

An E-Textiles Workshop for Undergraduate Learning

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Undergraduate Research

What Are E-Textiles?

- **Electronic textiles (e-textiles)**
combine digital technology with
textile objects
 - E.g., clothing with sensors,
lights, motors



Applications

- **Medicine**

- Blood Pressure Monitoring
- Sleep Monitoring

- **Wearable Computing**

- Smart Watch
- Smart Glasses

- **Theatrical Design**



Educational Benefits

- **Offer opportunities for teaching...**
 - Circuit Design
 - Computer Programming
 - Iterative Design
 - Sewing

Related Work

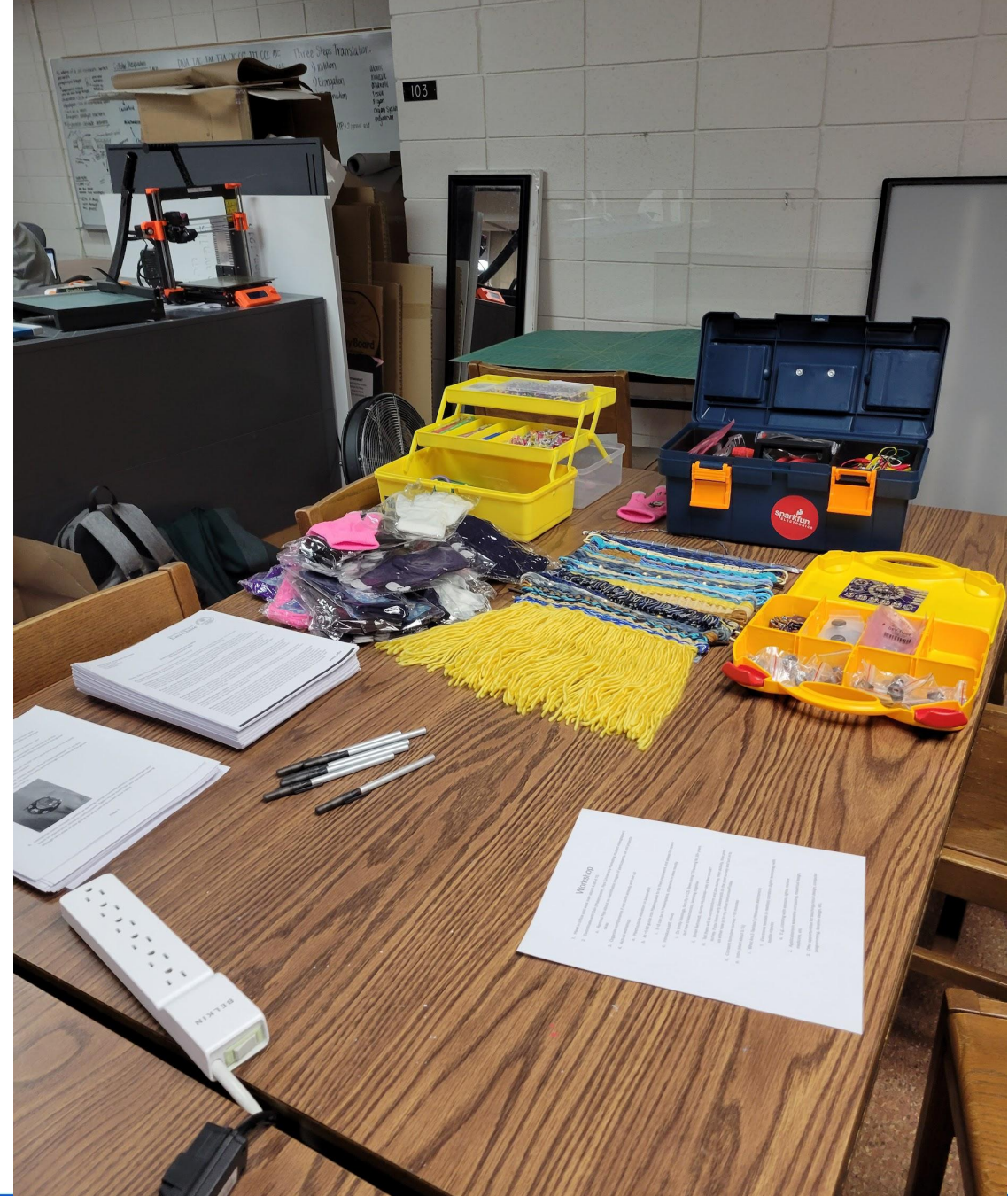
- **Hébert and Jenson (2020) deployed two workshops in an elementary aged setting**
 - One took place in class, one was extracurricular
- **Hughes and Morrison (2018) used an e-textiles workshop to include children previously under-represented in extra curricular growth activities**
 - Shows that e-textiles provide opportunities for many groups

Research Gap

- **While conducting a literature review, we noticed a research gap in the field:**
 - Many studies were conducted in younger age groups, and few were conducted in undergraduate settings
 - Will a study conducted in the undergraduate level still have the same effects?

Learning Goals

- This workshop was designed to teach students more about...
 - E-Textiles and their applications
 - Circuits and Circuit Design
 - Sewing



RQ 1

- **How does taking part in an e-textiles workshop impact students' perceptions of circuit design and sewing?**

RQ 2

- **How does taking part in an e-textiles workshop impact students' knowledge of circuit design and sewing?**

RQ 3

- **What opportunities does taking part in an e-textiles workshop provide for students historically underrepresented in the field of computer science?**

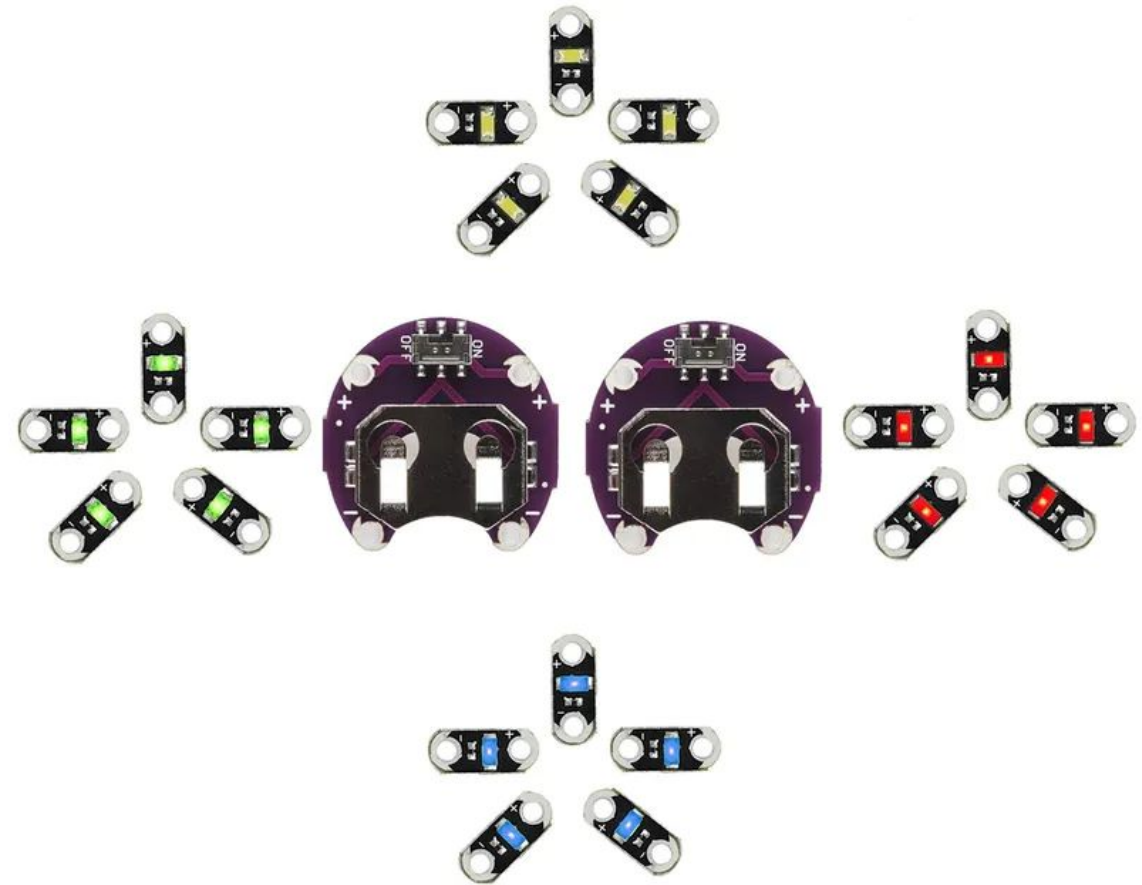
Our Workshop

- We tasked students to create an E-Textile glove that performs a function of their choice
 - Options included:
 - Lights
 - Vibration
- We used pre/post surveys to measure the students' knowledge and interest.



E-Textile Gloves

- **How do they work?**
 - Conductive thread attaches components
 - Students sew a basic circuit along the fingers of the glove
 - When fingers are touched together in an “O” shape, the desired function activates



Example



Workshop Video



Measures

- **Survey Questions**

- Interest and knowledge on a 1-7 scale
- Example: “I enjoy working with electronics/circuit design.” (1-7)

- **Quiz Questions**

- Knowledge questions about material
- Example: “What is a short circuit?”

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	-	-	-	-	-

Results (RQ 1)

- **Significant positive changes**
 - Circuit Enjoyment ($p = 0.02$)
 - Median score increased from 5 to 5.5
 - Mean score increased from 4.83 to 5.42
 - Sewing Enjoyment ($p = 0.02$)
 - Median score increased from 4 to 5
 - Mean score increased from 3.67 to 4.67

Results (RQ 2)

- **Significant positive changes**
 - Circuit Knowledge ($p = 0.0$)
 - Median score increased from 2.5 to 3.5
 - Mean score increased from 2.83 to 3.91

Results (RQ 3)

- **Female Journalism student**

- Originally attended as a photographer, but decided to stay and participate
- Self-reported circuit knowledge and enjoyment both increased from 3 to 5 (2 points)

- **Geography Student**

- Initially reported very low interest
 - 3 in circuit enjoyment
 - 2 in sewing enjoyment
- Had the largest increase in quiz scores
 - From 7 to 10 (3 points)
- Interest in e-textiles increased from 2 to 4 (2 points)

Discussion

- **Increases in knowledge indicate that this workshop would be beneficial for a classroom setting**
 - Students generally agreed with this (Average of 5.5 out of 7)
- **Results indicate workshops being a good entry point**
- **The increase in sewing interest means this could also be useful for introducing people to new potential interests**

Future Work

- The data collected from this workshop will be used to study and teach...
 - E-Textiles
 - Circuit Design
 - Sewing
 - Coding



Acknowledgements

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- **We thank the staff of the Office of Research and Sponsored Programs for their valuable feedback during the development of this project.**

Contribution

We contributed empirical evidence of the effectiveness of an e-textiles workshop for teaching undergraduate students, whereas most existing studies targeted younger audiences.

Thank you for listening!

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