

## **Development and assessment of an applied STEM camp in fashion and entrepreneurship to advance social mobility of high school students**

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### **Abstract:**

This study proposes and advocates for applied STEM (science, technology, engineering, and mathematics) education to solve a low interest and retention in STEM college majors among high school students, especially those from underserved backgrounds. Applied STEM emphasises the practical application of STEM concepts and principles to familiar subjects such as fashion and entrepreneurship to increase students' interest and their intention to pursue college careers in STEM fields. The results demonstrate the effectiveness of an experiential Applied STEM Camp developed in this study and attended by 120 high school students. A series of paired sample t-tests show that participants' knowledge, interest, and intentions to enrol in a STEM-related college major have increased after the camp. Analysis of participants' reflections on the camp experiences further supports the statistical results. The research findings are important for recruiting high school students to pursue applied STEM college careers.

**Keywords:** Applied STEM | fashion | entrepreneurship | STEM camp

### **Article:**

#### **1. Introduction**

As artificial intelligence, digitised systems, big data, and other technological innovations are integrated into the workplace, STEM skills (science, technology, engineering, and mathematics) are increasingly in high demand across different industries and types of jobs (Black et al., 2021). However, there is a shortage of new talent with relevant knowledge and skills because students' interest in STEM college majors has declined (Mikalef & Krogstie, 2018). Chen (2013) reported that approximately 40 percent of college students, who initially enrol in a STEM major, either change it to a non-STEM major, or drop out of college. The statistics are even worse for women, students of colour, and first-generation and low-income students

(Griffith, 2010; Hill, Corbett, & Rose, 2010; Kokkelenberg & Sinha, 2010). Compared to an average US high school graduate, students from disadvantaged backgrounds are less likely to pursue higher education in general (Rotermund & Burke, 2021). After graduation, these students tend to get low-paying service jobs, limiting their social mobility and increasing unemployment and poverty risks (Breen, 2005).

Encouraging high school students, primarily from underserved communities, to consider applied STEM disciplines might be a viable solution to the problem. In this study, we propose the concept and advocate for applied STEM, which we define as academic disciplines that use science, technology, engineering, and/or mathematics within a specific professional field, such as fashion, entrepreneurship, food, kinesiology, etc. Because conventional STEM courses are primarily taught using abstract concepts and theoretical approaches emphasising identification, calculation, and documentation (Plasman & Gottfried, 2016), students do not see the real-life application and thus get discouraged from learning (Stone & Lewis, 2012). In contrast, applied STEM courses emphasise the practical application of STEM concepts to subjects that students can relate to and are interested in, such as fashion and entrepreneurship. For example, teenage girls' interest in fashion is well-documented (e.g. Beaudoin, Lachance, & Robitaille, 2003; Drake-Bridges & Burgess, 2010). Fashion encompasses apparel engineering and innovative 3D technology, textile science, retail math, consumer analytics, and entrepreneurship. Similarly, approximately 60 percent of adolescents are interested in owning a business rather than pursuing a corporate job (Junior Achievement USA, 2022).

Researchers advocate for organising camps to create students' awareness and increase their interest in STEM-related careers (McCarthy & Slater, 2011; Plotkowski, Sheline, Dill, & Noble, 2008). Participating in camps can foster students' curiosity and provide them with an opportunity to explore STEM-related careers in an informal environment outside the classroom. In this study, we developed, tested, and evaluated the effectiveness of experiential learning modules in an applied STEM camp to engage high school students in science-, math-, and technology-based activities. The objectives of this study were: (1) to raise awareness of applied STEM career opportunities among high school students, focusing on fashion and entrepreneurship, and (2) to increase students' interest in and their intention to pursue college careers in STEM fields.

## **2. Literature review**

### **2.1. Fashion and STEM**

Careers in fashion require the knowledge of science, technology, engineering, and mathematics (Hathcock, Dickerson, Eckhoff, & Katsioloudis, 2015). To illustrate, industry professionals must have extensive knowledge of textile science, rooted in chemistry and physics, to select materials with specific properties such as shrinkage, durability, drapability, and other relevant aspects. (Wimberley & Thompson, 2010). Fashion graduates must know the fundamentals of various fibres, yarns, and fabrics' structure and properties to appropriately use them in different contexts such as clothing, home, or automotive textiles (Dunn & Phillips, 2002). Designers utilise the principles of mathematics and engineering when creating new products. Apparel engineering entails complicated two- to three-dimensional pattern transformations and manipulations using advanced software, body scanning, and virtual prototyping (Dunne et al., 2015). According to Ashby, Shercliff, and Cebon (2007), the

knowledge of design and material properties such as colour, weight, stability, being waterproof or breathable is considered science-based knowledge. In contrast, the knowledge of 3D printing, laser cutting, leather carving, and sewing machines is considered technological knowledge. Further, retail analytics relies on math skills in technologically intensive business operations. According to Clodfelter (2018), arithmetic is applied at every level of retail operations from part-time sales interns to executive level professionals. Similarly, retail data analytics is employed to understand consumer insights based on which companies make sales forecasts and business decisions to maximise customer satisfaction (Clodfelter, 2018).

Underrepresentation of women in STEM professions has led to development of educational programmes designed to strengthen young women's interest in and attitude toward STEM (e.g. Brotman & Moore, 2008; Fadigan & Hammerich, 2004; Valla & Williams, 2012). Most of these programmes were designed around conventional STEM subjects (e.g. Buck, Beeman-Cawallader, & Trauth-Nare, 2012; Chen et al., 2011; Denner, Werner, Martinez, & Bean, 2012; Hammack & High, 2014). Buechley and Hill (2010) conducted a comparison between two educational platforms: Arduino and LilyPad Arduino. Arduino is a platform for teaching conventional STEM topics such as engineering and computer science in schools and universities. Whereas LilyPad Arduino allows to create e-textiles without the need for traditional sewing. The researchers found that 86 percent of Arduino projects were done by male students, while 65 percent of LilyPad projects were done by female students. This indicates that, despite both projects being equally challenging and involving similar coding tasks, girls showed a preference for participating in LilyPad due to its sewing aspect, even though it involved virtual and electronic sewing. This finding is not surprising as teenage girls and young women tend to be interested in fashion (Beaudoin et al., 2003; Drake-Bridges & Burgess, 2010). Therefore, scholars suggest incorporating fashion to promote STEM education among girls (Buchholz, Shively, Pepler, & Wohlwend, 2014; Carter, Beachner, & Daugherty, 2015; Pepler, 2013; Stewart et al., 2020).

## 2.2. Entrepreneurship and STEM

In the real world, the borders between the four areas of conventional STEM (science, technology, engineering, and mathematics) are not clearly defined, and many problems require interdisciplinary solutions (Lyons, 2020). Entrepreneurship is one field that yields positive results when incorporated into conventional STEM. Entrepreneurship integrates traditional STEM elements such as computing, engineering, game creation, and other technology-intensive applications. Sari, Çelik, Pektaş, and Yalçın (2022) reported enhanced problem-solving and entrepreneurial abilities of participants after the STEM-focused Arduino camp. In a study dedicated to increasing black male high school students' interest in computer science and coding through participation in a camp that employed entrepreneurship-based activities, students demonstrated an increased interest in STEM (Washington, Mejjias, & Burge, 2020). Therefore, infusing entrepreneurship into STEM-related topics is an effective strategy.

## 2.3. Theoretical framework

Researchers have extensively used activity theory to understand how students engage with and learn STEM-related subjects (e.g. Reveles, Kelly, & Durán, 2007; Wade-Jaimes, Cohen, & Calandra, 2019). Activity theory emerged from the work of Vygotsky and Cole (1978) and his

student Leont'ev (1981). It was further developed and popularised by Engestrom (1987). According to the theory, 'doing precedes thinking, goals, images, cognitive models, intentions, and abstract notions like definition and determinant' (Gyasi et al., 2021, p. 2). The theory consists of six elements: the subject (the participant), the object (the intended activity), the rule (the set of guidelines or requirements that govern the activity), the tool (the mediating device), the context (the learning environment), and interaction during the activity (Sung, Yang, & Lee, 2017). The theory served as a theoretical framework in this study.

## 2.4. Interest in STEM

Existing research indicates that STEM camps have a positive effect on student learning, interest, and attitude toward STEM careers (e.g. Bathgate, Schunn, & Correnti, 2014; Bee, Puck, & Heimdahl, 2007; Dalbotten et al., 2014; Dave et al., 2010; Fields, 2009). For example, Ouyang and Hayden (2010) showed that Hispanic middle school students developed positive attitudes toward science and technology after participating in a STEM camp. Stewart et al. (2020) found that after a fashion and retail-themed coding camp, middle school students reported higher attitudes toward STEM in general and coding in particular. The authors measured several attitudes such as (a) science appreciation; (b) science curiosity; (c) self-efficacy; and (d) motivation for learning science. Based on activity theory and previous research, the following hypothesis was proposed:

H1: Students' **interest** in careers in (a) science, (b) technology, (c) engineering, and (d) math is higher after the STEM camp than before the camp.

## 2.5. Fashion and entrepreneurship as STEM fields

Previous studies showed that camps could effectively raise students' understanding of STEM careers. Hammack, Ivey, Utley, and High (2015) concluded that participants demonstrated a better understanding of engineering after participating in a STEM camp. Pepler (2013) found that leveraging cross-disciplinary elements in STEM education, such as incorporating e-textiles in a computing programme, resulted in enhanced learning outcomes. A literature review conducted by Deveci and Seikkula-Leino (2023) concluded that a combination of STEM and entrepreneurship education resulted in an increased entrepreneurial mindset of students and the ability to generate more value-added ideas. Therefore, it was expected that participation in a STEM camp would enhance students' beliefs that fashion and entrepreneurship careers require the applications of STEM. Based on activity theory and previous research, the following hypotheses were proposed:

H2: Students' **beliefs** that **fashion careers** involve (a) science, (b) technology, (c) engineering, and (d) math are higher after the STEM camp than before the camp.

H3: Students' **beliefs** that **entrepreneurship careers** involve (a) science, (b) technology, (c) engineering, and (d) math are higher after the STEM camp than before the camp.

H4: Students have more **knowledge** about (a) fashion careers and (b) entrepreneurship careers after the STEM camp than before the camp.

## 2.6. Intention to pursue STEM in college

Circumscription and compromise theory explains career choices by young people (Gottfredson, 1981). The theory assumes that people build a cognitive map of occupations by picking up occupational stereotypes from those around them. As young people build this map, they begin to decide which occupations are acceptable and which are unacceptable—those which fit with their developing self-concept and those which do not. Previous research demonstrated that students tend to view STEM-related careers more favourably due to participating in a STEM camp (Clark, Rogers, Spradling, & Pais, 2013). Longitudinal STEM camp studies reported that camp participants tended to pursue degrees in STEM fields (VanMeter-Adams, Frankenfeld, Bases, Espina, & Liotta, 2014). For example, Bee et al. (2007) found an increase in participants' appreciation of the engineering profession and interest in engineering and scientific careers. Similarly, in a study by Ivey and Palazolo (2011), 85 percent of participants reported that a STEM programme increased their interest in engineering careers. The literature suggests that camp participants are more likely to develop career interests and choose to attend college in STEM-related fields. Based on circumscription and compromise theory and previous research, the following hypothesis was proposed:

H5: Students have a higher **intention** to enroll in a college major that is (a) science-, (b) technology-, (c) engineering-, and (d) math-related after the STEM camp than before the camp.

## 3. Effective STEM camp strategies

Previous research indicates that hands-on camps served as an effective way to promote STEM-related careers among adolescents (Fields, 2009). Researchers have proposed various strategies to develop successful STEM camps and programmes: providing a peer-learning environment (Stewart et al., 2020), leading students to use technology autonomously (Hammack et al., 2015), and introducing inspiring camp mentors and speakers (Prieto-Rodriguez, Sincock, & Blackmore, 2020). Song and Glick (2004) emphasise the role of students' perceptions of their potential careers and earnings as important factors igniting their interest in STEM. Moreover, the interdisciplinary content of STEM camps was found to play a significant role in the effectiveness of STEM camps. Dunne et al. (2015) found that the interdisciplinary nature of a fashion-focused STEM programme was instrumental in capitalising on students' interest in fashion design to bridge the interest over to STEM fields. They recommended emphasising fashion content and using hands-on learning activities to engage participants and keep them interested (Dunne et al., 2015).

## 4. Description of the applied STEM camp design

Our research used effective STEM camps strategies from previous studies to develop the curriculum for the Applied STEM Camp. Based on activity theory and extant research, the camp was developed using the following best practices in pedagogical approaches and instructional strategies:

- creating a fun and safe environment to empower students and generate interest in STEM;

- using an interdisciplinary approach to apply STEM concepts in the fields that students can easily relate to, such as fashion and entrepreneurship;
- designing hands-on sessions to allow participants to utilise technology and apply STEM principles in the context of fashion and entrepreneurship;
- facilitating peer-to-peer learning environment during experiential sessions;
- providing an opportunity to interact with inspiring peer mentors, undergraduate and graduate students in fashion and entrepreneurship to learn about college and professional careers in the fields; and
- engaging participants with professors in the areas of fashion and entrepreneurship.

## 5. Method

Applied STEM Camp participants were recruited from two high schools located in two North Carolina counties. The authors collaborated with fashion and entrepreneurship teachers in participating high schools to reach students interested in the subjects. After the Institutional Review Boards approved the study, researchers visited participating high schools to collect parental (for minor students) and students' consent forms and to distribute an information flyer about the camp and the survey. Approximately 120 students and 16 teachers attended the camp. Due to the space limitations, it was possible to accommodate students from two high schools only. However, fashion and entrepreneurship teachers from 13 different high schools participated in the camp.

To assess the effectiveness of the camp on high school students' awareness and interest in STEM and STEM-related college majors, two paper-based surveys were administered. The first survey was completed by participants about a week before the camp, and the second survey was conducted one week following the camp. A structured questionnaire was used to measure students' attitudes toward STEM and intentions to enrol in STEM-related majors in college. The items for the survey were adapted from previous research and measured students' knowledge and interest in college careers in STEM, fashion, and entrepreneurship (Christensen, Knezek, & Tyler-Wood, 2014; Kier, Blanchard, Osborne, & Albert, 2014; Oh, Jia, Lorentson, & LaBanca, 2013b) and intention to enrol in college in a STEM major (Chenoweth & Galliher, 2004; Gibbons & Borders, 2010; Oh, Jia, Sibuma, Lorentson, & LaBanca, 2013a). The items were measured with a six-point Likert scale (1-Strongly Disagree and 6-Strongly Agree). The final section of the survey included questions about student background, such as age, gender, ethnicity, school year, and favourite subjects and classes. The second survey also included open-ended questions to collect students' reflection and feedback about the camp.

Collected data were analysed to examine the differences in student attitudes and intentions to enrol in college in a STEM-related major before and after the camp. Paired sample t-tests were used for testing the proposed hypotheses and evaluating the effectiveness of the Applied STEM Camp in increasing students' interest in and their intention to pursue college careers in STEM fields.

### 5.1. Description of participants

Out of the 120 high school students who participated in the Applied STEM Camp, 86 students completed the pre-camp survey, and 76 completed the post-camp survey. After matching the collected responses to the pre-camp survey to the responses to the post-camp survey by

students to perform a paired sample t-test, it was determined that 57 camp participants completed both surveys. These participants constituted the final research sample used to analyse the data (Table 1). Students were between 14 and 17 years old, and most of them were female (76%). About half of the participants (47%) were White, a quarter (26%) were Black or African American, and the rest identified as Hispanic (16%) or Asian (7%). About 81% of students took a fashion or apparel-related course in high school, and 24% took an entrepreneurship-related course.

**Table 1. Description of research participants.**

Demographics	Number	Percentage
<b>Age</b>		
14	9	15.8%
15	13	22.8%
16	19	33.3%
17	15	26.3%
Missing	1	1.8%
<b>Gender</b>		
Female	44	77.2%
Male	9	15.8%
Others	4	7.0%
<b>Ethnicity</b>		
African American or Black	15	26.3%
American Indian or Alaska Native	1	1.8%
Asian American	4	7.0%
Caucasian American or White	27	47.4%
Hispanic or Latino	9	15.8%
Others	1	1.8%
<b>Academic year</b>		
Freshman	10	17.5%
Sophomore	18	31.6%
Junior	15	26.3%
Senior	14	24.6%
<b>Students who took fashion or apparel course at high school</b>		
Yes	47	82.5%
No	10	17.5%
<b>Students who took entrepreneurship course at high school</b>		
Yes	14	24.6%
No	43	75.4%

Note. Valid n = 57

## 6. Results and discussion

### 6.1. Analysis of quantitative data

The results of the research hypotheses testing are presented in Table 2. The pre-camp and the post-camp means and standard deviations for the research variables are reported. The results of paired sample t-tests are presented in the table and discussed below.

Research Variables	Pre-Camp		Post-Camp		t-test
	Mean	SD	Mean	SD	
<b>Interest in STEM careers (H1a-d)</b>					
I am interested in careers that involve science	3.60	1.50	3.95	1.14	2.08*
I am interested in careers that involve technology	3.98	1.32	4.33	0.95	2.78**
I am interested in careers that involve engineering	2.98	1.42	3.38	1.15	2.48*
I am interested in careers that involve math	2.23	1.24	2.82	1.47	3.73***
<b>Beliefs that fashion careers involve STEM (H2a-d)</b>					
Many fashion careers involve science	4.05	0.95	4.42	1.05	3.24**
Fashion-related careers require the use of technology	4.82	0.93	5.19	0.833	2.24**
Some fashion careers involve engineering	4.40	1.03	4.73	0.891	2.07*
Some fashion careers involve math	4.74	0.92	4.80	1.02	0.38
<b>Beliefs that entrepreneurship careers involve STEM (H3a-d)</b>					
Many entrepreneurship careers involve science	4.07	0.89	4.52	1.02	2.46*
Entrepreneurship careers require the use of technology	4.76	0.72	5.05	0.83	2.59*
Some entrepreneurship careers involve engineering	4.51	0.81	4.62	0.93	0.74
Many entrepreneurship careers involve math	4.62	0.93	4.78	0.96	1.14
<b>Knowledge about fashion and entrepreneurship careers (H4a &amp; b)</b>					
Knowledge of fashion-related careers.	4.05	0.95	4.73	0.73	4.98***
Knowledge of entrepreneurship-related careers.	3.65	1.19	4.25	1.17	3.72***
<b>Intention to Enroll in a STEM-related College Major (H5a-d)</b>					
Plan to enrol in a science-related major	3.00	1.40	3.42	1.35	2.66**
Plan to enrol in a technology-related major	3.00	1.32	3.75	1.18	5.27***
Plan to enrol in an engineering -related major	2.48	1.10	3.13	1.21	4.18***
Plan to enrol in a math-related major	2.02	1.13	2.61	1.45	4.22***

Note: two-tailed tests of significance - \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

### 6.1.1. Interest in STEM careers

Hypotheses 1 predicted that students had a higher interest in science (H1a), technology (H1b), engineering (H1c), and math (H1d) careers after the Applied STEM Camp than before the camp. The results show that all four means of students' interest in STEM careers were significantly higher after participating in the camp (Table 2): interest in science careers

( $t(56) = 2.08, p < 0.05$ ), technology careers ( $t(56) = 2.78, p < 0.01$ ), engineering careers ( $t(56) = 2.48, p < 0.05$ ), and math careers ( $t(56) = 3.73, p < 0.001$ ). Therefore, all four hypotheses were supported, indicating that students became more interested in STEM careers due to the camp experience. It should be noted that overall, the interest in technology-related careers was the highest ( $M = 4.33$ ), whereas the interest in math-related careers was the lowest ( $M = 2.82$ ) (Table 2).

#### 6.1.2. Stem in fashion careers

Hypotheses 2 predicted that students' beliefs that fashion careers involve science (H2a), technology (H2b), engineering (H2c), and math (H2d) were higher after the Applied STEM Camp than before the camp. The results show that three means of students' beliefs that fashion careers involve STEM subjects were significantly higher after the camp (Table 2): science ( $t(56) = 3.24, p < 0.01$ ), technology ( $t(56) = 3.24, p < 0.01$ ), and engineering ( $t(56) = 2.07, p < 0.05$ ). However, the belief that some fashion careers involve math remained the same. The results supported three of the four hypotheses (H2a, H2b, and H2c), indicating that camp participants were more aware of science, technology, and engineering used in fashion careers. It is important to note that all four means were relatively high even before the camp (4.05-4.82 on a six-point scale), indicating that students knew that fashion careers involve STEM. The high means are likely because most camp participants (81%) took a fashion or apparel-related course in high school (Table 1). Nevertheless, the means increased even more after the camp (4.42-5.19), except for math.

#### 6.1.3. Stem in entrepreneurship careers

Hypotheses 3 predicted that students' beliefs that entrepreneurship careers involve science (H3a), technology (H3b), engineering (H3c), and math (H3d) were higher after the Applied STEM Camp than before the camp. The results show that two means of students' beliefs that entrepreneurship careers involve STEM were significantly higher after the camp (Table 2): for science ( $t(56) = 2.46, p < 0.05$ ) and technology ( $t(56) = 2.59, p < 0.05$ ). The results supported two of the four hypotheses (H3a and H3b), indicating that students had an increased level of awareness about the use of science and technology in entrepreneurship careers due to participating in the camp. However, the beliefs that some entrepreneurship careers involve engineering and math remained the same, therefore, hypotheses H3c and H3d were rejected. All four means were relatively high even before the camp (4.07-4.76 on a six-point scale), indicating that students understood that entrepreneurship careers involve STEM, even though only a quarter of participants (24%) took an entrepreneurship course in high school. However, the means for science and technology increased even more after the camp (4.52 and 5.05, respectively).

#### 6.1.4. Knowledge about fashion and entrepreneurship careers

Hypotheses 4 predicted that students had more knowledge about fashion (H4a) and entrepreneurship (H4b) careers after the Applied STEM Camp than before the camp. The results show that both knowledge means were significantly higher after the camp (Table 2). Students became more knowledgeable about fashion ( $t(56) = 4.98, p < 0.001$ ) and entrepreneurship

( $t(56) = 3.72, p < 0.001$ ) careers as a result of participating in the camp. Therefore, hypotheses 4a and 4b were supported.

#### 6.1.5. College enrollment intention

Hypotheses 5 predicted that students had a higher intention to enrol in a science (H5a), technology (H5b), engineering (H5c), and math (H5d) related college majors after the Applied STEM Camp than before the camp. The results of the paired samples  $t$ -tests show that the means of all four intention were significantly higher after the camp (Table 2). Participants had higher intention to enrol in science ( $t(56) = 2.66, p < 0.05$ ), technology ( $t(56) = 5.27, p < 0.001$ ), engineering ( $t(56) = 4.18, p < 0.001$ ), and math college major ( $t(56) = 4.22, p < 0.001$ ) after the camp. Hence, the results supported hypotheses H4a, H4b, H4c, and H4d.

#### 6.2. Analysis of qualitative data

Most participants (91.2%) responded to open-ended questions in the post-camp survey to reflect on the Applied STEM Camp and overwhelmingly agreed that the experience was beneficial. To analyse students' reflections, a thematic analysis procedure was used to identify common themes and interpret the data (Braun & Clarke, 2006). Three themes emerged based on the analysis: (1) New Career Ideas, (2) College Campus Experience, and (3) Connecting STEM and Fashion. The themes are discussed below, with participants' quotes included.

##### 6.2.1. New career ideas

Participants consistently noted that the camp exposed them to new applied STEM career ideas not accessible at their schools. They agreed that such educational programmes are instrumental for learning about different career paths and 'trying them on.' One student explained, 'I think the camps are very useful in exposing students to new career paths they haven't explored.' Another student agreed that experiences such as the Applied STEM Camp, '... bring awareness to students about different career paths in STEM and even [increase] people's intention toward STEM who never thought about it.' Participants' reflections support the quantitative results as they illustrate how the experiences at the camp enhanced awareness and interest in STEM-related careers among high school students. A student noted, 'Very useful! STEM camp gave us examples of how we can use science, technology, engineering, and math with majors and jobs we can take.'

##### 6.2.2. College campus experience

Participants unanimously agreed that they greatly benefited from the real-life college campus experience. Being a 'college student for a day' by participating in the various camp activities, walking around the college campus, interacting with current undergraduate and graduate students, and eating lunch at the campus cafeteria allowed the high school students to directly experience and understand what it would be like studying an applied science subject at the university. One student explained, 'I think that camps are useful, for seniors especially. It gives them a good opportunity to see the resources in this college.' Another student agreed, 'I believe camps like applied STEM camp are very useful for high school students. Camps like

these give experiences for students, that as a preview for what to expect in preparing for college courses and classes.'

### 6.2.3. Connecting STEM and fashion

Participants' comments reflected how surprised they were to learn about broad career opportunities within the fashion industry, 'I learned that there are more jobs in fashion than we think.' Even though most participants (81%) took a fashion or apparel course in high school, they needed to figure out what to do with a degree in fashion, especially with a focus on applied STEM. At the camp, participants learned that the fashion industry requires very diverse science, technology, engineering, and math applications, which they were unaware of before the camp. As one participant explained, 'I learned that STEM and fashion are two very intertwined topics and that there are many more careers in fashion than I thought there was.' The camp helped high school students realise STEM and fashion go hand in hand, 'What I learned about STEM applications in fashion was that technology and science are a lot more integrated in modern day fashion than most people think. STEM applications also vary a lot in regards to the different roles and departments there are in fashion.'

## 7. Conclusion and implications

This study aimed to increase high school students' awareness and interest in applied STEM professions and college majors. To achieve this purpose, the authors developed the Applied STEM Camp curriculum to demonstrate how STEM concepts are used in the fields of fashion and entrepreneurship. To evaluate the effectiveness of the camp, high school students' interests, knowledge, and intentions related to STEM were measured through pre- and post-camp surveys.

The results demonstrate the effectiveness of the developed Applied STEM Camp in (a) creating awareness of applied STEM career opportunities in fashion and entrepreneurship and (b) increasing students' interest in and their intention to pursue college careers in STEM fields. Out of the 18 proposed research hypotheses, 15 were supported. The themes developed based on the qualitative data analysis further support the impact of the camp's experiences on participants' attitudes and intentions toward STEM.

After the camp, students became more interested in STEM-related careers. The findings are consistent with previous research indicating more favourable attitudes toward STEM subjects among students due to various educational experiences (e.g. Ouyang & Hayden, 2010; Stewart et al., 2020). Further, there was a significant increase in student perceptions that fashion and entrepreneurship careers involve science and technology, but not math. The camp clearly enabled students to see the connections of fashion and entrepreneurship with science and technology (as well as engineering for fashion but not entrepreneurship). However, students might need to see the relationship between math and fashion/entrepreneurship careers directly. Thus, future educational programmes targeting high school students might emphasise highlighting how mathematical concepts and principles benefit the business and design of fashion products and entrepreneurs.

Overall students' knowledge about fashion and entrepreneurship careers increased after completing the camp. This fact is significant from the perspective of professional orientation, especially, for high school seniors and juniors who tend to struggle when selecting a professional

path following graduation. Because of increased knowledge and interest, camp participants had a higher intention to pursue STEM majors in college, confirming previous research on the positive impact of STEM camps on participants' college enrolment intentions (Clark et al., 2013; VanMeter-Adams et al., 2014). In our study, students expressed that the camp experience provided knowledge about careers they were unaware of and offered an authentic and exciting real-life college campus experience, thus enhancing student interest in pursuing college education in general. This revelation is significant for students who might not have considered a college career after high school.

The research results confirmed previous literature on the positive impact of infusing cross-disciplinary elements in STEM education (Ogle, Hyllegard, Rambo-Hernandez, & Park, 2017; Pepler, 2013; Sari et al., 2022; Washington et al., 2020). Our study specifically demonstrates that high school students' perceptions of fashion and entrepreneurship as applied STEM careers can be enhanced even through a one-day immersive experience. Given the high attrition rates from STEM majors in college, especially among underrepresented students (i.e. women, students of colour, first-generation and low-income students), this research highlights the importance of academic disciplines that apply science, technology, engineering, and/or mathematics within a specific professional field such as fashion, entrepreneurship, food, and other similar careers.

These findings carry significant implications for educators and policymakers alike. For educators, the study underscores the importance of incorporating interdisciplinary approaches into STEM education. By integrating fashion and entrepreneurship into the STEM curricula, educators can engage students with practical applications and real-world contexts, thereby increasing interest and engagement with concepts and principles that can be challenging due to theoretical and abstract nature of traditional STEM subjects. Furthermore, the study highlights the value of immersive and experiential learning opportunities, exemplified by the Applied STEM Camp, in attracting and retaining students in STEM-related college programmes. The Applied STEM Camp experience can be replicated at other institutions to encourage students to consider fashion and entrepreneurship careers and to attract bright young women and men to these academic programmes.

From a policy perspective, the study emphasises the need to challenge traditional perceptions of STEM and broaden the career pathways within these fields. By promoting applied STEM careers in fashion, entrepreneurship, and other professions, policymakers can encourage diversity, innovation, and creativity within STEM disciplines. This approach not only addresses the talent gap in the STEM fields but also fosters a more inclusive and dynamic workforce prepared to tackle the complex challenges of the future.

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