Increasing objective and subjective knowledge of the environmental impact of cotton and polyester apparel: implications for educating future industry professionals

By: Elena E. Karpova, Nancy N. Hodges, Farhan Haque, Farimah Bayat

Abstract:

This study examined students' knowledge of the environmental impact of cotton and polyester along with their intentions to use them for producing apparel. This is the first study to measure both objective and subjective environmental knowledge among students as future industry professionals. A survey was completed by 39 apparel students in the U.S. before and after a four-part project. Results demonstrate that students' objective and subjective knowledge increased significantly after the project. Students demonstrated greater knowledge and types of facts about the environmental impact of cotton and polyester apparel after completing the project (objective knowledge). Moreover, students believed that after the project they knew more about the topic (subjective knowledge). Although intentions to use cotton or polyester fibres did not change for the total sample, there were important differences depending on the assigned position represented in a class debate conducted during the project. The results have important implications for educators.

Keywords: objective knowledge | subjective knowledge | cotton | polyester | environmental impact

Article:

1. Literature review

The negative environmental impact of the textile and apparel industries across the entire product lifecycle is well-recognized and documented (e.g. Kozlowski, Bardecki, & Searcy, Citation2012; Marcketti & Karpova, Citation2020). Decisions made early in the supply chain, such as choosing fibre for producing yarn and fabric, have critical repercussions for product sustainability at different stages of the garment lifecycle (Laitala, Klepp, & Henry, Citation2018). For example, production of different fibres leads to varied types and intensities of environmental impact, including the emission of greenhouse gases and the use of water and other resources. Similarly, at

the consumption and disposal stages, a wide range of fibre properties determine the ecological footprint of clothing, such as moisture absorption and wicking for laundry, durability for garment longevity, and biodegradability and recyclability at the end of a product's life. Yet, knowledge about the environmental impacts of different fibres is insufficient, even among industry professionals (Karell & Niinimäki, Citation2020).

In this study, we focused on two primary textile fibres used in apparel: polyester and cotton. Polyester accounts for roughly one half of the world's fibre production (Preferred Fiber and Materials, Citation2021). Cotton, as the second most common fibre, represents about a quarter of the total global fibre production (USDA, Citation2021) and even more for apparel. Cotton's share in the apparel markets of the largest apparel importers (i.e. US, EU, Japan) averages 55 percent (Devine, Citation2022). In contrast, other common textile fibres (e.g. viscose, wool, polyamide, and silk) each account for less than six percent of the global fibre production. These statistics underscore the significance of polyester and cotton fibres for the apparel market.

Based on a review of extant research examining the knowledge of textile and apparel environmental impact, several important inquiry areas were identified. First, most prior studies have focused on knowledge of the fashion industry's ecological footprint among consumers (e.g. Han & Stoel, Citation2016; Kim & Damhorst, Citation1998; Su, Zhou, & Gil, Citation2019), and not among current or future industry professionals. However, while consumers' knowledge is primarily concerned with apparel use, care, and disposal (Norum, Citation2017), professionals' knowledge must encompass the entire apparel lifecycle, from fibre production to garment disposal. Further, industry professionals act as gate keepers when making decisions about what to produce and how, including the choice of fibres to be used in garment production, thereby determining the options available to consumers (LeHew & Meyer, Citation2005). Thus, our study focused on examining what apparel students, as future industry professionals, know about the environmental footprint of the two main apparel fibres: cotton and polyester.

Second, nearly all existing studies have examined participants' subjective, or perceived knowledge of the industry's environmental impact (e.g. Han & Stoel, Citation2016; Kim & Damhorst, Citation1998; Liu et al., Citation2020; Oh & Abraham, Citation2016; Sadachar, Feng, Karpova, & Manchiraju, Citation2016; Stöhr & van der Woude, Citation2021; Su et al., Citation2019). In contrast, a limited number of studies have measured participants' objective, or actual knowledge on the topic (Albloushy, Citation2016; Han, Citation2019). In other words, extant research has focused on what consumers believe they know about the harm of textile and apparel production and/or consumption, but not their true knowledge. Yet, scholars have established that both subjective knowledge and objective knowledge are critical to shaping attitudes and behaviours (Raju, Lonial, & Mangold, Citation1995). Therefore, our study examined future industry professionals' subjective and objective knowledge of the environmental impact of cotton and polyester across the product lifecycle, from fibre manufacturing through garment disposal.

Finally, one strategy for reducing the textile and apparel industry's effects on the environment is to prepare competent and knowledgeable professionals who can make informed and responsible decisions when developing, sourcing, marketing, and servicing products (Sadachar et al., Citation2016). For current and future industry professionals, understanding sustainable and unsustainable properties of different textile fibres is an imperative in order to make responsible choices. Therefore, increasing apparel students' knowledge regarding the environmental impact of their business decisions, such as what fibre to use when producing yarn and fabrics, might facilitate a successful transition of the fashion industry to sustainable practices.

In this study, we investigated how both subjective and objective knowledge of the environmental impact of cotton and polyester apparel might be increased among students as future industry professionals.

Based on the important research areas identified, two objectives guided this study. The first objective was to design an effective learning experience to increase apparel students' objective and subjective knowledge about the environmental impact of cotton and polyester apparel. The second objective was to examine how, as future professionals, the learning experience might influence students' intention to use cotton and polyester fibres for producing apparel. To address the research objectives, a project consisting of multiple assignments was designed and implemented. Apparel students' objective and subjective knowledge, as well as their intention to use the two fibres for apparel production, were measured both before and after the project.

1.1. Subjective and objective knowledge

When evaluating what people know about a topic, it is important to consider both objective and subjective knowledge. Objective knowledge is the actual amount and type of facts stored in one's memory on a specific subject (Pieniak, Aertsens, & Verbeke, Citation2010; Raju et al., Citation1995). Subjective knowledge is the feeling of knowing, or one's self-reported perception of how much they know about an issue (Eija, Eila, & Pongsakdi, Citation2017). Objective knowledge is required for industry professionals to make apparel products with reduced ecological footprints (Karell & Niinimäki, Citation2020). At the same time, research from across disciplines indicates that subjective knowledge is important because it contributes to increased self-confidence and problem-solving skills (Feick, Park, & Mothersbaugh, Citation1992; Raju et al., Citation1995).

In the context of textiles and apparel, extant research has focused on consumers' understanding of textile and apparel environmental impact, but not knowledge among industry professionals. Although a few studies relied on apparel students as research participants (e.g. HaBrookshire & Norum, Citation2011; Hiller Connell & Kozar, Citation2012), they were studied as consumers and not from the perspective of future industry professionals learning to make business decisions. Researchers primarily examined consumers' subjective knowledge, or perceptions of how much they know about the environmental footprint of apparel, whereas only two studies measured their objective, or true knowledge. Albloushy (Citation2016) evaluated consumers' objective knowledge of textile and apparel product environmental impact but focused on the manufacturing stage rather than the consumption stage. Han (Citation2019) concluded that consumers' objective and subjective knowledge about organic cotton apparel were two independent and distinct constructs. The author demonstrated that consumers who were willing to search for and pay more for organic cotton apparel had higher subjective knowledge, yet had the same objective knowledge as consumers who did not care about organic fibres. No study has examined current or future professionals' objective and subjective knowledge about the environmental impact of apparel across the product lifecycle. Thus, in this study, we examined future industry professionals' objective and subjective knowledge of the environmental impact of cotton and polyester apparel.

1.2. Increasing knowledge

Most industry professionals do not have sufficient knowledge to make environmentally responsible decisions relative to textile and apparel production (Hur & Cassidy, Citation2019; Lawless & Medvedev, Citation2016). Karell and Niinimäki (Citation2020) argued that the lack of knowledge regarding the ecological impact of different materials and products serves as a barrier to achieving sustainable industry practices. Hur and Cassidy (Citation2019) emphasised a crucial need to increase sustainability-related knowledge among industry practitioners as well as textile and apparel scholars and students. Only when equipped with this knowledge can industry leaders, including future professionals, facilitate a shift toward a reduced footprint.

According to cognitive psychology theory, people learn by acquiring and processing information (International Bureau of Education, Citationn.d.; Johnson, Citation2006). There is empirical evidence suggesting that learning can increase both objective and subjective knowledge across different topics and types of learners. Textile and apparel scholars have applied various instructional strategies to increase students' understanding of social responsibility (Hwang, Lee, Ghalachyan, & Karpova, Citation2022; Lee, Ghalachyan, Hwang, & Karpova, Citation2017), the global fashion industry (Karpova, Jacobs, Lee, & Andrew, Citation2011), and social and environmental issues in the apparel and textile industries (Baytar & Ashdown, Citation2014; Hiller Connell & Kozar, Citation2012). However, no research has examined whether learning about the industry's environmental impact can increase both subjective and objective knowledge. Therefore, based on cognitive learning theory and previous research, the following hypotheses were proposed:

H1. Students' objective knowledge about the environmental impact of cotton and polyester apparel is higher after completing the project than before the project.

H2. Students' subjective knowledge about the environmental impact of cotton and polyester apparel is higher after completing the project than before the project.

1.3. Intention to use cotton or polyester fiber for apparel production

Previous studies indicate that knowledge about fashion's ecological footprint might be one of the most important factors in shaping consumers' sustainable intentions and behaviours (e.g. Hiller Connell & Kozar, Citation2012; Kang, Liu, & Kim, Citation2013). Albloushy (Citation2016) found that objective knowledge about the environmental impact of textile and apparel manufacturing influenced consumers' sustainable attitudes and behaviours. Han (Citation2019) reported a positive relationship between subjective knowledge and intention to search and pay more for clothing made of organic cotton. However, no study has examined whether learning about the environmental impact of apparel products might influence textile and apparel business decisions.

Extant research in politics (Kim, Mckinnon, & Kim, Citation2012), psychology (Allen, Citation1991), public health (Paek & Gunther, Citation2007), and other fields demonstrates a complex relationship between knowledge and people's attitudes and behavioural intentions (Petty & Cacioppo, Citation1986). A critical determinant of the relationship appears to be the type of knowledge considered, or the type of information received about an issue: (a) partial or one-sided information, and (b) complete or two-sided information to allow for both proposing and opposing sides of the issue (Allen, Citation1991). Petty and Cacioppo (Citation1986) used the elaboration

likelihood model (ELM) to explain how sidedness of information influenced people's judgment about a topic. According to the theory and supported by prior studies, two-sided or balanced information has little to no effect on an individual's attitudes and intentions (Paek & Gunther, Citation2007; Robertson, Carlsen, & Bright, Citation2002). A study by Lee, Karpova, and Baytar (Citation2019) confirmed that two-sided information about animal-based fashion had no effect on consumer attitudes and purchase intentions of fur and leather product, whereas one-sided information influenced consumer attitudes and purchase intentions.

In our study, to learn about the environmental impact of cotton and polyester apparel, students were asked to research and compare the positive and negative properties of both fibres, thus they were considering two-sided information. Based on ELM and existing research evidence, the following hypotheses were proposed:

H3. Students' intention to use cotton for producing apparel is the same before and after the project.

H4. Students' intention to use polyester for producing apparel is the same before and after the project.

2. Project design

2.1. Constructive controversy

Constructive controversy was selected as an instructional strategy to design an effective learning experience for increasing student knowledge of the environmental impact of cotton and polyester apparel across the product lifecycle. The strategy consists of comprehensive research and debate, where participants deliberate a controversial issue to reach an agreement based on best evidence and reasoning from proponents and opponents (Johnson & Johnson, Citation2007). As a 'skilled discussion of opposing positions', constructive controversy is a popular teaching method as well as a tool used for corporate decision-making (Tjosvold, Wedley, & Field, Citation1986, p. 126). Constructive controversy contributes to increased participant engagement and open-minded discussion, thus leading to higher achievement, innovative outcomes, enhanced cognitive and moral reasoning, and greater self-esteem (Johnson & Johnson, Citation2007).

According to this instructional strategy, students first conduct comprehensive research on a contentious issue selected by the instructor. Next, the class is divided into teams of proponents and opponents of the issue to compile evidence and prepare arguments in support of a position. During a debate, both sides critically evaluate and refute each other's case as well as rebut criticisms of their position (Tjosvold, Citation2008). Following the debate, participants synthesise and integrate the most compelling facts to reach a consensus on the issue.

2.2. Project description

Building on constructive controversy principles, a project consisting of four sequential assignments was developed: (1) research report; (2) debate; (3) negotiation of sourcing decision; and (4) critical reflection on the learning experience. The first three activities were team-based, with the fourth being individual. In addition, at the beginning and end of the project, each student completed a survey to measure their knowledge of the environmental impact of cotton and

polyester apparel as well as their intention to use these fibres for producing an apparel line with a reduced ecological footprint.

For the research report, student teams collected science-based facts from multiple sources about the environmental impact of cotton and polyester from fibre, yarn, and fabric manufacturing to the use, care, and disposal of garments. Teams compiled a report to compare and contrast the two fibres across the product lifecycle. A list of recommended sources was provided for the assignment by the instructor as a starting point.

For the second assignment, each team was randomly assigned one fibre (cotton or polyester) and a position (environmentally friendly or not) to defend in the debate. Teams were assigned a debate position after submitting the research report to allow for an unbiased examination of both fibres. Using the best research evidence available, critical thinking, and logical reasoning, each team prepared a strong message to argue the assigned position. The message consisted of three statements: opening, main argument, and closing. In addition, teams had to be prepared to deliver a rebuttal in response to the opponent's main statement. To effectively communicate their positions, teams were free to use any medium, such as PowerPoint slides and posters for presenting tables, graphs, images, samples, and other visuals.

Following the debate, each team deliberated to negotiate a sourcing decision to use 100% cotton fibre or 100% polyester fibre for producing a line of t-shirts with a reduced environmental impact. Student teams synthesised and integrated complex information to make a judgment and compile a short essay to explain their business decision. For the last assignment of the project, students completed a guided individual essay to explain the team's sourcing decision and reflect on the project experience and learning outcomes by answering a series of open-ended questions.

3. Method

To increase student knowledge about the environmental impact of cotton and polyester apparel, the four-assignment project based on constructive controversy was implemented in an upper-level undergraduate sourcing course in an apparel programme at a US university. Students enrolled in the sourcing course were recruited to participate in the study, which was approved by the Institutional Review Board. Participants did not receive any incentives, as the project was completed as part of the course. All students enrolled in the sourcing course had completed a required textile science course but did not take any prior sustainability courses focusing on textile and apparel. To evaluate how student knowledge may change as a result of completing the project, an online survey was administered twice: once before (pre-test) and once after (post-test) the learning experience. The survey assessed students' objective and subjective knowledge about the environmental impact of cotton and polyester apparel across the product lifecycle, as well as their intention to use the fibres for sourcing a clothing line with minimal environmental impact.

Objective knowledge about the environmental impact of cotton and polyester apparel was measured with a scale adapted from Albloushy (Citation2016) to address the purpose of the current study. We used various science-based, peer-reviewed sources to obtain factual information about cotton and polyester and the environmental impact of both fibres. A scale consisting of twelve items had three response options to choose from: don't know, true, and false (or don't know, cotton, and polyester). Participant responses were scored as follows: 1 = correct response; 0 = don't know; and −1 = incorrect response. For data analysis, a total score of objective knowledge was calculated for each participant by summing up the scores for all twelve items. The maximum possible score was 12, and minimum possible score was −12. Examples of questions include:

- The raw materials used to manufacture polyester and other synthetic fibres are primarily derived from nonrenewable resources such as petroleum. (Don't know/True/False)

- Even though cotton and polyester garments shed a lot of microfibers during laundry, _____ microfibers will remain in the ocean for a much longer time. (Don't know/Cotton/ Polyester)

To measure subjective knowledge about the environmental impact of cotton and polyester apparel, ten items were developed to mirror the content of the objective knowledge scale because no existing scale was available. Where appropriate, items from scales used in previous research to measure consumers' subjective knowledge of the fashion industry's environmental impact were adapted (e.g. Han, Citation2019; Sadachar et al., Citation2016). All ten items were measured with a 4-point Likert scale, ranging from 1 = 'I have no knowledge' to 4 = 'I am very knowledgeable' (Arachchi & Managi, Citation2021) (see Table 1 for the scale items).

Table 1. Factor loading for the subjective knowledge scale.

	Subjective Knowledge Items	Factor Loading
1.	Damage to the environment from toxic chemicals used to produce cotton vs. polyester fibre.	.825
2.	The relative amount of water required to produce cotton vs. polyester fibre.	.737
3.	How the type of resources (renewable or non-renewable) used to produce cotton and polyester apparel relates to sustainability.	.644
4.	The relative amount of energy consumed for drying cotton apparel vs. polyester apparel.	.733
5.	The relative amount of greenhouse gases released during home laundry of cotton clothes vs. polyester clothes.	.731
6.	How longevity of a garment (cotton vs. polyester) relates to the overall garment's environmental impact.	.704
7.	Biodegradable properties of cotton apparel vs. polyester apparel.	.656
8.	Recyclability of disposed cotton clothes vs. polyester clothes to make new fibres to produce new fabric.	.695
9.	The overall environmental impact of cotton apparel vs. polyester apparel throughout product lifecycle.	.708
	Eigenvalue	4.62
	% of variance	51.29

Intention to use cotton and polyester fibres for making apparel with minimal environmental impact was measured with four items for each fibre. The scale was adapted from a well-established purchase intention scale (e.g. Sadachar et al., Citation2016) to the context of our study. Examples of questions include: 'I will consider using only cotton (polyester) materials to make apparel with minimal environmental impact' and 'I will use only cotton (polyester) materials to make apparel with minimal environmental impact.' The intention was measured with a 6-point Likert scale, ranging from 'strongly disagree to 'strongly agree'. The survey concluded with basic demographic

questions. In addition, the post-test survey had open-ended questions to gather students' feedback on the learning outcomes and experiences. Examples of the questions were:

- Describe what you learned from working on the project. Be specific and provide examples.

- Is this knowledge beneficial for you as a future industry professional? Please explain.

- What part of the project helped you learn the most? Why?

- What was the most challenging part of the project? Why?

4. Results

4.1. Description of participants

The research sample consisted of 39 apparel students who completed both pre – and post-test surveys. Most participants were women (82%). Participants' average age was 20.6 years, and most were between 21 and 23 years (62%) or 19–20 years (37%). Most had a retail concentration (68%), with the others specialising in apparel design. The majority of participants identified as African American (38%), followed by Caucasian (32%), Hispanic (17%), and Asian American (8.8%). Most participants were juniors (59%), followed by seniors (21%) and sophomores (20%). For the project, participants were divided into eight teams, and each team had between four and five members.

4.2. Analysis of scales

Principal component analysis was performed for the subjective knowledge scale. Nine out of ten items loaded on one factor that explained 51.29 percent of the total variance (Table 1). After removing one item from the subjective knowledge scale, the remaining nine items loaded on one factor, with reliability of Cronbach's $\alpha = .89$ and Eigenvalue of 4.62. The scales measuring the intention to use cotton and polyester fibres for producing apparel demonstrated high internal consistency, with Cronbach's alphas of $\alpha = .88$ for cotton and $\alpha = .94$ for polyester. Correlation between subjective knowledge and objective knowledge was not significant, both before and after the project.

4.3. Objective and subjective knowledge

To test Hypotheses 1 and 2, paired sample t-tests were used to compare students' objective knowledge scores and subjective knowledge means before the project and after the project (Table 2). The results demonstrate that students' objective knowledge after the project ($M = 6.50$) was higher than before the project ($M = 3.55$). Likewise, students' subjective knowledge after the project ($M = 3.41$) was higher than before the project ($M = 1.97$). Thus, both Hypotheses 1 and 2 were supported. Students demonstrated higher subjective and objective knowledge about the environmental impact of cotton and polyester apparel after the project compared to before the project.

Table 2. Objective knowledge scores and subjective knowledge means before (pre-test) and after (post-test) the project.

Type of Knowledge	Pre-test score/mean (SD)	Post-test score/mean (SD)	Paired t-test	p
Objective	3.55 (2.63)	6.50 (3.03)	−2.71	.011*
Subjective	1.97 (.51)	3.41 (.47)	−15.21	.000**

*p ≤ .05, **p ≤ .001.

4.4. Intention to use cotton and polyester fibers

4.4.1. Total sample

For the total sample (Table 3, shaded row), an analysis of the means shows that before the project, students' intention to use cotton for sourcing apparel with reduced environmental impact (M = 3.78) was higher than their intention to use polyester (M = 2.65), as the t-test value of 5.26 was significant (p < .001). The same was true after the project. Students' intention to use cotton to make apparel with minimal environmental impact was higher (M = 3.79) than their intention to use polyester (M = 2.68), as the t-test value of 4.75 was significant (p < .001). Overall, participants believed that using cotton fibre results in apparel products with reduced environmental impact compared to apparel products made of polyester. The same results were recorded before and after the project.

Table 3. Intent to use cotton and polyester before and after the project, for the total sample and the samples by the debate positions, pro-cotton and pro-polyester.

Sample	Intent to use cotton, (SD)		Paired t-test	Sign., p	Intent to use polyester, (SD)		Paired t-test	Sign., p
	Pre-test	Post-test			Pre-test	Post-test		
Total sample, N = 39	3.78 (.92)	3.79 (1.01)	-.06	.95	2.65 (.98)	2.68 (1.05)	-.19	.85
Pro-cotton Sample	**3.60** (.77)	**4.21** (.91)	**−3.15**	**.006***	2.66 (.93)	2.43 (1.09)	.92	.37
Pro-poly Sample	3.94 (1.03)	**3.39** (.96)	1.56	.13	2.64 (1.04)	2.91 (.98)	−1.16	.25
Difference between the two samples	t = −1.14 p = .26	**t = 2.74 p = .009***			t = .64 p = .95	t = −1.44 p = .16		

*p ≤ .05.

To test Hypotheses 3 and 4, paired sample t-tests were used to compare the means of intention to use cotton and intention to use polyester before the project (pre-test) and after the project (post-test) for the total sample of 39 participants (Table 3). Students' intention to use cotton for sourcing apparel was the same before (M = 3.78) and after the project (M = 3.79). Similarly, students' intention to use polyester for sourcing apparel was the same before (M = 2.65) and after the project (M = 2.68). For the total sample, Hypotheses 3 and 4 were supported, indicating no change in students' intention to use cotton or polyester for sourcing apparel after completing the project.

4.4.2. Samples by the debate position

To account for the position students were assigned to argue for/against in the debate, the total sample was divided into two groups, as follows:

- pro-cotton sample (n = 19) – four teams that debated for cotton / against polyester;

- pro-poly sample (n = 20) – four teams that debated for polyester / against cotton.

Intention to use cotton. Paired sample t-tests showed that students in the pro-cotton sample had higher intention to use cotton after the project (M = 4.21) than before the project (M = 3.60). In contrast, students in the pro-poly sample demonstrated a different trend – it appeared that their intention to use cotton before the project (M = 3.94) was higher than after the project (M = 3.39). However, the difference was not statistically significant, which is likely due to the small sample size (n = 20).

  Intention to use polyester. Paired sample t-tests showed that there was no significant difference in students' intention to use polyester before and after the project for both the pro-cotton and pro-poly samples (Table 3). Although there was only one significant difference between pro-cotton and pro-poly samples in the intention to use cotton (Table 3), Figure 1 illustrates that the dynamics in students' intention to use a fibre after the project was influenced by the assigned debate position (pro-cotton or pro-polyester). That is, students who argued for cotton (polyester) demonstrated an upward trend in the intention to use cotton (polyester) and a downward trend in the intention to use polyester (cotton). It is likely that these trends will be statistically significant with a larger sample size.
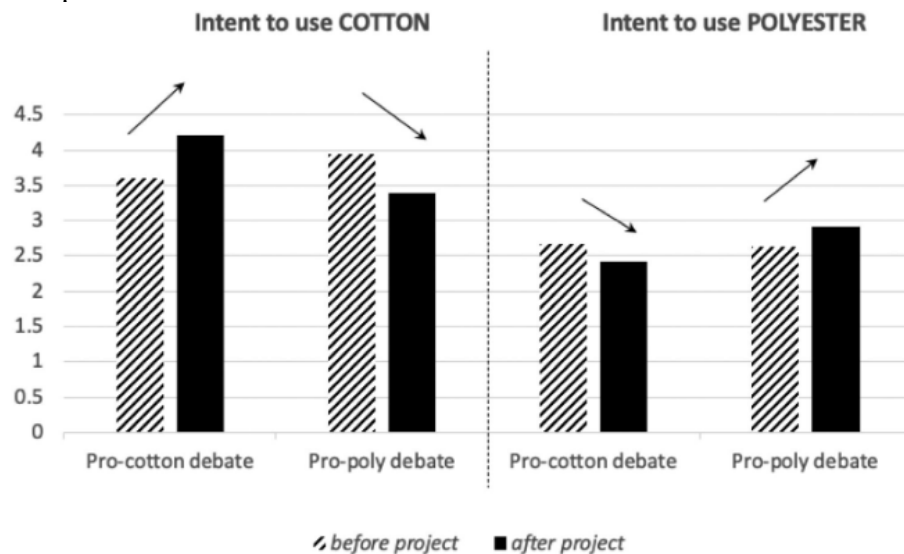

Figure 1. Intent to use cotton and polyester to make apparel before and after the project for the two samples, pro-cotton and pro-poly, based on the debate position.

Further, after the project, there was a significant difference (t = 2.74; p = .009) in the intention to use cotton between the two samples. Students in the pro-cotton sample demonstrated higher intention to use cotton (M = 4.21) than students in the pro-poly sample (M = 3.39). Before the

project, there was no significant difference in the students' intention to use cotton or polyester between the pro-cotton and pro-poly samples (Table 3).

4.5. Sourcing decision: cotton or polyester?

Following the debate and team discussion, six out of the eight teams selected cotton (75%) for producing a line of t-shirts with minimal environmental impact. The other two teams (25%) selected polyester. All four pro-cotton teams decided to use cotton for sourcing t-shirts. Out of the four pro-poly teams, two chose polyester and the other two decided on cotton. In other words, six teams (75%) selected the fibre in the direction of their assigned debate position. This team-based result is in line with the results regarding individual intention to use cotton or polyester in the direction of the assigned debate position (Figure 1).

4.6. Student reflections

Students' individual reflections on their learning outcomes and experiences were content analyzed for common themes. Three themes emerged from the analysis. The first theme summarised participants' perspectives about the project. Students unanimously agreed that the project was 'very informative,' and they learned a lot about the environmental footprint resulting from the production and consumption of cotton versus polyester apparel, 'it helped me gain a lot of knowledge in a short amount of time' (Participant 15). Students frequently commented that the project was 'fun' and 'engaging' because of the debate part, 'the debate portion of the project brought everything together and made the project worth all the work we put into it' (Participant 6).

The second theme explored how the project affected participants as consumers. Roughly half of the students indicated that because of the new knowledge gained about cotton and polyester fibres resulting from the project, they planned to change their behaviours as consumers, 'I am sure that I will now make different decisions based on the knowledge learned' (Participant 22). These participants believed that the project was 'a really good way to learn that as consumers we need to be better informed about the things that we buy and how we contribute to the negative effects,' and it motivated them to assume responsibility for their consumption choices, 'Prior to this project I would not pay attention to what my garment was made of and the effects it had on the environment. Moving forward, I will always be checking the labels to see what my garment is made out of' (Participant 4).

The third theme examined the impact of the project on students as future industry professionals. All participants expressed a commitment to make 'better,' 'informed,' 'educated,' 'ethical,' and 'sustainable' decisions as future industry professionals, 'I truly believe that the knowledge gained will impact different decisions made in the near and far future' (Participant 29). Student reflections indicated an understanding that there is no 'perfect' fibre and all production processes come at an ecological cost, 'the project puts into perspective the struggle of industries to come up with ways to cause less harm to the environment because even with organic cotton and recycled polyester there are still issues' (Participant 33).

5. Discussion

This study examined future industry professionals' knowledge of the environmental impact of cotton and polyester along with their intention to use these fibres for producing apparel. To our

knowledge, this is the first empirical study designed to measure both subjective and objective knowledge among apparel students. The results indicate that the project developed in the study allowed students to not only gain knowledge about the two main apparel fibres, but also to evaluate this information critically and then apply it to make a business decision with the goal of minimising the product's ecological footprint. The scales for measuring objective and subjective knowledge of the environmental impact of cotton and polyester could be used in future research to assess student learning outcomes and their preparedness to make informed and responsible decisions when developing, manufacturing, and marketing apparel and other textile-based products. The scales could also be useful for examining current industry professionals' objective and subjective knowledge on the topic and for exploring how different types of knowledge might influence business decisions. Based on this information, special educational programmes such as webinars or online modules leading to certifications might be developed and offered to increase industry professionals' knowledge of the pros and cons of cotton and polyester apparel in terms of the ecological footprint of both and spanning from fibre production to product disposal.

The results of this study demonstrate that students' objective and subjective knowledge increased significantly after the project. Students demonstrated that they had a greater amount of knowledge and types of facts about the environmental impact of cotton and polyester apparel after completing the project, or their objective knowledge. Participants also believed that after the project they knew more about the topic, or their subjective knowledge, which has been shown to enhance self-efficacy and problem-solving skills (Feick et al., Citation1992; Raju et al., Citation1995). Increasing objective and subjective environmental knowledge among future textile and apparel industry professionals is critical for their ability to make responsible design and business decisions. The findings highlight the importance of including sustainability-related topics in the curriculum for preparing knowledgeable and confident graduates capable of transforming the industry.

The results of the study indicate that, for the total sample, students' intention to use cotton and intention to use polyester for producing apparel were the same before and after the project. As predicted, after completing comprehensive research on both the positive and negative aspects of cotton and polyester apparel, students obtained a balanced, two-sided perspective on the environmental impacts of the two fibres. Because students learned about both sustainable and unsustainable characteristics of cotton and polyester apparel production and consumption, their intentions to use the two fibres did not change, thereby supporting previous research on the effect of two-sided information on consumer attitudes (Lee et al., Citation2019; Paek & Gunther, Citation2007; Robertson et al., Citation2002).

However, when intentions to use cotton and polyester were analyzed by the two sub-samples based on what students argued for in the debate assignment (cotton sustainable/polyester non-sustainable position vs. polyester sustainable/cotton non-sustainable position), the results revealed that looking at the intentions of the total sample masked an interesting dynamic. That is, the intention to use cotton differed for students depending on what fibre they argued for in the debate. After the project, students who argued for cotton/against polyester in the debate had higher intentions to use cotton for sourcing apparel in comparison with students who argued for polyester/against cotton. These results were further supported by the teams' selection of fibre to make apparel with a minimal environmental footprint. Out of the eight total teams, six teams (75%) selected the fibre in the direction of their assigned debate position. In other words, students were more likely to select the fibre that they were randomly assigned to argue for during the debate. Due to the small number of total participants (N = 39) and even smaller numbers based on the two

debate positions (n = 19 and n = 20), some relationships were not found to be significant, which is a limitation of the study.

The findings of this study have important implications for educators, who must ensure that students receive balanced information when learning about complex issues surrounding fashion production and consumption, or any issue for that matter. It is necessary for students to critically examine an issue from different perspectives to form unbiased attitudes and intentions. Further, when developing course assignments (e.g. creating project scenarios, selecting cases, assigning debate positions or simulation roles), it is essential to understand how educators' decisions might influence students' attitudes and behavioural intentions regarding a topic or issue in the future. The results offer a promising research direction to examine how advocating for certain behaviours, such as responsible apparel consumption, might influence students' intentions and future behaviours, including sustainable practices.

Through completing the project, future industry professionals have practiced developing important skills that they will be able to use in their careers. When faced with solving a complex problem, they collected science-based information from various sources to consider the pros and cons of the issue, and then critically analyzed this information to make an informed, but not necessarily perfect, decision. As new manufacturing processes and innovative fibres and fabrics are developed, knowledge can become outdated, but the learned process of seeking and scrutinising information, considering diverse perspectives, and making the best decision given the facts can still be utilised by these students and applied to different areas of their lives – from the personal to the professional and the civic. It is critical for educators to employ and further assess innovative pedagogical strategies that increase students' critical thinking skills in such ways.

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