2015 Proceedings Santa Fe, New Mexico

Exploring Naïve Spatial Understanding in Patternmaking

Kristen Morris, Susan Ashdown, Charlotte Coffman, Fran Kozen, Katherine Dao, Denise Green
Cornell University, USA
Lucy E. Dunne, Jordyn Reich, University of Minnesota, USA

Keywords: Spatial Visualization, Patternmaking, STEM learning, K-12 Education

Introduction Style Engineers (initially titled Smart Clothing: Smart Girls) is in its 4th year of development. Cornell University and University of Minnesota researchers in partnership with 4-H and Girls, Inc. use hands-on fashion-focused activities to introduce girls age 10 to 15 to STEM principles through their interest in fashion. We developed an activity to guide the girls in manipulating pattern shapes for skirts to discover and develop their spatial visualization abilities. The principal objectives of this activity were to explore the relationships between 2D pattern shapes and 3D garment shapes and apply the 2D/3D transformation learned from one garment type to another garment type. Spatial visualization is essential in many STEM careers and is a foundational component of apparel patternmaking. Spatial visualization is the "ability to mentally manipulate an entire spatial configuration, to imagine the rotation of depicted objects, to imagine the folding or unfolding of flat patterns, and to imagine the relative changes of position of objects in space" (McGee, 1979). Activities, which improve spatial abilities in young girls are valuable which is evident in studies demonstrate that as early as age 4 ½, boys already show a better grasp of spatial relationships than girls do (Levine et al., 1999). In clothing design, spatial visualization makes it possible to read an image (sketch or photograph) and understand the 3D shape and the 2D pattern that creates the shape by inferring information not evident in the single view image. This research builds on a past study of naïve spatial understanding of pattern shapes which identified straight gathers and the combination of straight gathers and flare as sources of misunderstanding for middle school girls and university freshmen (Dunne et al., 2014). Here, we discuss the instructional strategy and results of our activity and identify sources of spatial misunderstanding in middle school girls.

Methods This exercise was delivered at both Cornell University and the University of Minnesota (UMN) during the summer of 2014 to 43 middle school girls (Cornell n=29; UMN n=14). The girls worked in groups of 2-5, each with a leader facilitating the activity. The activity is as follows: 1) Groups were provided with an image of a skirt via mood board (Figure 1); 2) groups were asked to replicate the skirt using tissue paper on ½ scale forms; 3) if the students could not decide how to proceed they were provided with the first prompt, a physical ½ scale mock-up of the skirt depicted in the image; and 4) if the students were still having trouble, the facilitator used a second prompt that led the students through the process using manipulation of geometric shapes and slash

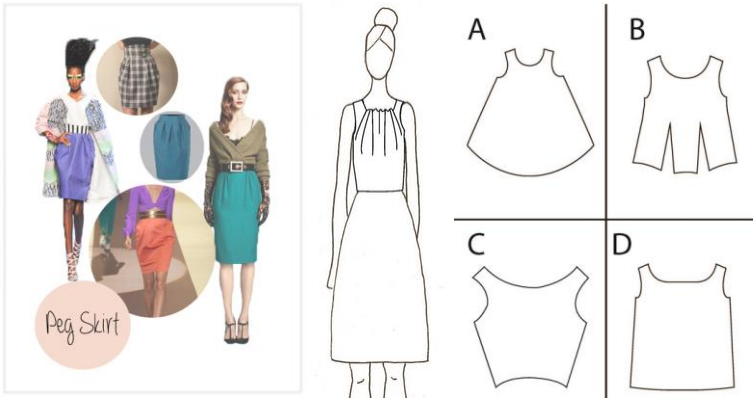

Figure 1: Example of the materials provided to the girls. From left: mood board, illustration of top with same treatment as the skirt, and quiz question

© 2015, International Textile and Apparel Association, Inc. ALL RIGHTS RESERVED

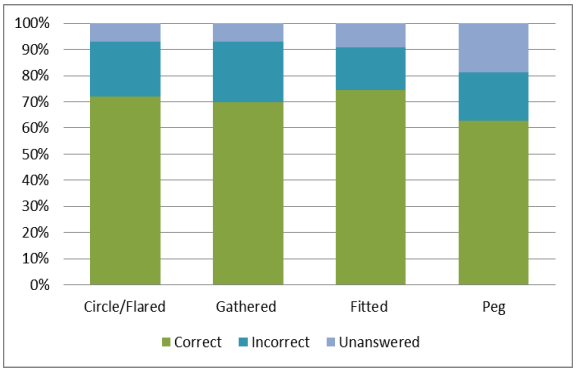

Figure 2: Quiz questions percentage of correct responses

and spread techniques. This method was repeated for four skirt types: flared, gathered, fitted, and peg skirts. Data were collected through 1) video recordings of each group activity and 2) quiz questions that asked students to apply the concept they just learned to a blouse. A qualitative analysis of the video recordings identified how girls processed spatial thinking.

Results/Findings Figure 2 shows the percentage of correct and incorrect quiz responses (n=42). The results reveal a good understanding of the 2D pattern shape when applied to a different area of the body. The students had the most difficulty with the peg skirt, followed by the gathered skirt.

Fitted: The quiz and video data indicate that the fitted skirt was the easiest for the girls to visualize and create in 3D. This is also the only skirt that substracts, rather than adds fullness. *Circle/Flared:* The quiz responses show a good understanding of the pattern shape necessary to create a flared garment. The video shows a variety of methods employed to create the tissue paper garments. Students who had prior patternmaking experience used a 2D approach, taking measurements from the form, calculating the radius of the waist, and drawing a circular hemline. The other groups began the process by creating a fitted tube or a cone shape in 3D. Two of four groups completed the flared skirt in the time allowed. *Gathered:* Video recordings of the gathered skirt activity show that the students had a variety of misconceptions in visualizing the skirt including creating a flared pattern shape, pleating the paper all the way from waist to hem or to the center of the paper instead of just at the waist. The physical skirt had a neligable effect on clarifying the concept. On the other hand, an investigation of the incorrect quiz responses showed that some girls confused the correct answer with the fitted shirt with darts shape, revealing a misconception that volume is not subtracted, but rather added to create the shape. The problems of visualizing the gathered skirt are consistent with findings from Dunne et al. (2014). *Peg:* The peg skirt was the most challengeing. It required the most clarification from the instructors and use of the physical skirt prompt. The relationship between the flared skirt shape and the peg skirt shape was not clear to the girls and none of the groups achieved a 2D peg pattern piece.

Conclusions We observed that skirts which required adding fullness were more difficult than the skirt that subtracted fullness. The peg skirt was the most challenging concept for the girls to apply to another garment. Creating a flared skirt and peg skirt was a challenge for many of the groups, as the girls struggled with the concept of adding additional fullness to create volume.

Acknowledgements This work was supported by the National Science Foundation under Grants 1139466 and 1139501.

References

Dunne, L., Ramaswamy, H., Reich, J., Ashdown, S., Coffman, C., Kozen, F., … Ruehlow, S. (2014). Smart Clothing Smart Girls: Teaching Spatial Manipulation through Garment Patterns. In *71st annual International Textile and Apparel Association Conference* (p. 2). Charlotte, NC.

Levine, S.C., Huttenlocher, J., Taylor, A. & Langrock, A. (1999) Early sex differences in spatial ability. *Developmental Psychology, 35*(4), 940-949.

McGee, M. (1979). *Human spatial abilities.* New York: Praeger.

© 2015, International Textile and Apparel Association, Inc. ALL RIGHTS RESERVED
ITAA Proceedings, #72 – www.itaaonline.org