

# IMPLEMENTATION OF MICROCONTROLLERS INTO THE COLORADO FASHION DESIGN AND MERCHANDISING CURRICULUM: AN EXPLORATORY CASE STUDY

Dr. Katy Blatnick-Gagné

A hand-shaped circuit board with a microcontroller and various components. The board is blue and has a white outline of a hand. The fingers are numbered 1 through 10. The board is populated with various electronic components, including a microcontroller, a crystal oscillator, and several resistors. The text "STATEMENT PROBLEM AND PURPOSE" is overlaid in the center of the image.

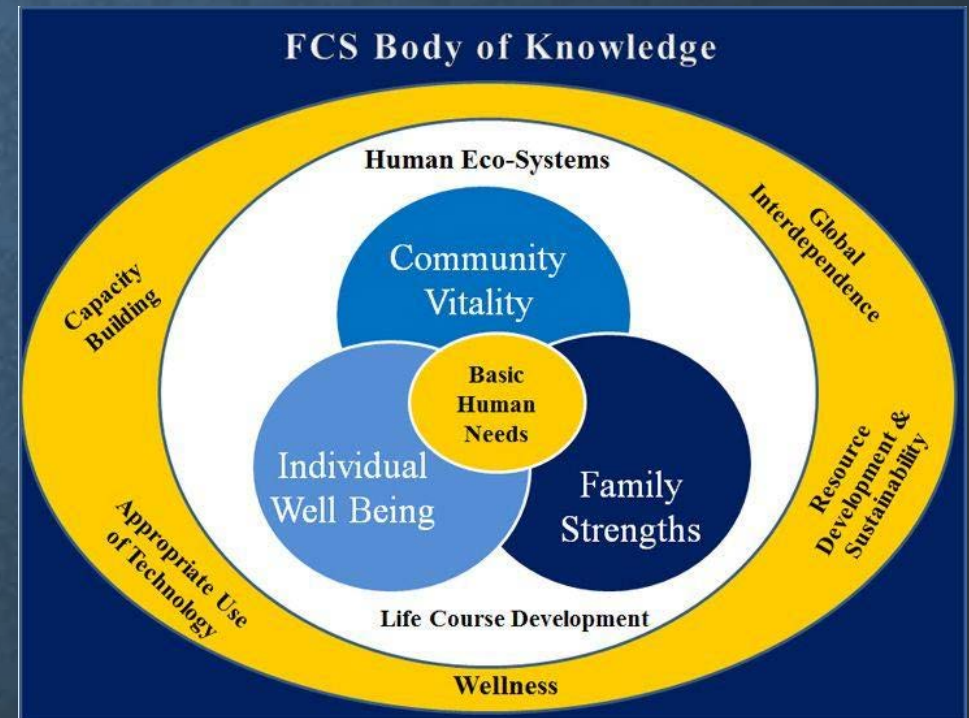
# STATEMENT PROBLEM AND PURPOSE

# STATEMENT OF THE PROBLEM

- Examining the use of electronic devices, such as computers, allows us to theorize and experiment with how they will influence us now and in the future (Buechley, et al., 2013).
- There have been many research studies that have been completed at post-secondary institutions, by professional organizations, and by business and industry that discuss the integration of technology into classrooms and schools (Cubero, 2015; Stager, 2007; Buechley, 2007; Buechley & Eisenberg, 2008).
- Research on how to successfully integrate technology, such as the microcontroller, into elective courses such as FCS Fashion Design and Merchandising was almost non-existent.

# FCS BODY OF KNOWLEDGE

- In its latest revision in 2003, the body of knowledge, which is referred to as the intellectual foundation of the field of family and consumer sciences, includes five cross-cutting themes.
- Appropriate use of technology is one of the five cross-cutting themes.
- I believe that technology will have the greatest impact on FCS curriculum now and in the future.
  - Microcontrollers in FCS FDM is a natural fit

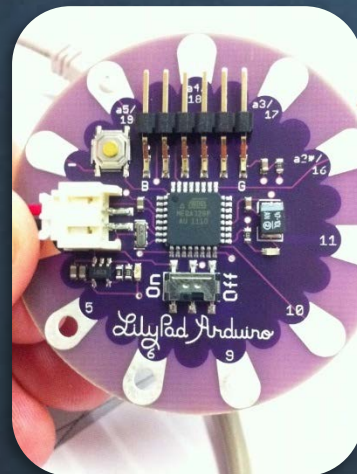


# PURPOSE OF THE STUDY

- There is a need for “ambient intelligence” where intelligent devices are integrated in everyday surroundings, smart clothing is a perfect place for this intelligence because it can be personalized, embedded, unobtrusive, and used anytime and anywhere (Cho, Lee, Cho, 2009).
- The Colorado Family and Consumer Sciences Fashion Design and Merchandising curriculum may have the potential to incorporate lessons in which teachers will share information with students about smart-e-textiles.

# PURPOSE OF THE STUDY, CONTINUED...

- This study focused on how the LilyPad Arduino can be implemented into the state-wide curriculum based on the data collected during the research phase which will focus on teacher input, administrator viewpoints, and available resources.



A hand-shaped circuit board with a yellow component and pink traces. The board is mounted on a wooden base with ten fingers. The fingers are numbered 1 through 10. The board has a yellow component with the text "RF 4000" and "1000" on it. The board is connected to a USB cable. The text "RESEARCH QUESTIONS" is overlaid on the board.

# RESEARCH QUESTIONS

# THE HEXAGON TOOL

- Created through implementation research (Kiser, Zabel and Smith, 2007) as a tool that can help states, districts and schools evaluate new and existing interventions using six broad factors (Blase, Kiser, Van Dyke, 2013).
- Used as a foundation for creating the research questions.

## The Hexagon Tool

### Exploring Context

The Hexagon Tool can be used as a planning tool to evaluate evidence-based programs and practices during the Exploration Stage of Implementation.

See the Active Implementation Hub Resource Library <http://implementation.fpg.unc.edu>

EBP:			
5 Point Rating Scale: High = 5; Medium = 3; Low = 1. Midpoints can be used and scored as a 2 or 4.			
	High	Med	Low
Need			
Fit			
Resource Availability			
Evidence			
Readiness for Replication			
Capacity to Implement			
<b>Total Score</b>			

**Capacity to Implement**

- Staff meet minimum qualifications
- Sustainability
  - Staff Competencies
  - Organization
  - Leadership
  - Financial
- Buy-in process operationalized
  - Practitioners
  - Families

**Need in school, district, state**

- Academic & socially significant Issues
- Parent & community perceptions of need
- Data indicating need

**Fit with current Initiatives**

- School, district, state priorities
- Organizational structures
- Community values

**Readiness for Replication**

- Qualified purveyor
- Expert or TA available
- Mature sites to observe
- Several replications
- Operational definitions of essential functions
- Implementation components operationalized:
  - Staff Competency
  - Org. Support
  - Leadership

**Evidence**

- Outcomes – Is it worth it?
- Fidelity data
- Cost – effectiveness data
- Number of studies
- Population similarities
- Diverse cultural groups
- Efficacy or Effectiveness

**Resources and supports for:**

- Curricula & Classroom
- Technology supports (IT dept.)
- Staffing
- Training
- Data Systems
- Coaching & Supervision
- Administration & system

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Adapted from work by Laurel J. Kiser, Michelle Zabel, Albert A. Zachik, and Joan Smith (2007)



# RESEARCH QUESTIONS

## Central Question

- How can Colorado Family and Consumer Sciences Fashion Design and Merchandising teachers successfully implement the use of microcontrollers into the state-wide curriculum?

## Sub Questions

- What **resources** are needed to successfully implement the use of microcontrollers into the Colorado Family and Consumer Sciences Fashion Design and Merchandising course?
- What is the **capacity** to implement the use of microcontrollers into the Colorado Family and Consumer Sciences Fashion Design and Merchandising course?
- When the use of microcontrollers is implemented in a Fashion Design and Merchandising class, what **evidence outcomes** might be expected if the practice is implemented well?



# LITERATURE REVIEW

# LITERATURE REVIEW

- Through the decades, home economics has played an important role. (Gentzler, 2012).
- There are parallels between clothing and textiles fields within FCS and STEM. FCS also allows for project-based, real-world learning (Carter, Beachner & Daugherty 2015).
- Opportunities exist to integrate computer science, engineering, textile, and fashion design to create e-textiles appeal to a broad audience and create a platform for PBL and powerful ideas (Buechley & Eisenberg, 2008).

A hand-shaped circuit board, possibly a glove-mounted device, with a microcontroller and various components. The board is purple and has white text and numbers. The text "Handy" is written across the palm area, and numbers 6, 7, 8, 9, 10, and 11 are written on the fingers. A yellow microcontroller is mounted on the board, and there are several other components and wires. The board is mounted on a wooden base.

# METHOD

# QUALITATIVE CASE STUDY

- Qualitative research studies foreshadow problems and explore the meaning of individuals or groups in a specific context (Gay et al. 2012).
- Qualitative research involves emerging questions and procedures: data are typically collected in the participants' setting, data analysis is derived from general or particular themes, and the researcher makes interpretations in regard to those themes. (Creswell, 2014).

# QUALITATIVE CASE STUDY

- Case study research is unique in that it leads to a different kind of knowledge compared to other types of research, and they provide intensive descriptions and analyses of a single unit or bounded system.
- Case studies are typically grounded in theory and can provide a variety of conclusions (Creswell, 2014).

A hand-shaped circuit board, possibly a wearable device, is shown. The board is purple and features a microcontroller (ATmega328P) and other components. The fingers are numbered 1 through 11. The text "Participant Description" is overlaid in white. The board is mounted on a wooden base.

# PARTICIPANT DESCRIPTION

<b>Participant</b>	<b>Number of Years Teaching FDM</b>	<b>Type of School</b>	<b>Interest in Participation</b>	<b>Willing to Integrate Tech</b>	<b>Knowledge of Microcontrollers</b>
Teacher 1	15	CTE Center	I held a workshop 2 years ago about STEM in FDM, looking to advance knowledge.	Yes, has experience with STEM	Yes
Teacher 2	9, CO & other States	Comprehensive High School, Denver Metro Area	This is a good way to incorporate tech and get kids thinking outside the box.	Yes	Yes, only through workshops
Teacher 3	12	Comprehensive High School, Denver Metro Area	I want to learn about new technology used in the fashion industry.	Yes	No. Used LilyPad coin-cell battery packs with LED Lights
Teacher 4	3	Comprehensive High School, Denver Metro Area	I love fashion design and am always looking for new ideas to use in my classroom.	Yes, masters is in Technology	No
Teacher 5	10	Comprehensive High School, Denver Metro Area	I'm interested in learning how to use the LilyPad in hopes of possibly integrating the technology into FDM.	No	Very little
Teacher 6	5	Comprehensive High School, Denver Metro Area	I want to learn more because I don't know what they are.	Yes, 4 out of 5 in comfort level	No
Program Director	11	State	I feel its important to continuously learn and update skills to be more effective in the classroom.	Yes- statewide initiative	Very little



A hand-shaped circuit board, possibly a glove or a sensor array, with a microcontroller and various components. The board is purple and has white text and numbers. The text includes "glove" and "Hand". The numbers are 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50. The board is mounted on a wooden base. The text "DATA COLLECTION" is overlaid in the center.

# DATA COLLECTION

# DATA COLLECTION

- Four Phases
  - Phase 1: Teacher Participant Recruitment
    - Interest Survey
  - Phase 2: Professional Development
    - Two-day Coding Fabric Academy workshop
    - Debrief Session
    - Post Survey



# DATA COLLECTION, CONTINUED...

- Phase 3: Phone Interviews
  - Guided questions & probing/clarifying questions (derived from Phase 2 survey)
- Phase 4: Site Visits and Interviews
  - Three site visits
  - In-person interviews with FCS Teachers
  - In-Person Interviews with the Administrator over the FDM program
  - Classroom Observations



A hand-shaped circuit board, likely a custom PCB, is shown. The board is purple and features a microcontroller chip (ATmega328P) and other components. The board is mounted on a wooden base that is shaped like a hand, with the fingers labeled with numbers 1 through 11. The board is connected to a USB cable. The word "RESULTS" is overlaid in white text on the board.

# RESULTS

# EMERGENT THEMES

- Themes aligned with the three broad factors of the Hexagon Tool

- Theme 1: **Resources**

- Funding
- Professional Development
- Technology Support

### The Hexagon Tool

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**Need in school, district, state**

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# EMERGENT THEMES, CONTINUED...

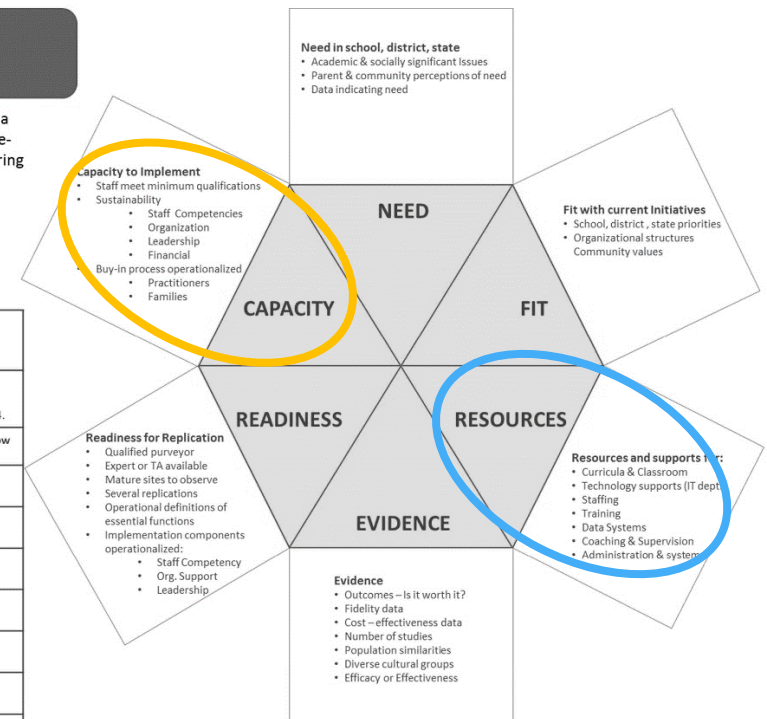
- Theme 2: **Capacity**
  - Personal Teaching Beliefs (Personal Epistemology)
  - Professional Development

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# EMERGENT THEMES, CONTINUED...

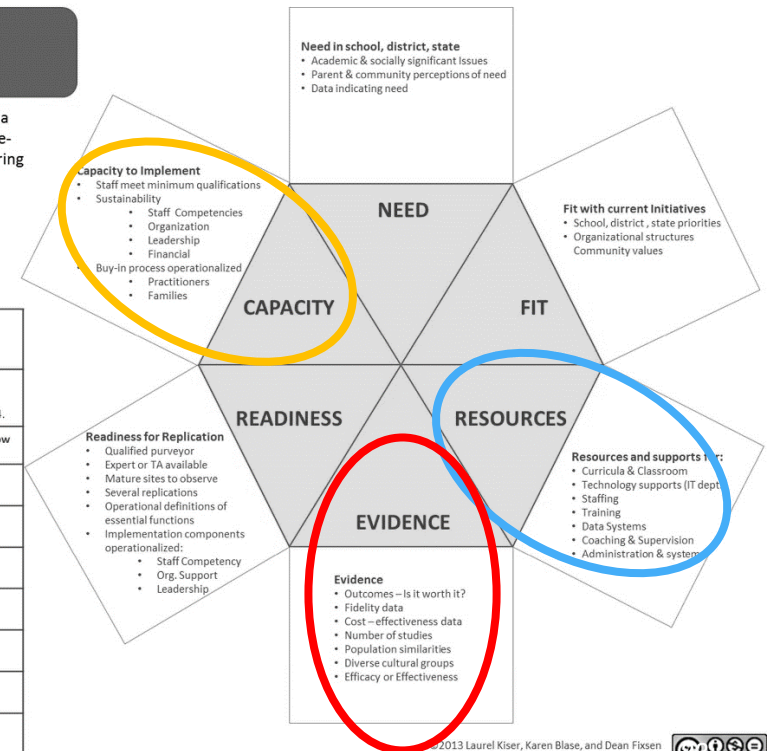
- Theme 3: Evidence Outcomes
  - Unit of Study
  - Intra and Cross-Curricular Connections

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A hand-shaped circuit board, possibly a prototyping board, with a microcontroller and various components. The board is blue and has a white outline of a hand. The fingers are numbered 1 through 10. The board is populated with various electronic components, including a microcontroller, a yellow component, and several resistors. The board is connected to a breadboard with white wires. The word "RECOMMENDATIONS" is overlaid in white text on the board.

# RECOMMENDATIONS



# RECOMMENDATION 1

- Provide Professional Development
  - Access to PD will be a key factor
  - May pique the interest of teachers
  - CO FCS Program Director must take a lead in providing PD
  - Hold workshops at the annual CATFACS Conference
  - Introductory workshops, similar to the two-day Coding Fabric Academy should be offered yearly, with advanced workshops as needed

# RECOMMENDATION 2

- Lesson Plans, Assessments and a Resources Library
  - Have an Implementation Team work with the CO FCS Program Director to
    - Create a Unit of Study that includes
      - Lesson Plans, Activities, Assessments and Rubrics
    - Develop a Resource Library that could be accessed by teachers and students
    - Make FCS Standards connections, crosswalk to CO Academic Standards and demonstrate STEM connections
    - Develop a FCCLA State-level Competitive Event

A hand-shaped circuit board, likely a custom PCB, is shown. The board is dark blue or purple and features a microcontroller chip (yellow) and various other components. The board is shaped like a hand with fingers, and the numbers 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, and 17 are printed on the fingers. The text "HANDS-ON EXPERIENCE" is overlaid in large white letters, and "Three Schools- Two Teachers" is overlaid in smaller white letters below it.

# HANDS-ON EXPERIENCE

Three Schools- Two Teachers

# HOW WERE THE LILYPADS INTRODUCED?

## 1. Journal

- If your clothes could do anything what would you make them do?
- Pair and Share

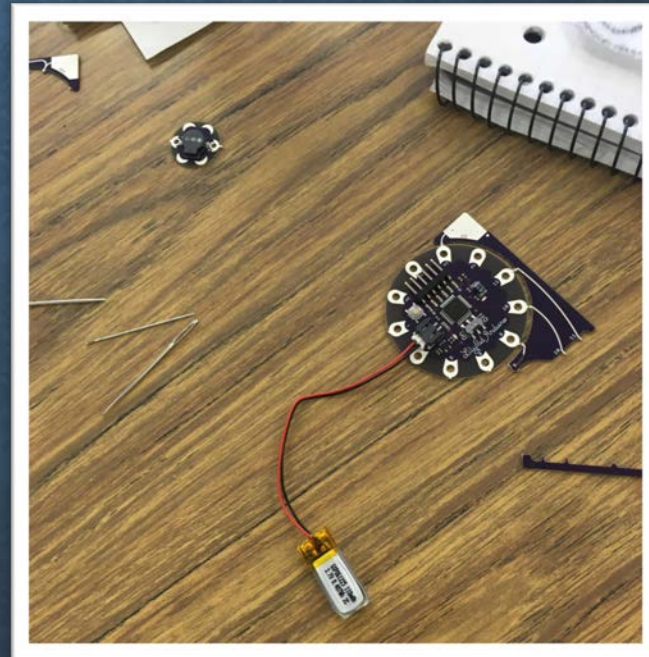
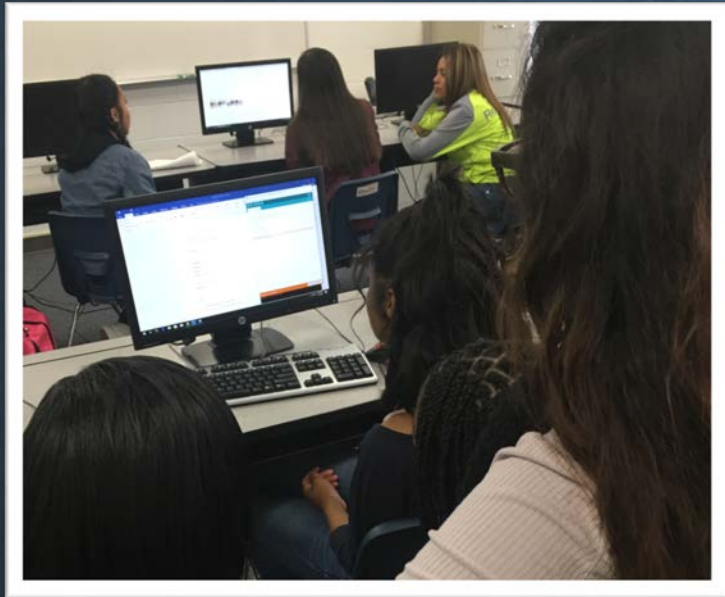
## 2. Watch one of the videos

- Have Students jot down things that stand out to them
- Discuss their observations
- The Future of Fashion Video- [https://www.youtube.com/watch?v=yzKM\\_DXfOBA](https://www.youtube.com/watch?v=yzKM_DXfOBA)

## 3. The Next Black- <https://www.youtube.com/watch?v=XCsGLWrE4Y>

# HOW DID I OBTAIN THE MICROCONTROLLERS and COIN-CELLS?

My LilyPad Arduinos were provided by Perkins funding from my CTE Director.



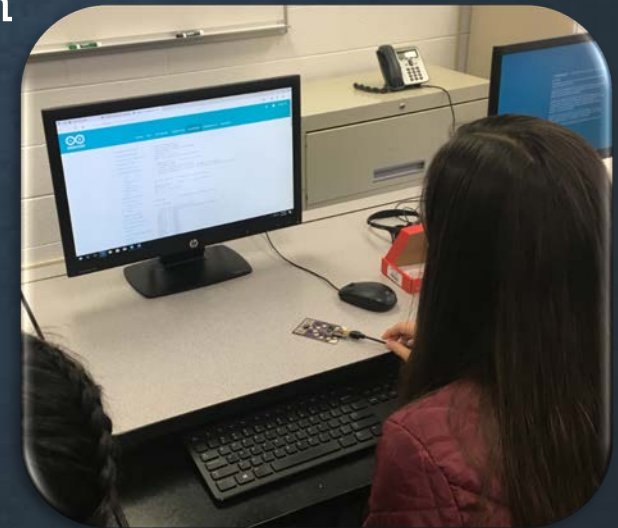
# WHAT DID I HAVE THE STUDENTS DO?

## Accessories of the Future Group Project

1. Students choose a customer and their outfit online
2. Students create a backstory for their customer
  - Customer must have a problem to solve with lights and sound
3. Students design a 2-D accessory that will compliment their chosen outfit
4. Add LilyPad to felt accessory
5. Present to class
6. Total Duration of Project = 5, 90 Minute class periods

# WHAT WENT WELL AND DIDN'T?

1. Getting the software onto the computers
  - Can only use a Chromebook if it has a USB port
2. Teaching students how the circuit works
3. Getting students to think outside the box- create a problem
4. Downloaded Sketch program works better than web-based option

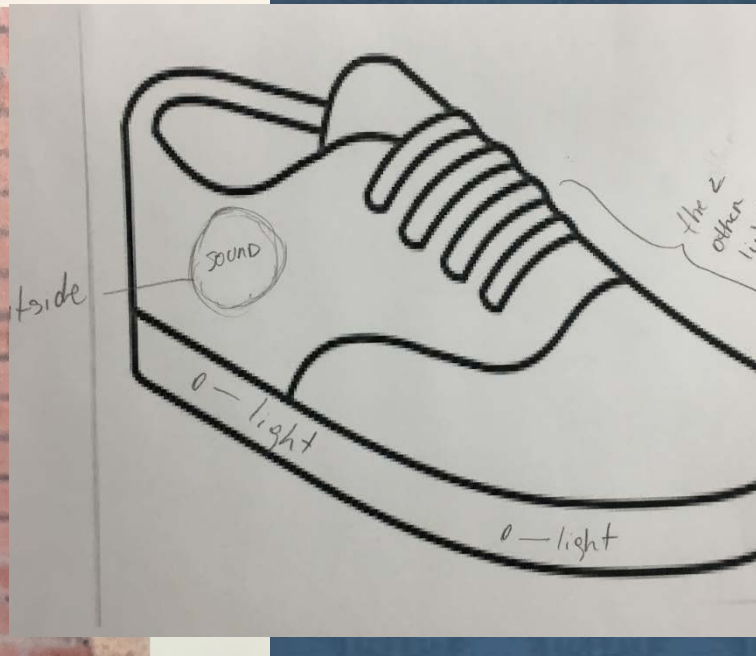


# RECOMMENDATIONS TO IMPLEMENT MICROCONTROLLERS

1. Make sure they know how to hand sew first
2. Implement in Fashion level 2



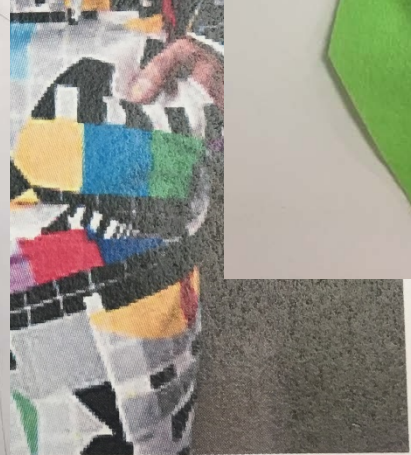
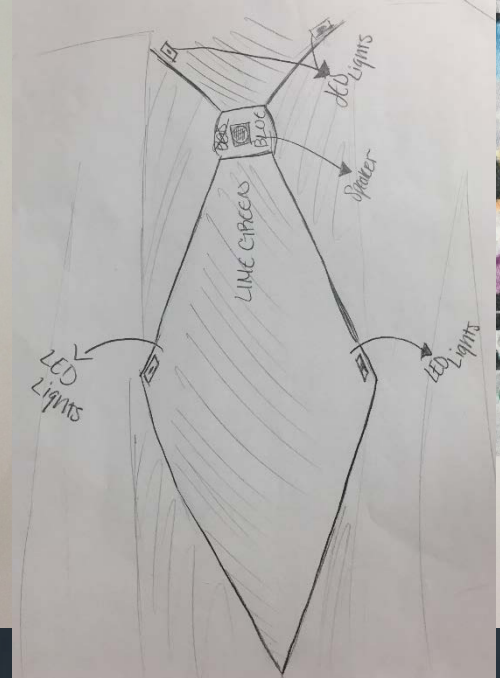




# Project Write Up

Our customer is Jessica, a 18 year old that likes to jog. She loves going to the park to jog at night time. We decided to make her a shoe that lights up on the bottom and plays music so the other joggers or animals know she's coming. We solved the problem by putting lights and sounds. The accessory complements the outfit because it's simple and casual and not that attractive.





## Project Write Up

Our customer, DJ MudPig, needs an accessory for the biggest party he's ever been asked to DJ for. He needs his signature song to play through his accessory so when he introduced himself to people they'd remember him forever (or so he thinks.)

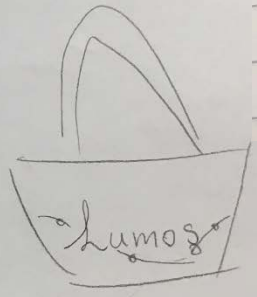
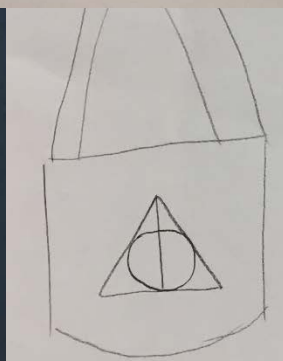
Thanks to our innovative technology his very stylish tie plays the Simpsons theme song & also matches his signature outfit.

DJ MudPig wears a suit w/ piano keys on it, w/ colors varying but it's generally lime green & dark blue, & white shoes. So this tie compliments his outfit by being one of the majority colors on the suit.

Alvanee Jones  
Nathan Blair  
Karl Villalobos  
3A Fashion

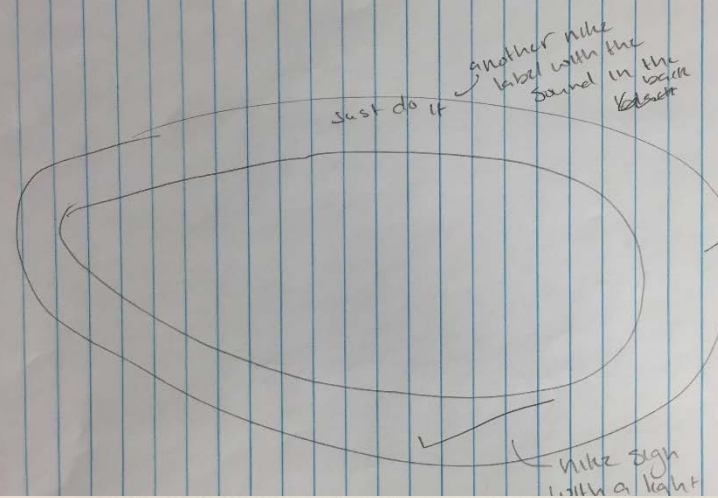


Our customer's name is Alice. She is a 23 year old college student who is going to Universal Studios for the grand opening of the new Harry Potter world that opened recently. She loves photography, reading, and art. She wants to be able to stand out and express herself by having unique accessories that not everyone has. The accessory compliments the outfit because it fits the colors & themes. It also adds more fun to the outfit because of the flashing lights. The lights will be helpful because it will be night time so not only will it be cool, but it will be helpful. A problem we had with our lily pad was finding a Harry Potter code because the ones we found were without lights & just sound so we ended up using the codes that our teacher provided us with & it still fits our theme. Our code was the melody one.



Emily, Tanleyja  
Anonda  
& Isis

Our customers name is Manah Lambardi a young 22 year old, mixed, track star. She is in her senior year of college with two full time schedules. The first one is specifically for her studies and the other one strictly for training. During the day it can be challenging to juggle both. Manah and her trainer have decided that it would be best if she trained at night, and study during the day. However at night in the big city of New York City it can be extremely hectic. This could become a problem for Manah so she decided she would go talk to a few designers about creating something just for her. After talking to a few she and Anonda little came up with the idea of a headband that would flash lights and play music outloud. Manah became so happy because at first she was mostly concerned about her safety. She needed something that would let the cars know she is there and not have to worry about predators. Manah loves the brand nire so, little decided she would contact their headquarters about creating a personalised headband to fit her needs. The headband compliments her various running outfits all while



# HOW WERE THE LILYPADS INTRODUCED?

- Brainstormed ideas for fashion and technology
  - What they already know about?
- Presentation on high-tech fashion design (topics that catch their attention)
  - Photonic crystal insulation and coating materials
  - Kevlar strength, lighting and hydroponic clothing
  - Students researched how different technology helps our society
- Showing some wild examples of technology with fashion
- How to use the conductive thread
  - Positive and negative charge
- Demonstration and videos about how to sew LilyPads and Arduinos



# HOW DID I OBTAIN THE MICROCONTROLLERS and COIN-CELLS?

- Funding Student Organization Grant- Both the Coin-Cell and Microcontrollers
- Applied for Perkins Grant Funding (through District)
- Fundraising through Fashion Class
- Century Link Grant



# WHAT DID I HAVE THE STUDENTS DO?

## FASHION ACCESSORIES



# WHAT WENT WELL AND DIDN'T?

## What went well:

- Students enjoyed being creative with Lilly Pad and lighting
- Students enjoyed the collaboration with other students
- Students were excited when the lighting worked and Arduinos worked. Sense of excitement
- The students who worked with the microcontrollers were excited to have them play the songs/tunes

## Adjustments I will make for next time:

- Lack of funding for enough Arduinos for entire class
- Let students have an option, so only two groups use the microcontrollers





# RECOMMENDATIONS TO IMPLEMENT MICROCONTROLLERS

STUDENTS ARE EXCITED TO LEARN ABOUT NEW TECHNOLOGY. THEY CAN TEACH YOU!!



# QUESTIONS?

- Dr. Katy Blatnick-Gagne
  - PowerPoint and Handouts: [www.stellarevo.com](http://www.stellarevo.com)
  - [katy.blatnick-gagne@ttu.edu](mailto:katy.blatnick-gagne@ttu.edu)
- Arielle Bergmann
  - [abergmann@cherrycreekschools.org](mailto:abergmann@cherrycreekschools.org)
- Dalene Bricker
  - [Dalene.bricker@adams12.org](mailto:Dalene.bricker@adams12.org)

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