

An E-Textiles Workshop for Undergraduate Learning

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ABSTRACT

Electronic textiles (e-textiles) integrate various materials such as sensors and power sources directly into fabrics to enable detection and transmission of data. During our study, we conducted an interactive workshop with 12 participants designed to teach circuit design and sewing skills to undergraduates and increase their interest in these topics. Our participants were led through an activity where they used conductive thread and mechanical components to modify a regular fabric glove into an e-textile. During our study, students reported high interest in e-textiles and received high scores on a circuit design and sewing quiz after the activity. We found statistically significant increases in several measures, including participants' self-reported knowledge and enjoyment of circuit design and enjoyment of sewing. Using the data collected from our study, we plan to design a teaching module that could be deployed and evaluated in a classroom or extra-curricular setting to teach introductory electronics at an undergraduate level.

BACKGROUND

The educational uses of e-textiles provide many advantages as opposed to traditional teaching methods, inspired by theories such as embodied learning and constructionist learning (e.g., [1]). By using a tactile hands-on learning approach, students are able to better understand the connections between computer hardware, and the code that allows it to run [2]. Prior work has studied applications of e-textiles in education and has been described in papers such as the recent literature review by Behrendt and Hastings [3]. These studies focused on using e-textile workshops to teach students of ages that ranged from elementary school through high school. We observed that most studies target younger audiences, rather than the undergraduate level. We address this research gap by conducting our e-textiles workshop in an undergraduate setting and evaluating its effectiveness.

RESEARCH QUESTIONS

1. How does taking part in an e-textiles workshop impact students' perceptions of circuit design and sewing?
2. How does taking part in an e-textiles workshop impact students' knowledge of circuit design and sewing?
3. What opportunities does taking part in an e-textiles workshop provide for students historically underrepresented in the field of computer science?

REFERENCES

- [1] Idit Ed Harel and Seymour Ed Papert. Constructionism. Ablex Publishing, 1991.
- [2] Yasmin B Kafai, Deborah A Fields, and Kristin A Searle. Making technology visible: Connecting the learning of crafts, circuitry and coding in youth e-textile designs. In Proceedings of the 10th international conference of the learning sciences, pages 188–195. ICLS, 2012.
- [3] Ethan Behrendt and Emily M Hastings. A review of e-textiles in learning environments. In Proceedings of the 2025 Conference on Creativity and Cognition, pages 508–511, 2025.

METHODOLOGY

To answer our research questions, we conducted an experiment which included a two-hour workshop event tasking a group of undergraduate college students with creating their own electronic textile glove as a way of learning concepts related to its construction. The experiment was approved by the IRB at our university.

Participants were recruited via an email advertisement sent to majors and minors in the following departments and programs at our university: Computer Science (CS), Software Engineering, Artificial Intelligence, Materials Science and Biomedical Engineering, Physics and Astronomy, Pre-Engineering, Art & Design, Theatre, and Entrepreneurship. The event was also shared with relevant student organizations (the Student Association for Computing Machinery and Fashion Club) via reaching out to members of their leadership teams, and several fliers were posted on bulletin boards around campus. These recruitment efforts resulted in 12 participants who attended the workshop event, which was held in our university's Makerspace on a weekday evening.



Figure 1: E-Textile gloves created by participants.

RESULTS

Measure	Pre-Survey		Post-Survey		Change			Analysis	
	Avg	St Dev	Avg	St Dev	Mean	Med	St Dev	t	p
Interest	5	1.47	6	1.30	0.5	0	1.09	1.59	0.07
Interest (no keep)	5	1.00	5	0.78	0.08	0	1.08	0.27	0.40
Circuits Impact	6.5	1.53	7	0.89	0.5	0	0.90	1.91	0.04*
Sewing Impact	3.5	1.82	5	1.15	0.92	1	1.24	2.56	0.01*
Circuits Knowl.	2.5	1.27	3.5	1.44	1.08	1	0.79	4.73	0.00*
Circuits Enjoy.	5	1.59	5.5	1.44	0.58	0.5	0.90	2.24	0.02*
Sewing Knowl.	2.5	1.90	3	1.67	0.33	0.5	0.98	1.17	0.13
Sewing Enjoy.	4	1.78	5	1.67	1	1	1.41	2.45	0.02*
Quiz Score	7.17	0.72	7.42	1.50	0.25	0	1.42	0.61	0.28
Enjoyment	-	-	7	1.17	-	-	-	-	-
Have in Class	-	-	5.5	2.04	-	-	-	-	-

Table 1: Statistical results from the workshop.

DISCUSSION

The students who participated in the e-textiles workshop showed an increase in knowledge and interest afterwards. This improvement indicates that this activity was useful for teaching and that a later version may be helpful in a classroom setting. Our participants agreed with this possibility, being mostly supportive of the idea of a similar activity being integrated into a course at the university.

Of the participants, almost all were white men who studied computer science. However, some students were in other, less related fields or of demographics typically underrepresented in CS. Despite these differences, these students showed great increases in interest and knowledge that indicate an ease of accessibility for those who are not stereotypical CS students. Even those who did not express great interest in the premise of the activity still showed substantial improvements in quiz scores. These findings suggest that an e-textiles activity could provide an entry point into the field for many other groups that may feel apprehensive about participating in computer science and its related areas of study. By giving students a view into basic concepts that potentially relate to interests or hobbies they already have, they may feel more comfortable with the field as a whole. Our results that participants felt more positively towards sewing after the workshop (a significant increase in their enjoyment of sewing and a more positive impact of sewing on their interest in e-textiles) indicate that such activities could also introduce technically-oriented students to fields they might not otherwise consider pursuing.

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