Using Kolb's Experiential Learning Cycle to lead students in learning about sewable circuits

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Key words: wearable, technology, experiential, electronics

Strategy and purpose. An ever-increasing incorporation of technology into apparel products is seen (MarketResearch.com, 2016). However, apparel curriculums do not typically teach how to integrate electrical components into garments, leaving a knowledge gap for students entering the workforce. To address this gap, a wearable technology learning unit and project was developed and implemented in an undergraduate creative design studio class.

Implementation. The course description is "exploration of the creative process and sources of inspiration with emphasis on wearable art; experimentation of advanced design problem solving, alternative materials, fabric manipulation, and pattern-making techniques." The course includes the creation of three wearable art ensembles, each guided by a design brief. This paper reports on one of those projects, whose design brief required the incorporation of electronic components. Students had previous knowledge of apparel construction, textiles and patternmaking, but no previous experience with electronics. First, to build foundational knowledge of electricity, circuits, and methods for working with sewable electronic components and conductive textiles, the instructor developed and delivered a series of PPT lectures based on assigned readings from *Designing with Smart Textiles* (Kettley, 2016). Learnings from lectures were supported and reinforced with in-class and homework activities. Next, to promote deep understanding this knowledge, hands-on exercises were designed based on the Experiential Learning Cycle (Kolb, 1984). The cycle includes four stages: "(1) having a concrete experience followed by (2) observation of and reflection on that experience which leads to (3) the formation of abstract concepts (analysis) and generalizations (conclusions) which are then (4) used to test hypothesis in future situations, resulting in new experiences" (McLeod, 2013). The order of the exercises was structured to create a continuing, building cycle of learning. Each exercise built on the knowledge gained and questions raised in the previous exercise, spurring interest in the next exercise (Table 1). Components used in the exercises included sewable LEDs with built-in resistors, sewable battery holders, 3V coin cell batteries, and conductive thread (Figure 1).

Figure 1 Electronic components in a series circuit

Effectiveness of the strategy and future plans. Using the Kolb (1984) Experiential Learning Cycle to structure the knowledge-building of sewable circuits was effective in helping students overcome their initial fears of working with electricity. The learning atmosphere was fun and playful (Figure 2). Each success (or failure) spurred the students on to further experimentation and further knowledge gains. Students were able to use their sewable circuits knowledge to design and produce their creative wearable garment ensembles, even branching out to learn about and


Figure 2 Enthusiastic Learners

incorporate additional electronic components. The exercise will be used again. A written component (e.g. worksheet) will be added for students to later reference their knowledge gained.

Table 1
Relationship of Exercises to Experiential Learning Cycle Stages

Exercise	1. Concrete Experience	2. Reflective Observation	3. Abstract Conceptualization	4. Active Experimentation
Series Circuit	Sew a series circuit with, a battery and one LED.	The light turns on (*or doesn't turn on*) when I put the battery in.	The correct direction of the electronic components in the circuit is essential.	This is great! What would happen if I sewed another LED into my circuit?
Two LED Series Circuit	As above, with two LEDs.	The lights do not turn on when I put the battery in.	Matching electrical component needs to battery power is essential.	Bummer. How can I get multiple LEDs lit up with my one battery?
Parallel Circuit	Create a parallel circuit with a battery and two LEDs.	The lights turn on when I put the battery in.	Type of circuit makes a difference in how many components can be powered.	This is fun! I wonder how many LEDs I can power off of this one battery.
"Infinite" Parallel Circuit	As above, with "infinite" LEDs.	8 + LEDs can be added and still light up when I put the battery in.	A lot more lights can be added to my project if I use a parallel circuit.	How can I turn the lights on and off without having to take the battery in and out?
Sewable Switch	As above, insert a switch into the circuit.	The lights turn on and off with the switch.	Switches can control the flow of power.	This is hard—not great for clothes.
DIY soft switch made of felt and conductive taffeta	As above, replace with a soft pressure switch.	The lights turn on when I press the switch.	I can use pressure to control the flow of power.	Oh wow! Think of all the ways I can use this in my wearable art project!

References

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