

Repurposing apparel: A guided process for sustainable design education

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Abstract

The goal of this study was to explore educational strategies to teach repurposing, in the apparel design classroom guided by the gold standard project based learning (GSPBL) model. The researchers collected and analyzed project reflections from participants over four semesters, utilizing a qualitative research approach. Results of the data analysis impacted the evolution of the project (four iterations) and suggested five instructional practices to build upon the project structure to teach repurposing in the apparel design classroom. Educational strategies made throughout the study influenced students' approach to their design process, conscientious of textile waste, and perception toward repurposing. Successful outcomes of the study included the development of transferrable skills, such as creative and critical design thinking, problem solving, and time management, as well as learning satisfaction. Additionally, findings of this study contributed to the body of knowledge of sustainable design: repurposing. Overall, this research guides teaching sustainable design practices.

Keywords: repurposing, sustainable design education, project based learning

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Introduction

Addressing sustainability issues in apparel design education is a subject of increasing importance. The production, use, and disposal of apparel products have innumerable damaging impacts to the environment. These impacts have been growing substantially and are expected to

grow as population and consumption rates continue to increase. Global Fashion Agenda (2017) projects that the consumption of apparel will increase by 63% by 2030, reaching 102 million tons. In the meantime, repurposing is a strategic way to extend product cycles by adding value in used garments (Eike et al., 2020). Presently, about one fifth of apparel goods are reused, recycled, or repurposed, with most apparel consumed ending in landfills (Kozlowski et al., 2018). Discarded clothing may be transformed into meaningful, functional, and re-valued products through repurposing which can lead to substantial decreases in the textile waste stream (Young, et al., 2004).

Palomo-Lovinski & Kim (2014) revealed that fashion designers do not necessarily have a clear vision as how to implement sustainability into their work-flow process to create positive impact. Their study suggested the lethargy in industry sustainability efforts is largely due to apparel design education having minimal sustainability integration into curriculum. Few studies suggested introducing sustainable design practices in patternmaking courses (Gam & Banning, 2020; Hall & Orzada, 2014).

In an effort to build student's knowledge of approaches to sustainable apparel design, the goal of this study was to explore educational strategies to teach repurposing, in the apparel design classroom through project based learning. Project based learning is a student-centered pedagogy that actively involves students with real-world challenges to gain deeper knowledge through practices (Larmer et al, 2015). As students are introduced and encouraged to practice sustainable design approaches, such as repurposing, they may make proactive sustainable design decisions in future coursework and when working in the industry. Additionally, researchers aimed to add to the knowledge base of sustainable design through repurposing. The following research questions were addressed:

1. What are some suggested instructional practices for teaching the repurposing process to intermediate-level apparel design students?
2. How does sustainable design education, through repurposing, contribute to the knowledge base of sustainable design?

Literature Review

Project Based Learning (PBL) and Teaching – Gold Standard

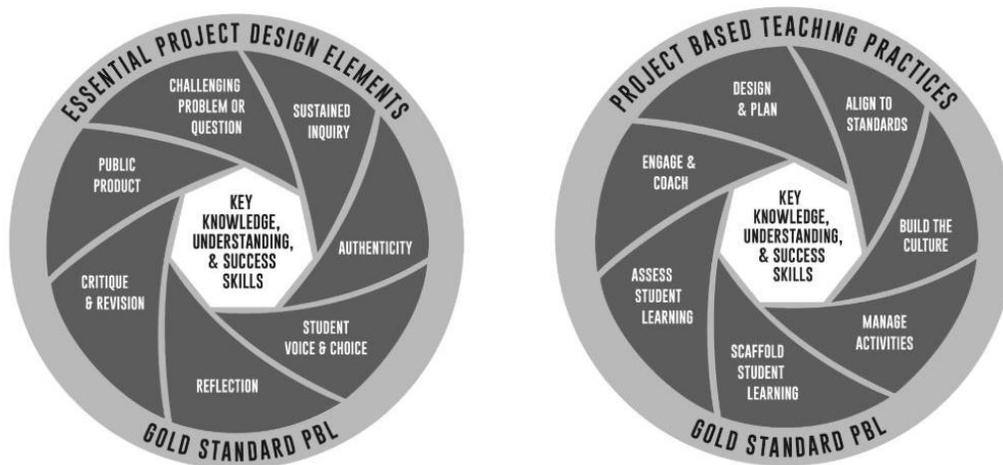
Project Based Learning (PBL), originally suggested by Kilpatrick (1988), is an instructional approach that engages students into a subject through purposeful activity. PBL contains an extended inquiry process with authentic questions and carefully designed tasks (Kilpatrick, 1988). Gold Standard Project Based Learning (GSPBL) further focuses on information and concepts that are more complex and require critical thinking and systematic analysis (Larmer et al, 2015). GSPBL aims to “develop not only students’ understanding but also their ability to use and apply that understanding in the future” (Larmer et al, 2015, p. 35). GSPBL identifies three professional skills that are cultivated through guided learning: critical thinking/problem solving, collaboration, and self-management. These align with the expected skills for students to possess in the modern workplace (LeHew & Meyer, 2005).

GSPBL consists of seven essential project design elements (see Figure 1). First, public product is set as the tangible outcome to provide student motivation as an important contribution to the community. Teachers pose a challenging problem/question, which leads students to work in a sustained and authentic manner. Students are guided by the instructor throughout the project and encouraged to voice their decisions based on research. Reflections assist in self-evaluation so that students may modify strategies for effective outcomes. GSPBL emphasizes the importance

of improving quality of work through critique and revision. Feedback allow students to complete a quality project and achieve outlined learning goals (Larmer et al, 2015).

Figure 1

Gold standard project based learning models



Note: Gold standard project design and teaching practice models for project based learning. Reprinted from “Setting the standard for project based learning: A proven approach to rigorous classroom instruction”, by J. Larmer, J. Mergendoller, and S. Boss, 2015, ASCD. Copyright 2015 by ASCD. Reprinted with permission

Sustainable Design Practice: Repurposing

Repurposing is a sustainable design practice which can extend material use and reclaim existing goods for functional or creative purposes. Fletcher (2008) suggested three strategies for waste management in the product development area: reuse of product, repairing and reconditioning of either whole products or parts of products, and recycling of raw materials. Research suggests the greatest opportunity for reclaimed textiles is to repurpose them into new products (Hawley, 2000).

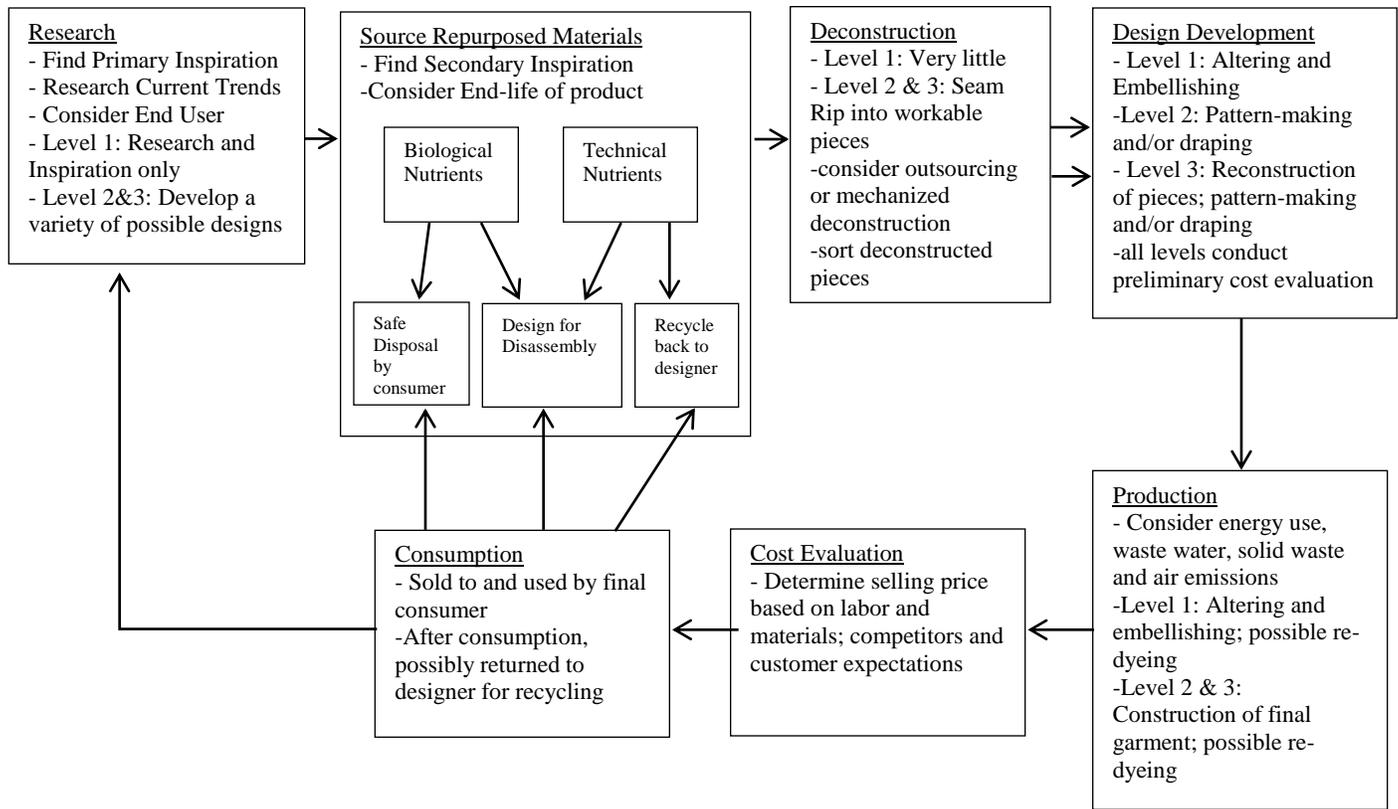
While sustainable practices are growing in some areas of the apparel industry, such as slow fashion (Henninger et al., 2016), co-design (McCann, 2014), and socially responsible

consumer behavior (Szmigin, Carrigan, & McEachern, 2009), a formal process for utilizing textile waste (pre or post-consumer) in the design and production process has yet to be established. One possible reason for delay in large-scale sustainable design integration is associated with minimal knowledge and application of design processes amongst apparel design professionals (Palomo-Lovinski & Kim, 2014).

Irick (2013) surveyed designers who practiced repurposing in their business approach and proposed a process model for repurposing textile and apparel goods (see Figure 2). Identified from this research were three levels of repurposing: redecorating, subtractive, and additive. In level one, redecorating to repurpose, minor alterations in fit or style and/or embellishments are made to the original garment. Level 2, subtractive repurposing, involves cutting a smaller garment from a larger garment or textile. In level 3, additive repurposing, pieces of fabric, either pieces deconstructed from the original garment or pre-consumer scrap waste is pieced together to create a new textile then new product. Lapolla & Sanders (2015) identified creativity levels associated with a hands-on/practice-based workshop that involved repairing or repurposing unwanted apparel goods from personal wardrobes that align with the levels identified by Irick (2013). Similarly, Janigo and Wu (2015) identified similar complexity levels of repurposing (redesign) when exploring a co-design model for entrepreneurial venture.

Figure 2

Process for repurposing



Note: Process for Repurposing. Reprinted from “Examination of the design process of repurposed apparel and accessories: An application of diffusion of innovations theory”, by E. Irick, Oklahoma State University, p.106. 2013 ProQuest dissertation. Reprinted with permission.

Sustainability and apparel curriculum

Recent apparel (design) graduates have minimal knowledge of sustainability concerns for large-scale industry integration (Paloma-Lovinski & Kim, 2014) as formalized processes for sustainable approaches, such as repurposing, don't exist. According to Gam and Banning (2011), the design sector acknowledges the vital importance of sustainability, however, little has been explored on how to teach the concept. Fletcher and Williams (2013) developed a graduate-level Fashion and Environment course that incorporated the interdependence of nature, humans and

societal well-being through the lens of the fashion industry. Kennedy and Terpstra (2013) found a lecture series to be successful in increasing awareness and understanding of basic sustainability concepts. The majority of research available on teaching sustainable practices relates to general sustainability or connected to upper-level design courses.

A problem-based learning method was used by Gam and Banning (2011) to introduce students to sustainable design approaches, including use of organic, renewable, post-consumer, or naturally-dyed fabrics for product development in a fashion show planning course. Study outcomes revealed positive changes in student attitudes regarding the initial impression of sustainable design, broadened perspectives on sustainability, and increased creative efforts. DeLong et al. (2017) discovered that regarding the design process of repurposing, students found inspiration in the fabrics, yet felt constrained. Gam and Banning (2020) used the PBL method to teach zero-waste design, which resulted in an increase in students' interest in sustainable living and fashion as well as awareness of fabric waste generated in the design and pattern cutting process.

This study introduced repurposing into an intermediate-level (sophomore) apparel construction course. This early introduction to sustainable design practices allows students to make sustainable decisions throughout their academic careers while also impacting their practices as consumers.

Methods

The purpose of this study was to explore educational strategies for teaching the repurposing design process while contributing to the body of knowledge of sustainable design. This was accomplished through the development and assessment of a repurposing project guided by the GSPBL framework in an apparel design classroom. A qualitative research approach was

used where student and instructor reflections served as measurement tools. Reflections were guided by prompts (Karppinen et al., 2019) which evolved through project iterations.

Curriculum and Course Structure

Competency of apparel construction is a key knowledge area and skill for those working in creative, functional, and technical positions in the apparel industry. Therefore, apparel programs contain a variety of courses where construction is required. The course under study had not previously incorporated sustainability principles, nor was sustainable design a course learning objective. The prerequisite, an introductory apparel construction course, also did not incorporate sustainable principles, but focused on production skills.

An intermediate (sophomore) level apparel construction class was selected for the repurposing project to address the gap in research involving sustainability integration into lower-level design courses. In this class, students build on construction skills learned in the prerequisite in addition to learning basic pattern alteration concepts from working with commercial patterns. This course is part of the required curriculum for apparel majors and minors where students complete multiple sets of half-scale samples and then complete three full-scale projects (knit garment, lined-jacket, and repurposing garment). Research was conducted over four spring terms, resulting in four iterations of the project.

Project Development and Implementation

The initial development of the repurposing project was guided by the GSPBL framework (Larmer et al, 2015) and the repurposing design process (Irick, 2013). Table 1 outlines the initial structure of the project. Modifications were made with each of the four project iterations based on student and instructor reflections. The project was designed to align with program and

departmental curriculum standards. *Please contact the authors for further project details and assessment tools.*

Table 1

Initial structure for repurposing project

Essential Element of GSPBL	Application of the GSPBL elements	Element integration into Repurposing Project
Challenging Problem or Question	Provides learning purpose with meaningful and challenging problem or question Encourages students to feel they need to know the answer	Challenging Problem Prompt: Source, design, and create a wearable product that combats pre or post-consumer textile waste, generating minimal to zero waste.
Sustained Inquiry	Promotes additional deeper questions Guides to identify tasks to be completed Difficult questions that take time to think through and solve	Trialing and adjusting techniques that promote minimal waste, using levels two and three of the repurposing model.
Authenticity	Represents a real-world scenario Encourages students to experience real-world tools Leads students to measure the impact of their actions on their community	Sourcing of materials from local/community or personal resources Practicing sourcing, design, and construction skills
Student Voice & Choice	Gives students an opportunity to express their own ideas Allows students to take the initiative in solving the problem Enhances their autonomy and competence Encourages self-motivated students to make logical and intelligent choices	Students self-selected repurposing level (approach) for project Students sourced materials and were allowed creative freedom in pattern alteration to carry out design directions
Reflection	Makes students to evaluate thoughtfully through the project tasks Assures their deeper understandings on the subject Enables students to modify their strategies as needed for effective outcomes	Written reflection to repurposing project experiences Prompt: Reflect on your repurposing design process and address any challenges. Provide details on the materials you used and end product created
Critique & Revision	Enables students to receive feedback from teachers and peers Uses rubrics, models, or formal feedback protocols Evaluates students' ability to employ critical thinking/problem solving, collaboration, and self-management skills as summative assessments	In-class progress critiques were provided by the instructor Informal progress critiques included feedback on design, production techniques, and projected textile waste generation
Public Product	A tangible product that can make an important contribution to school morale and community perceptions Motivates students to get highly involved in the project Provides increased satisfaction of students as they perceive their work as worthwhile	Physical creation of repurposed apparel piece Optional exhibition of work(s) in annual student fashion show

For the first two iterations, the repurposing project was the final project for the course and for the second two iterations, it was changed to the second project. GSPBL teaching practices were grounded by key subject knowledge, understanding, and success skills including basic design principles, textiles, construction/production, problem solving, communication, and project management. A ‘sustainability-minded’ class culture was cultivated by the instructor through the sharing of sustainable practices and examples with the class. The instructor engaged with students to provide mentorship and formative assessments.

The context of the problem (Larmer et al., 2015) was identified as intense competition in the apparel industry leading to low retail prices; consumer overconsumption, and quick discard of apparel goods (Stephens, 1985; Claudio, 2007). Utilizing repurposing methods can substantially reduce the amount of virgin textiles needed for new products and combat textile waste issues. Incorporating this design perspective into this course, allows students to build creative problem-solving skills while addressing sustainability issues connected to pre- and post-consumer textile waste.

Participants

Participants were students enrolled in a sophomore-level apparel construction course in a mountain-west region university. Students included 2 males and 42 females (n= 44) who were of traditional college age (19-22). Enrollment in the course ranged from 9-12 students each semester over a four-year study period. The majority of the participants were academic sophomores (56%, n=25), while 31% (n=14) were juniors and 11% (n=5) were seniors. The academic associations of the students were as follows: 86% (n=38) were Design, Merchandising and Textiles majors; 47% (n=21) were Apparel Design minors, and 9% (n=4) were Non-majors.

Additionally, the instructor of the class (facilitator of the repurposing project) was also a participant in this study.

Data Collection and Analysis

A qualitative approach was used to explore educational strategies to teach the repurposing process. End of project participant reflections served as data sources in this study. Content analysis was used to analyze the reflections as this technique enables researchers to inquire into the symbolic meanings of diverse forms of messages and texts and to produce a practical guide to action (Krippendorff, 1980). Related themes were first observed and discussed amongst researchers to increase result objectivity, as suggested by Schwandt, Lincoln, & Guba (2007). Qualitative coding software (Nvivo) was used for identification and categorization of themes, categories, subcategories, and frequencies. Initial categories were identified by visual overview of reflections and then subcategories were identified, reviewed, and edited to reflect content. Coding was performed by two of the researchers (excluding the researcher directly involved in project facilitation).

Results

Student participants in this study reflected on their experiences of the repurposing project by broadly responding to their understanding of sustainability in the apparel industry. Also, they addressed their environmental impact, reflecting on techniques and materials used to create their projects, specific challenges experienced in the process, learning of repurposing methods, and intent to practice repurposing in the future. The student reflections highlighted areas of successful educational strategies as well as gaps in content, apparel design/construction-focused technique(s), and success skills for future iterations of the project to address. Instructor reflections focused on summative details on the entire project with specific focus on

educational/instructional suggestions to overcome observed student challenges. These reflections guided adjustments throughout project iterations. Coding of reflections allowed researchers to identify reoccurring themes and frequencies.

Nvivo software was used to determine inter-coder reliability by comparing responses between coders and provides the percent agreement. The range for the percent agreement was 88.0%-99.6% across coders and classifications. This was deemed an acceptable level of inter-coder reliability. It is important to note the evolution of project iterations (and reflection prompts) may have impacted reflection content and therefore, frequency of theme reference(s).

Evolution of the repurposing project

This project was conducted in four iterations and evolved over time. In all four iterations of the project, students were required to write a 2-page reflection paper regarding the project and use a commercially-purchased pattern. Table 2 outlines the progression of the four iterations. Below paragraphs briefly summarize the evolution of this repurposing project.

Table 2

Repurposing project iteration evolution

Iteration	Instruction	Repurposing methods	End product	Assessment	Student Reflection Prompts	Instructor Reflection Prompts
1 <i>n</i> = 9	Overview of sustainability challenges of apparel industry Minimal discussion of repurposing performed	Subtractive or additive methods	Clothing item or accessory	Construction technique only Written reflection	Explain design process, materials utilized and end product created	Outline key successes and challenges for student learning of repurposing (whole process)
2 <i>n</i> = 12	Increased discussion of sustainability in industry (role of consumer) and repurposing Examples of repurposed garment shown	Consideration of original textile source features Subtractive or additive methods	Clothing item	Construction technique and fit Required to submit textile waste generated and write reflection.	Explain design process materials utilized, end product created, and opinion of repurposing	Outline successes and challenges for student learning of repurposing Efficiency in student use of repurposed materials and methods used

3 <i>n</i> = 11	Discussion of sustainability research focusing on consumer Specific levels of repurposing process Examples of repurposed garment shown	Consideration of features and amount/shape of original textile source for end product Subtractive or additive methods Alteration of pattern to fit textiles	Clothing item	Construction technique and fit Required to submit textile waste generated and write reflection	Explain design process from research/repurposing method used materials utilized, end product created, opinion of repurposing, and change in awareness of sustainability and /or textile waste	Outline successes and challenges for student learning of repurposing Student comprehension sustainability in industry Efficient use of repurposed materials and methods used
4 <i>n</i> = 12	In-depth discussion on sustainable design approaches Elaboration of repurposing process Examples of repurposed garments Repurposing stitching techniques provided for reference	Consideration of features and amount/shape of original textile source for end product Subtractive or additive methods Alteration of pattern to fit available textiles	Clothing item	Construction technique and fit Required to submit textile waste generated and write reflection	Explain design process from research./repurposing method used, materials utilized, end product created, opinion of repurposing, and change in awareness of sustainability and/or textile waste	Outline successes and challenges for student learning of repurposing Student comprehension sustainability in industry Efficient use of repurposed materials and methods used Understanding of additional sustainable design practices Pedagogy reflection

Project iteration 1. In the first project iteration, students were encouraged to research methods of repurposing and were allowed to use either deconstructed second-hand clothing or pre-consumer textile waste scraps. Students were allowed to create either an apparel or accessory item.

Project iteration 2. Project iteration two involved an increased discussion of repurposing methods in class and students were allowed to use deconstructed second-hand clothing or pre-consumer textile waste scraps. If students chose to use deconstructed second-hand clothing, they were instructed to consider the functional and aesthetic aspects of the original garment(s) and design details. In order to sufficiently challenge students, all were required to create an apparel item through repurposing and proper fit was assessed. Additionally, students submitted remaining unused/scrap textiles for the instructor to assess efficient use of materials.

Project iteration 3. In the third iteration of this project, an increased discussion of repurposing methods, specifically based on the repurposing model was included. Students were allowed to use deconstructed second-hand clothing or pre-consumer textile waste, but were required to choose either additive or subtractive repurposing methods. Examples of repurposed garments efficiently utilizing materials were shown. Students were encouraged to consider shape and size of original garment (to deconstruct) when planning design and were allowed to reshape purchased pattern pieces to fit materials available. Students created a garment where proper fit was assessed and submitted textile scraps.

Project iteration 4. Project iteration four built on previous iterations and included a formal repurposing methods lecture was created and accessible for student reference, examples of repurposed garments were shown and small samples were created to show various construction and stitching techniques. Students were encouraged to consider design details and notions of the original garment, as well as size and shape of material source (pattern design alterations to fit available materials were encouraged).

To provide reference points for the reader, materials utilized and end products created from pre or post-consumer textile waste is first described followed by repurposing processes employed. This section is then followed by overarching themes from the coded reflections. These themes align with reflection prompts and are supported through content (written quote) of subcategory data. Frequencies of all themes and subcategories are outlined in Table 3 and further expanded in each subsequent section. Outlined frequencies reflect direct statements made by participants through project reflection. High frequencies indicate strong educational strategies employed in this project while low frequencies identify opportunities for teaching adaptations.

Table 3*Repurposing project themes and frequencies*

Themes	Project iteration frequencies				Total frequencies
<u>Opinion of repurposing</u>					
Transferrable Skills	48	47	50	26	171
<i>Creative & critical design thinking</i>	11	18	19	14	62
<i>Challenging reward</i>	18	16	14	6	54
<i>Useful/applicable</i>	5	9	7	3	24
<i>Problem solving</i>	11	4	3	1	19
<i>Time management</i>	3	-	7	2	12
Satisfaction of repurposing	17	20	17	23	77
<u>Sustainability Awareness in Apparel</u>					
Change design process	9	40	16	18	83
<i>Materials & approach</i>	5	19	8	7	39
<i>Construction challenges</i>	3	13	6	5	27
<i>Alter style/size</i>	1	8	2	6	17
Waste conscientious	9	32	14	12	67
Increased intention to repurpose	16	11	12	16	55
Changed perception of repurposing	4	8	15	12	39

Materials utilized to create new products

Material resources in this study included scraps of fabric from prior projects, apparel/fashion items purchased at second-hand retailers, and unwanted or unusable personal clothing. In total, skirts, dresses, and pants ($f = 38$) were utilized most as original textile materials. The second most utilized material source was select fabrics/scraps ($f = 29$), followed by shirts/blouses ($f = 17$), purses/bags/accessories ($f = 9$), and blazers/jackets/coats ($f = 6$). Some students used multiple material sources (e.g. two pairs of pants and one shirt or multiple ties) to create a single final product, so there is not an equal relationship between resources and outputs.

Over the course of study, students completed 46 fashion items, including ready-to-wear style goods and accessories from a variety of material sources (each student made a single product and two students created an additional item/accessory). End products created included

skirts/dresses/pants ($f = 21$), vest/shawl/poncho ($f = 11$), shirt/corset ($f = 10$), and purse/bag ($f = 4$). Items were made for self, friend, family member, or child of family/friend.

Repurposing processes employed

Students were exposed to a variety of different sustainable design approaches and repurposing techniques via presentation, samples, and visual showcase. Five categories related to repurposing processes employed were: (a) Deconstruct unwanted textile goods for fabric yardage ($f = 35$), (b) Piecing fabrics to create new textile ($f = 31$), (c) Intentional material selection for fabrication or color ($f = 28$), (d) Separation and pattern alteration to accommodate available textiles ($f = 19$), and (e) Retaining original garment component in new design ($f = 14$). Two subcategories within ‘intentional material selection’ that emerged in analysis were: (a) Specific color/textures ($f = 16$) and (b) Sentimental value ($f = 12$). Students typically employed multiple methods to create their fashion items.

Opinion of repurposing

The researchers identified two categories related to the ‘opinion of repurposing’ theme: (a) Transferrable skills (with five subcategories) and (b) Satisfaction of repurposing. The ‘transferrable skills’ category includes five subcategories: (a) Creative and critical design thinking ($f = 62$), (b) Challenging reward ($f = 54$), (c) Useful/applicable ($f = 24$), (d) Problem solving ($f = 19$), and (e) Time management ($f = 12$). This category was termed according to findings from Andrew and Higson (2008), LeHew and Meyer (2005), and Eike, Myers, and Sturges (2018) who identified communication, time management, and interpersonal relationships (to name a few) as ‘transferable (soft) skills’ needed to develop cooperative and diverse global work environments found in apparel industries. The following student quotes provide example of subcategory content:

Courses that include a sustainability focus are very beneficial in understanding the causes and effects, however they [other classes] don't really give us a chance to put this knowledge into practice. [Creative and critical design thinking]

Old ragged jeans went from a pair just sitting on a shelf to a skirt that will be worn many times in the future. The process of watching something change from one thing to another was fun, challenging, and rewarding. [Challenging reward]

I liked the concept behind this project. It is a sustainable and useful skill if you find a fabric you really love that's in a different form. [Useful/applicable]

There are ways of aligning pattern pieces in order to create the least amount of scraps possible. This is challenging, but do-able. This project really helped with me with problem-solving and perseverance. [Problem solving]

In the future, I plan on researching and planning a bit more before I start the project. I tend to get very excited about starting a new project and don't think everything out before I start. This hurt me in the end. [Time management]

Satisfaction of repurposing.

The satisfaction of repurposing category ($f = 77$) included comments pertaining to student views of their repurposing learning experiences. The following comments support student satisfaction with the act of repurposing through class project:

I thought it (the project) was a very fun and clever idea. I enjoyed making something out of repurposed materials.

All in all, I got a lot of pleasure and had fun making my repurposed vest because the method gave me creative freedom when making the (textile) fabric.

Sustainability awareness in apparel

The researchers identified four categories related to sustainability awareness in apparel based upon views experienced in the repurposing project: (a) Change design process ($f = 83$), (b) Waste conscientious ($f = 67$), (c) Increased intention to repurpose ($f = 55$), and (d) Changed perception of repurposing ($f = 39$). Within the 'change design process' category, three subcategories emerged in analysis: (a) Materials and approach ($f = 39$), (b), Construction challenges ($f = 27$), and (c) Alter style/size ($f = 17$).

Change design process

Statements suggest changes in design process may impact successfulness of end product or recommendations for implementing repurposing techniques in a larger scale process. It is important to note that while these findings focus on participant views, many professionals who repurpose for profit identified some of these same challenges (Irick, 2013).

I would have changed textiles selected: using all knit fabrics instead of a mixture of different textiles. [Materials and approach]

I struggled more with my sewing than I did with anything else. It was hard to get the fabric through the serger without drastic stretching. [Construction challenges]

I should have used the front piece of fabric for the back and vice versa. I believe the garment would have looked better if these changes were made. [Alter style/size]

Waste Conscientious

The category of ‘waste conscientious’ within the apparel sustainability theme was formulated from statements regarding a (new) understanding of the relationship between design approaches and textile waste generation. The following statements capture some of these views:

I believe that this project is very beneficial for all students. As a student studying apparel, we learn in many different courses that overconsumption and material waste are major issues in the fashion industry today.

This project helped me understand the importance of fabric efficiency. It’s really shocking to learn how much fabric we waste just in our sewing class, which makes me wonder how much fabric is wasted in commercial production.

Increased intention to repurpose

The increased intention to repurpose category included comments about how students planned to use sustainable approaches, such as repurposing, in future coursework and/or their career trajectory. The following comments describe how the repurposing project impacted their design approaches for the future:

It opened my eyes to the idea of creating new textiles, which I didn't know before. I now look at fabric waste in a new light.

I really enjoyed this project, especially since this is the type of thing that I would love to do in the future for profit. It's something I am very passionate about.

Changed perception of repurposing

The changed perception of repurposing category included comments about how student views evolved to look at unused or unwanted material and clothing as a resource rather than waste. The following comments describe this change of viewpoint regarding second-hand, scrap fabric, or unwanted clothing textile materials as a desirable resource:

It made me realize that there are a lot of things that we can do with leftover scraps of fabric. They don't necessarily have to be thrown away.

I definitely will go thrift store shopping more with the intention of finding pieces to repurpose for class or personal projects.

My opinion on repurposing has changed. I respect the process more now that I went through the process of deconstructing finished garments and worked through how to use the fabric most efficiently.

Instructor reflections

As previously stated, the instructor who facilitated the repurposing project performed reflections in order to identify successes and challenges associated with the study after each project iteration and at the conclusion of the study. Iteration modifications were based on observations made in the classroom, student written reflections, and instructor reflections to address points that received low frequency references. The instructor reflected upon student's overall comprehension of environmental impact of the apparel industry, their abilities to differentiate between different approaches to sustainable design, and the pedagogical approach of GSPBL. The following paragraph summarizes key findings from the instructor's reflections.

One of the main successes of this study was that students learned a different design process where they considered materials (pre and post-consumer textile waste) early in the design process to mitigate textiles entering the solid waste stream. This success aligns with the high frequencies of student quotes regarding materials and waste conscientious. Another success of this study involved students increased intention to repurpose in the future. This was a consistent comment from participants through all iterations and the researchers found this very optimistic for students, both as career professionals and as consumers. Additionally, upon instructor observation, a new method of repurposing was discovered and added to the existing model by Irick (2013). This new method is explained further in the discussion section. Some of the greatest challenges experienced in this project were associated with student hesitation to design and create/construct in a process that was different than the traditional design process where designs are developed, materials are purchased, patterns are cut and sewn, and waste is discarded. This hesitation then impacted students' time management to complete the project and overcome other challenges experienced in the construction process. Modifications were made in each project iteration to provide more instruction of apparel industry sustainability issues and sustainable design approaches and techniques, while also showing completed examples of repurposed designs. These modifications led to gradual increase of sustainability references in student reflections.

Overall, participants involved in this study identified the repurposing project to be an enjoyable, yet challenging approach to advancing their apparel construction knowledge and skills. Many students expressed that the repurposing project gave them an opportunity to push their creativity while providing an alternative view of material as resources. Students gained skills directly related to their academic discipline (apparel design, construction, and some

patternmaking) as well as problem solving and time management skills that can be used throughout their life and transferable to a plethora of situations. The GSPBL was deemed a successful framework for project development and teaching practices to educate students on repurposing as a sustainable design approach.

Discussion

The goal of this study was to explore educational strategies to teach repurposing in the apparel design classroom guided by the GSPBL model. As students were introduced and encouraged to practice repurposing as a sustainable design approach to combating textile waste issues they made proactive references to continue designing for sustainability in future coursework and upon work in industry. Additionally, researchers aimed to add to the knowledge base of sustainable design through repurposing by building upon the original repurposing process model (Irick, 2013).

Based on the results of this research and in addressing research question one, “what are some suggested instructional practices for teaching the repurposing process to intermediate-level apparel design students?” the GSPBL framework was deemed a strong model to follow to develop and facilitate design challenges in a studio setting. Based on participant reflections and instructor observations, the following list provides suggested instructional practices to build upon the structure provided in this study to teach repurposing to design students using the GSPBL model:

1. Provide a broad context of sustainable design approaches used in apparel and textiles to frame how sourcing materials and design decisions impact end product; provide multiple examples of approaches to encourage student voice and choice.

2. Allow for time in project to have students complete small samples of techniques employed at each level of repurposing prior to committing to design direction to encourage sustained inquiry and scaffold learning. Techniques may include piecing to create continual/larger textiles, quilting, quilt-and-slash, free motion quilting, freeform embroidery, pleating, and other piecing or surface design techniques (Eike et al, 2020).
3. Connect students with industry brands who practice sustainable design approaches, particularly repurposing, in their business model to promote authenticity of ‘real world’ situations. This suggestion aligns with the need to better educate apparel graduates to implement sustainable practices prior to entering industry careers (Palomo-Lovinski & Kim, 2014).
4. Provide opportunities for students to interact with peers through formative critique sessions to encourage modification/revisions throughout the design and development process and development of success skills; consider developing mid-project reflection to encourage self-management. This suggestion aligns with findings by Gam and Banning (2011) and DeLong et al. (2017) that designing from challenges pushes students to develop creative solutions.
5. Build a culture that embodies sustainability thought and action throughout academic program to encourage deep and meaningful learning.

In summary, a more guided and detailed approach to the project based learning pedagogy would be suggested to increase student motivation and learning of the repurposing process. Additionally, as this class was a sophomore-level course, the students had very little or no prior experience with sustainable design practices, it appeared that giving students more guidance in

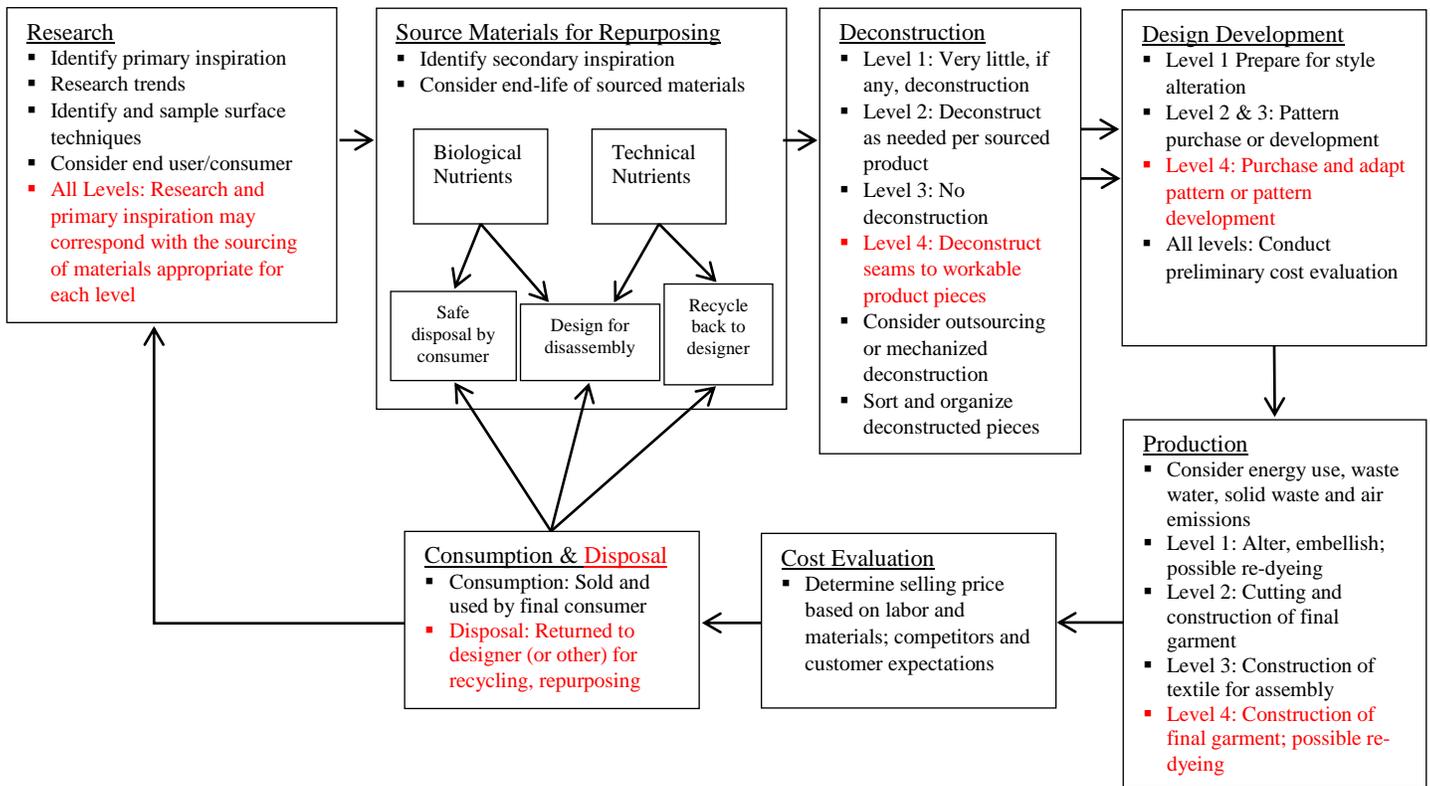
the development stage of their project increased their creativity, quality of the output, and efficient use of materials.

Based on the results of this research and in addressing research question two, “how does sustainable design education, through repurposing, contribute to the knowledge base of sustainable design?” it was observed that students desired to develop products that more closely aligned with available textiles (deconstructed or pieced). This approach resulted in the creation of a new level of repurposing, labeled *Intentional Patterning*. This method refers to the deliberate separation and alteration of pattern pieces to accommodate available sizes and shapes of fabric. This method allowed for more efficient use of material resources, decreasing quantity of textile waste generated.

This study adds to the scholarship of sustainable design, specifically that of repurposing, by furthering the research by Irick (2013) through the addition of the fourth level of repurposing (intentional patterning) and refining the overall process. Figure 3 outlines the revised repurposing process; font color adjustment highlights key revisions to process as outcomes of this study.

Figure 3

Revised process for repurposing



Conclusion

The need to consider sustainability in the apparel industry is gaining awareness among fashion professionals and many researchers are focusing on student education. Previous research has suggested that there is a lag in implementing sustainable practices into the apparel industry due to a lack of awareness or understanding from recent graduates. The purpose of this research was to incorporate repurposing into an apparel construction course using previous repurposing research and the GSPBL as a guiding models. This research focused on teaching repurposing as a function of sustainable design and how this can inform the knowledge base of sustainable design.

To create a much needed seismic change in the fashion industry, apparel design educators need to shift curriculum for students to design within the boundary of sustainability.

Future iterations of this repurposing project include integration of the five suggested instructional strategies. The researchers are confident that continuing to modify and evolve this repurposing project, following the GSPBL model as a guide, will produce creative solutions in other sustainable design approaches. As this project was integrated into a construction course, opportunities exist for project incorporation into advanced design course as students will have knowledge to develop product patterns to employ level four of the repurposing process: intentional patterning. Regarding the repurposing model, future research may include testing of the model for production and the cost effectiveness of the multiple levels of repurposing.

References

- Andrews, J., & Higson, H. (2008). Graduate employability, ‘soft skills’ versus ‘hard’ business knowledge: A European study. *Higher Education in Europe*, 33(4), 411–422.
<https://doi.org/10.1080/03797720802522627>
- Claudio, L. (2007). Waste couture: Environmental impact of the clothing industry, *Environmental Health Perspectives*, 115 (9), A449–A454.
<https://doi.org/10.1289/ehp.115-a449>
- DeLong, M., Alice Casto, M., Min, S., & Goncu-Berk, G. (2017). Exploring an up- cycling design process for apparel design education. *Fashion Practice*, 9(1), 48–68.
<https://doi.org/10.1080/17569370.2016.1148309>
- Eike, R., Irick, E., McKinney, E., Zhang, L., & Sanders, E. (2020). Repurposing design process. In S. S. Muthu & M. A. Gardetti (Eds.), *Sustainability in the Textile and Apparel Industries: Sustainable Textiles, Clothing Design and Repurposing* (pp. 189–239). Springer. <https://doi.org/10.1007/978-3-030-37929-2>
- Eike, R., Myers, B., & Sturges, D. (2018). The impact of service-learning targeting apparel design majors: A qualitative analysis of learning growth. *Family and Consumer Sciences Research Journal*, 46(3). <https://doi.org/10.1111/fcsr.12250>
- Fletcher, K. (2008). *Sustainable Fashion and Textiles Design Journeys*. Earthscan.

- Fletcher, K., & Williams, D. (2013). Fashion education in sustainability in practice. *Research Journal of Textile and Apparel*, 17(2), 81–88. <https://doi.org/10.1108/RJTA-17-02-2013-B011>
- Gam, H., & Banning, J. (2011). Addressing sustainable apparel design challenges with problem-based learning. *Clothing and Textiles Research Journal*, 29(3), 202–215. <https://doi.org/10.1177/0887302X11414874>
- Gam, H., & Banning, J. (2020). Teaching sustainability in fashion design courses through a zero-waste design project. *Clothing and Textiles Research Journal*. <https://doi.org/10.1177/0887302X20906470>
- Global Fashion Agenda. (2017). *Pulse of the fashion industry report*. https://www.globalfashionagenda.com/wp-content/uploads/2017/05/Pulse-of-the-Fashion-Industry_2017.pdf
- Hall, M. & Orzada, B. (2014). *Zero waste patternmaking in the classroom: Creative approaches to teaching sustainable design* [Conference session]. International Textile and Apparel Association Annual Conference, Charlotte, NC, United States. https://lib.dr.iastate.edu/itaa_proceedings/2014/presentations/6
- Hawley, J. (2000). Textile recycling as a system: A micro/macro analysis. *Journal of Family and Consumer Sciences*, 92(4), 40–43. <https://doi.org/10.1533/9781845691424.1.7>
- Henninger, C., Alevizou, P., & Oates, C. (2016). What is sustainable fashion? *Journal of Fashion Marketing and Management*, 20(4), 400–416. <https://doi.org/10.1108/JFMM-07-2015-0052>
- Irick, E. (2013). *Examination of the design process of repurposed apparel and accessories: An application of diffusion of innovations theory* (Publication No. 3614420) [Doctoral dissertation, Oklahoma State University]. ProQuest Dissertations and Theses Global. <https://search.proquest.com/docview/1520789665?accountid=10906>
- Janigo, K., & Wu, J. (2015). Collaborative redesign of used clothes as a sustainable fashion solution and potential business opportunity. *Fashion Practice*, 7(1), 75–98. <https://doi.org/10.2752/175693815X14182200335736>
- Karppinen, S., Kallunki, V., & Komulainen, K. (2019). Interdisciplinary craft designing and invention pedagogy in teacher education: Student teachers creating smart textiles. *International Journal of Technology and Design Education*, 29(1), 57–74. <https://doi.org/10.1007/s10798-017-9436-x>
- Kennedy, T., & Terpstra, C. (2013). A stitch in time saves nine: Identifying pedagogies for teaching sustainability issues to fashion students. *Research Journal of Textile and Apparel*, 17(2), 127–135. <https://doi.org/10.1108/RJTA-17-02-2013-B015>

- Kilpatrick, W. H. (1988). *The project method: The use of the purposeful act in the educative process*. Columbia University.
[https://babel.hathitrust.org/cgi/pt?id=uc1.\\$b58973&view=1up&seq=7](https://babel.hathitrust.org/cgi/pt?id=uc1.$b58973&view=1up&seq=7)
- Kozlowski, A., Searcy, C., & Bardecki, M. (2018). The reDesign canvas: Fashion design as a tool for sustainability. *Journal of Cleaner Production*, 183, 194–207.
<https://doi.org/10.1016/j.jclepro.2018.02.014>
- Krippendorff, K. (1980). *Content analysis: An introduction to its methodology*. Sage Publications.
- Larmer, J., Mergendoller, J., & Boss, S. (2015). *Setting the standard for project based learning: A proven approach to rigorous classroom instruction*. ASCD.
- Lapolla, K., & Sanders, E. (2015). Using cocreation to engage everyday creativity in reusing and repairing apparel. *Clothing and Textiles Research Journal*, 33(3), 183–198.
<https://doi.org/10.1177/0887302X15572877>
- LeHew, M., & Meyer, D. (2005). Preparing global citizens for leadership in the textile and apparel industry. *Clothing and Textiles Research Journal*, 23(4), 290–297.
<https://doi.org/10.1177/0887302X0502300409>
- McCann, J. (2014). Co-design principles and practice: Working with the active ageing. In J. McCann & D. Bryson (Eds.), *Textile-led design for the active ageing population* (pp. 215–243). Springer. <https://doi.org/10.1016/B978-0-85709-538-1.00013-4>
- Palomo-Lovinski, N., & Kim, H. (2014). Fashion design industry impressions of current sustainable practices. *Fashion Practice*, 6(1), 87–106.
<https://doi.org/10.2752/175693814X13916967094911>
- Schwandt, T., Lincoln, Y., & Guba, E. (2007). Judging interpretations: But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Evaluation*, 114(2), 11–25. <https://doi.org/10.1002/ev.223>
- Stephens, S. (1985). *Attitudes toward socially responsible consumption, development and validation of a scale and investigation of relationships to clothing acquisition and discard behaviors* (Publication No. 8605464) [Doctoral dissertation, Virginia Polytechnic Institute and State University]. ProQuest Dissertations and Theses Global.
<https://search.proquest.com/docview/303430870?accountid=10906>
- Szmigin, I., Carrigan, M., & McEachern, M. (2009). The conscious consumer: Taking a flexible approach to ethical behaviour. *International Journal of Consumer Studies*, 33, 224–231.
<https://doi.org/10.1111/j.1470-6431.2009.00750.x>
- Young, C., Jirousek, C., & Ashdown, S. (2004). Undesigned: A study in sustainable design of apparel using post-consumer recycled clothing. *Clothing and Textiles Research Journal*, 22(1–2), 61–68. <https://doi.org/10.1177/0887302X0402200108>