories of self-efficacy: skill/knowledge self-efficacy ($M_{Pre\text{-}test} = 3.35$ vs. $M_{Post\text{-}test} = 3.58$, $t = -5.784$; $p < .001$), attitude self-efficacy ($M_{Pre\text{-}test} =$

3.16 vs. $M_{Post\text{-}test}$ = 3.35, t = -4.553; $p < .001$), and comprehensive self-efficacy ($M_{Pre\text{-}test}$ = 3.83 vs. $M_{Post\text{-}test}$ = 3.90, t = -2.054; $p < .05$). Scores further suggest that Phase III activities effectively improved students' self-efficacy toward the virtual/3D technology, indicating both a positive reaction to the technology and interest in learning to use it.

Conclusion and Implications. A website will be made available to provide no cost access to the products of the project to faculty teaching in apparel and textile programs. Faculty can use entire v-modules or just parts of them, depending on their interests and individual course needs, and students can access the information to acquire knowledge about various virtual/3D technologies to improve their self-efficacy and confidence in utilizing them. Given the fact that virtual/3D technologies are predicted to shape the industry of the future (Gonzalo et al., 2020; Kochar, 2022), best practices for teaching them are needed. Moreover, because students in apparel and textile programs are the industry professionals of the future, opportunities to develop applied technology knowledge and skills must be an essential part of the undergraduate experience. The outcomes of this project offer several means for apparel and textile program faculty to integrate opportunities for teaching and learning that are specifically designed to build students' virtual/3D technology skills and to therefore facilitate their career readiness.

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