



Integration of 3 Dimensional Modeling and Printing into Fashion Design Curriculum: Opportunities and Challenges.

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With the emergence and application of 3D printing (3DP) technologies, many industries are faced with the challenge of seeking the most talented designers transitioning from traditional design approaches (Kwon, Y. M., Lee, Y. A., & K, S. J., 2017). The fashion industry and academics are beginning to explore ways in which 3DP technologies can be applied to product design and manufacturing that meet consumer adoption requirements (Hanson, 2018). Although, 3DP has not yet reached the mainstream and mid-market segments it is now starting to trickle down into the luxury, accessory, and maker domains. 3DP technology is recognized as one of the major influential factors to dramatically change the work of designers and engineers and the functionality and comfortability of goods over the next 10 years (Wujec, 2011, p. 327). 3DP technology is at the forefront of design innovation and educators with limited time, resources, and knowledge are facing challenges with providing 3DP technology opportunities to students. Integrating 3DP technology into curricula is still at its early stages and requires more pedagogical development in higher education and fashion related disciplines. This study looks to engage in a dialogue between industry and academic professionals enabling an efficient exchange of information. The focus of this research is to identify the value of 3D modeling and printing, best practices for integration, and the barriers for adoption. When looking at 3DP curriculum integration and adoption, this study aims to 1) explore the added value and potential challenges to student learning and engagement; and 2) discover best 3DP training practices and approaches for academic professionals.

Due to 3DP's rapid growth it is critical for academics to prepare students for current and future fashion domains. The 21st century learning theory defined outcomes as life and career skills, learning and innovation skills (critical thinking, communication, collaboration, and creativity), information media, and technology skills. As well the defined support systems of standards and assessments, curriculum and instructions, professional development, and learning environments were used to support the focus of this research study ("Framework for 21st Century Learning," 2016).

To achieve this research goal, a qualitative research design was employed. Semi-structured interview was conducted with 3DP industry and academic professionals. This qualitative method is recommended for uncovering valuable insights, experiences, and perspectives that are difficult to obtain from other research techniques (Patton, 2015). Through purposive sampling techniques, eight industry experts and academic professionals who were qualified to offer information concerning 3DP fashion design were recruited. Interviews were conducted from February to March 2018 via phone, Facetime, and WhatsApp lasting 40-60 minutes per participant. The focus of the interviews examined their knowledge and application of 3DP technology for the

purpose of integrating into design curriculum. Once data collection was complete major themes were synthesized and recommendation for curriculum development was made.

Three major themes emerged from interview data: Utilization of 3DP technology has significant added value. One of the highest values added is expression, being able to create novelties and unique designs to demonstrate competence. Beyond aesthetic qualities there are opportunities to create functional and wearable product solutions. In addition to zero waste production, materials are recyclable and can be reused. 3DP technology has become an efficient method for production, workflow, and exchange of information. Using 3DP technology provides the ability for customization and limitless design possibilities. Although 3DP is not a magical solution to product design this technology can have a positive affect throughout the supply chain. Using 3DP technology helps engage students in untraditional thought processes and forces learners to enhance their 3D visualization skills as opposed to the traditional two dimensional method taught. Causing design learners to think creatively about shape, volume, space, materials, assembly, design approach, and best practices. There are several barriers, challenges, and limitations that exist when using and teaching 3DP technology. The most significant barrier for integrating 3DP technology into design curriculum is the lack of time, resources, funding, and educator knowledge and skill when adapting these technologies to fashion design. A barrier for students is increase accessibility and exposure. The challenge becomes how do educators implement and train design students in 3DP technology.

Educators have used several creative ways to integrate 3DP technology into their curriculum that best meet their program initiatives, time, funding, and resource accessibility constraints. Participants agree that you must start with basic foundations knowledge while teaching students how to approach the 3DP tool, limitations, how to use, application, material options, and 3DP technology capabilities. It is critical that students have exposure to 3D modeling, 3D printers, and a variety of materials throughout the design process. All parties agree that 3DP technology can assist in creating an opportunity for a collaborative environment to enhance student learning, engagement, workflow, exchange of information, and development of shared common language with others. Study participants agree that the specific 3D modeling software, printer, and artifact made is less significant in the integration process than providing the opportunity for exposure, application, critical thinking, and problem solving.

This research offers important implications and contributions to the value, barriers, and best practices for 3DP integration into fashion programs. Based on the rapid 3DP growth this research will educate, equip and prepare educators and students for emerging technologies in fashion. Based on the participants results this will enhance student's 3D visualization, workflow, practices used, and design approach capabilities. A study comparing the teaching methods used would provide additional 3DP integration options to help develop fashion curriculum.

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