The Development of a Digital Apparel Spatial Visualization Test

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Introduction

Apparel design professionals must work between 2D and 3D space every day in their careers, imagining flat 2D patterns as finished 3D garments. Spatial visualization skills, which include visualizing the resulting image from a cut and folded pattern and mentally manipulating 3D objects, are necessary to understand the 2D to 3D transformations used in apparel design (Fredette, 1995). The Apparel Spatial Visualization Test (ASVT) (Workman, Caldwell, & Kallal, 1999) is a valid measure of spatial visualization skills specific to the apparel discipline that has been used to train students (Orzada & Kallal, 2001; Workman & Lee, 2004; Workman & Zhang, 1999). Computer-aided design (CAD) software and the internet provide new opportunities for spatial visualization research and skill development (Strong & Smith, 2001).

The increasing digitization of the fashion industry requires apparel design professionals to understand 2D to 3D transformations in virtual space (Alvanon & Motif, 2018). CAD provides apparel design professionals the ability to make 3D virtual prototypes from 2D patterns (Baytar, 2018). Optitex has been shown to improve students' spatial visualization skills by showing the relationship between 2D patterns and virtual 3D prototypes (Baytar, 2018). The purpose of this study was to develop a digital version of the ASVT using Optitex and validate it as an accurate measure for testing apparel design students' spatial visualization skills.

Method

DASVT Development. The Digital Apparel Spatial Visualization Test (DASVT) was developed to maintain the structure of the ASVT but provide more information in the 2D patterns and utilize 3D garment models. Garment styles were updated to reflect current trends. The author digitized commercial patterns and used Optitex 2D/3D pattern design tools to clean the patterns, digitally stitch them together, and render 3D garment models. Grainlines, cut on fold arrows, etc. were added to the 2D patterns in Adobe Illustrator, and the 3D garment models were combined into rotating Gifs. 2D and 3D files were uploaded to the Canvas Learning Management system and embedded into the quiz platform.

Participants. Participants were 29 females enrolled in two apparel design classes at the University of Delaware. Classes included Apparel Product Assembly (APA) (n = 10) and Creative and Technical Design Studio (CTDS) (n = 19). APA covers basic clothing construction procedures and is the direct prerequisite for CTDS, which covers basic flat pattern techniques.

Materials. Three spatial visualization instruments were used— the Surface Development Test (SDT), the ASVT, and the newly developed DASVT. The SDT is a measure of general spatial visualization ability that is significantly correlated to the ASVT (Workman & Zhang, 1999). All tests were completed via Canvas, which reported raw scores out of 12 for the SDT and out of 20 for the ASVT and DASVT.

Procedure: This study follows a pretest-posttest quasi-experimental research design. CTDS students took the SDT and ASVT as a pretest on the first day of class. APA and CTDS students took the SDT, ASVT, and DASVT as a posttest on the last day of class. The students provided demographic and reflection responses. Students received traditional classroom instruction between the pretest and posttest. The IRB accepted the parameters of this study with exemption. Data analysis was completed in Microsoft Excel.

Results

DASVT Development. The DASVT was developed to measure spatial visualization skills specific to apparel design in digital space. The DASVT maintains the same parameters as the ASVT. The DASVT consists of 20 questions which each depict a set of pattern pieces ranging from two to ten pieces. Accompanying each set of pattern pieces are five 3D rotating garment

models which serve as the multiple-choice answers for the question. Participants are asked to identify which one of the garments could be made from the pattern pieces shown. Figure 1 provides examples of three questions included in the DASVT. During the test, the 3D models were in constant rotation.

Validation of Spatial Visualization Tests. Student reflection responses express that the use of 3D garment models in the DASVT was helpful for visualizing 2D patterns as 3D garments. Students used phrases including "you can see all angles," "patterns come to life," "see the garments in reality," and "more clear in 3D space" to express the benefit of the 3D models. Posttest data for both the APA class and the CTDS class indicate that the SDT and ASVT, SDT and DASVT, and ASVT and DASVT are positively correlated. The DASVT was significantly correlated to the SDT and ASVT for posttest scores from both classes. The ASVT was not significantly correlated to the SDT for students in APA, indicating the ASVT may not be the best measure of spatial visualization skills for beginning apparel design students.

Students' scores on the SDT and DASVT were significantly higher after indirect training during the semester. Students' scores on the ASVT were not significantly different after indirect training. Students scored significantly higher on the DASVT than the SDT and ASVT posttest and indicated it as the "easiest" of the three spatial tests. This is due to the greater information provided by the DASVT in the form of grainlines, fold lines, dart indications, and 3D views.

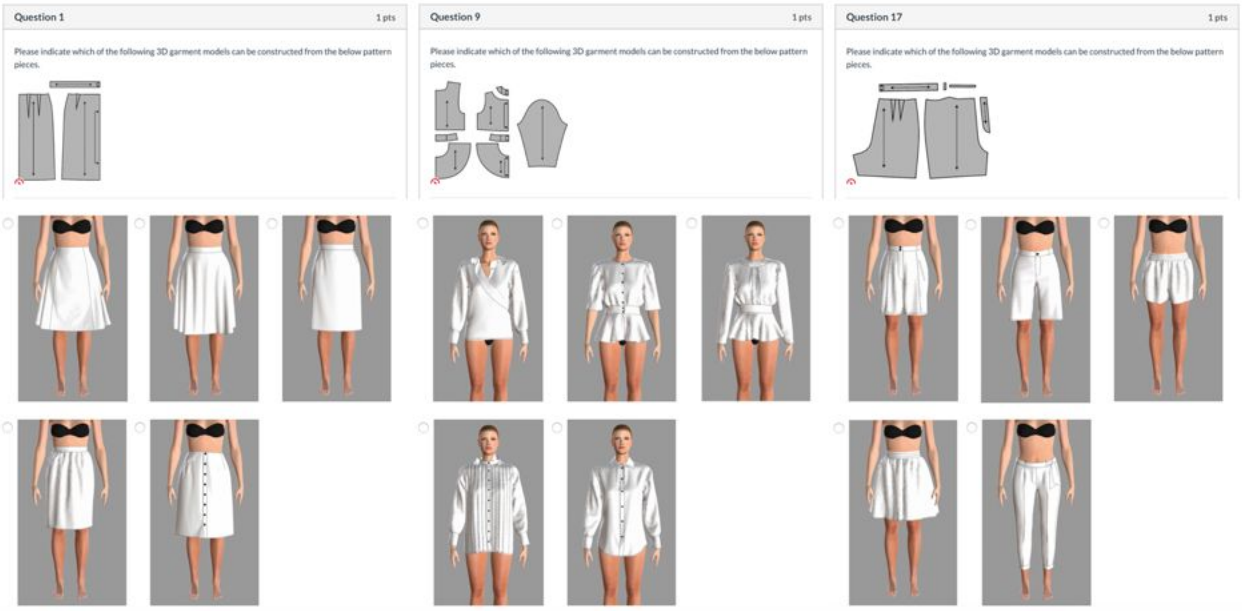

Figure 1. Example Questions from the Digital Apparel Spatial Visualization Test

Discussion

The DASVT is an accurate measure of spatial visualization skills specific to the apparel discipline. This study contributes to esteemed previous research while filling the empty space between traditional spatial skill development and today's digital learners. The DASVT is an instrumental tool for educating apparel design students and opens new research avenues.

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