

The Investigating Tactile Experiences and Textures with Sustainable Materials in Art and Design Education

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Abstract

This research investigates how tactile experiences with sustainable materials influence educational outcomes, emphasizing how interacting with these materials can enhance students' creativity, learning experiences, and increase awareness of sustainability. Traditional discussions have focused on the environmental benefits of these materials, often neglecting their educational and experiential value.

This study aims: (1) to explore tactile experiences with various sustainable materials; (2) to examine these materials through experiential learning practices; and (3) to measure students' agreement using a questionnaire on tactile experiences with sustainable materials in educational settings, thereby promoting a participatory and tactile-focused learning approach.

This study employed a mixed-methods approach, including in-depth interviews with three art and design experts, three participatory workshops, and questionnaires to collect data. The research involved 48 student participants in three participatory workshops, enabling an analysis of their tactile interactions with sustainable materials.

In the results, descriptive analysis showed the significant role of textures in enhancing the appeal of tactile experiences and the impact of sustainable materials on these experiences, thereby enriching educational engagement. The majority of student participants recognized the value of using sustainable materials in art and design education, indicating a better understanding and awareness. However, students' application of sustainable materials to art projects was limited.

In conclusion, the study highlights the educational and experiential value of tactile interactions with sustainable materials in art and design education. Integrating these materials can increase tactile experiences, sustainability awareness, and students' engagement. This research addresses the gap in the existing literature and recommends conducting further research and assessment of practical applications in the field.

Keywords: Tactile Experiences; Sustainable Materials; Texture; Art and Design Education

Introduction

Existing research has not sufficiently explored the role of tactile experiences with sustainable materials in art and design education. Sustainability goes beyond being considered merely a luxury or a trend. Nicolau (2023) emphasized that the use of sustainable materials, represents a significant shift in the art and design fields rather than a temporary trend. Chiang, Lin, and Lin (2023) pointed out that touch is crucial in how materials are interacted with in design. This has not been fully explored in terms of how tactile experiences influence the perception of materials. According to Stevens and Culén (2024), while design education plays a critical role in promoting the sustainability of everyday lives, it does not focus on the tactile aspects of engaging with materials. Instead, it emphasizes other aspects, such as how society can transition toward sustainability, integrating these ideas into the curriculum.

Existing literature is limited in the exploration of how tactile experiences with sustainable materials can impact art and design education. This gap hinders deeper engagement with materials and makes it more challenging for future practitioners to fully adopt sustainable philosophy and practices. Furthermore, neglecting the importance of physical interaction and tactile experiences with materials undermines the learning and creative processes, which are essential for connecting with sustainable practices.

In current art and design education, discussions on sustainability primarily focus on material use and often ignore the impact of tactile experiences associated with sustainable materials. Cheng (2018) observed that students who had experienced creativity training were better at integrating creative thinking into sustainability practices, leading to more effective and innovative approaches to environmental challenges. This study aims to address this gap by exploring how the use of sustainable materials can enhance tactile experiences in art and design education and how this impacts students' creativity and environmental awareness.

This study aims to provide insights into the educational and experiential benefits of sustainable materials by examining the impact of tactile interactions with these materials. These insights are expected to promote a better understanding of sustainability in art and design education and enhance the related literature. Hofverberg and Westerlund (2021) show how blending sustainable materials, tactile learning, and art education can effectively teach sustainability through engaging, hands-on experiences. The integration of tactile experiences with sustainable materials in educational settings can improve students' learning experiences and help them appreciate and understand sustainability and the use of sustainable materials better.

Research Objectives

1. To study tactile experiences with sustainable materials, including those sourced from seashell waste, eggshell waste, and Jesmonite.
2. To examine sustainable materials through experiential learning practices to discover their potential in enhancing the creative process.
3. To evaluate student perceptions of the impact of tactile experiences with sustainable materials in educational settings.

Literature Review

1. Understanding of Tactile Experiences

Tactile experiences uncover a complex and detailed domain that has been largely underexplored by researchers. The complexity of tactile experience stems from the inherently interactive nature of touch, where the acts of touching and being touched are equally crucial to the process (Atkinson et al., 2016). Tactile experience specifically pertains to the sense of touch alone, encompassing how surfaces, textures, weights, temperatures, and materials feel against the skin. Unlike sensations such as temperature or pain, tactile perceptions are specialized and related to the skin itself (Sonneveld, 2007). Ferreira (2019) suggests that touch, due to the dispersion of sensors throughout the body, differs from other senses, involving sensory experiences through the skin with a human connection. Tactile, or haptic, sensations cover a wide range of experiences, including both passive touch and active manipulation, which are essential for evaluating the textural aspects in art and design (Gallace & Spence, 2011). Rognoli (2010) underscores the inherent importance of tactile perception, which provides insight into the material nature of surroundings. Through tactile sensation, diverse sensory features of materials are revealed. Meng (2010) defines 'human touch' as the emotional connection and human essence that people often experience, highlighting that tactile experiences are not merely sensory but also intertwined with emotions and social interactions. When discussing tactile experiences, people often focus on the act of touching but neglect significant tactile interactions, such as deeper cognitive and emotional connections with sustainable materials.

2. Sustainable Materials

In the field of art and design, the classification of sustainable materials varies. Utsugi et al. (2007) describe them as environmentally conscious materials, Rognoli (2010) highlights their sustainability potential, and Karana & Nijkamp (2014) define them as eco-sensitive. Although distinctions between these terms may not always be clear, the broad scope is expected given the expanding field of sustainable materials, which exhibits diverse perspectives. Consolidating the study of sustainable materials into a general term to better understand which types of materials are considered sustainable is essential to this research. Umezawa et al. (2014) and Halada et al. (2003) emphasize that sustainable materials are developed through comprehensive lifecycle evaluations, are free of harmful substances, highly reusable, and reduce environmental harm. Grant and Mason (2013) describe sustainable materials as naturally replenishable and capable of breaking down into harmless components. Allwood (2016) notes that sustainable materials lack a precise definition but typically include economic, social, and environmental aspects.

In this study, Jesmonite is introduced as a new sustainable material, also known as a DIY material for art and design purposes. Parisi et al. (2017) mention that DIY materials constitute an increasingly large category under sustainable materials. Coppola et al. (2018) describe Jesmonite as a versatile, water-based, solvent-free resin system that can be colored. Its exceptional durability and fire resistance make it suitable for a wide range of creative and design applications, fostering creativity and innovation aligned with environmentally conscious art and design projects.

In terms of sustainability, waste materials are a subset of sustainable materials but are seldom discussed in art and design education. Hart (2020) discovered that seashell waste and eggshell waste, which are rich in calcium carbonate and minerals, can be used in art and design. Utilizing crab shell waste, clamshell waste, oyster shell waste, and eggshell waste (see Figure 1) can reduce environmental pollution and provide a sustainable alternative for art and design applications. Despite limited research in this field, advanced knowledge and technology to explore these materials are essential. This study aims to discuss and explore sustainable materials through definitions, knowledge, and terminology to better understand them.



Figure 1 Crab shell waste, clamshell waste, oyster shell waste, and eggshell waste
Source: Photography by author, 2024

3.The Significance of Texture

According to Alerby and Opstad (2022), texture conveys a blend of visual and tactile characteristics on surfaces, spanning realms of both natural and cultural origins, as well as various aspects of daily existence. Shao (2019) discusses how texture encompasses the structural composition and alterations observed on an object's surface, including the subjective perception and experience of these textural attributes. Texture can be perceived through both vision and touch. Discussing the significance of texture aims to explore its crucial role by examining tactile experiences through sustainable materials for art and design education.

Zuo et al. (2005) underscore the extensive range of textures, potentially numbering in the hundreds of thousands, which stem from diverse origins, incorporating natural inspiration, advancements in materials science and fabrication techniques, as well as virtual reality, imaginative realms, and everyday social interactions. Tactile, or haptic, sensations encompass a broad spectrum of experiences, including both passive touch and active manipulation, which are crucial in evaluating the textural aspects in art and design, particularly for sustainability.

This study aims to foster diverse understandings of texture and its relationship with art and design education, enhancing students' perception and appreciation of its meaning and importance. The motivation behind this study stems from the need to bridge the gap in understanding the impact of tactile experiences on the appreciation and use of sustainable materials in art and design education. This research challenges the traditional view of sustainability as an exclusive domain of luxury or trendiness, proposing instead a comprehensive approach that integrates tactile experiences into educational settings. By understanding sustainable materials, tactile experiences can be enhanced, promoting a deeper appreciation of texture.

Research Methodology

This study employs a mixed-methods approach to thoroughly investigate the tactile experiences associated with sustainable materials in art and design education. The methodology integrates expert in-depth interviews, participatory workshops, and questionnaires, all designed to deepen students' understanding of the tactile properties of these materials. Despite challenges such as individual differences in tactile perception and limited access to a wide variety of sustainable materials, the objective is to enhance comprehension of how tactile experiences can foster the use of sustainable materials. A crucial element of this research is the generation of evidence supporting the incorporation of sustainable practices within educational settings. To capture a range of perspectives on the impact of sustainable materials, in-depth interviews were conducted with three experts: a university professor specializing in art and design, a high school visual arts teacher, and a professional art director. The interviews were held at AMBA Coworking Space in Taipei, Taiwan, on January 2 and January 5. Additionally, three participatory workshops were conducted, involving 45 students from Dhurakij Pundit University in Bangkok, Thailand, who participated on January 15-16, 2024, and three student participants from Bangkok Design Week held on February 3, 2024, totaling 48 student participants. After these participatory workshops concluded, structured questionnaires were distributed to all student participants. This dual approach of participatory workshops and questionnaires ensures the comprehensive and reliable collection of data, enriching the study's overall depth and breadth. The methodology diagram is illustrated in Figure 3.

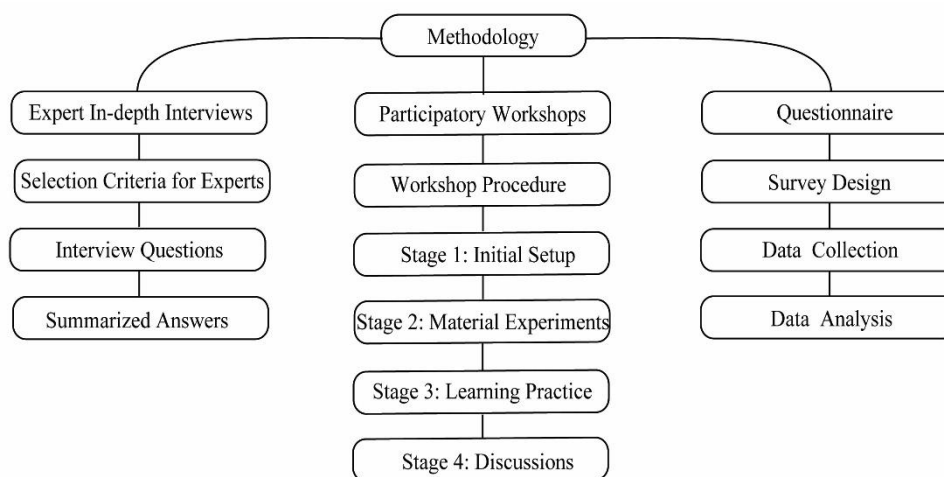


Figure 3 Methodology diagram framework

Source: Constructed by the author

Expert In-depth Interviews

The in-depth interviews were conducted with leading experts in the art and design field to investigate the role of tactile experiences facilitated by the use of sustainable materials. These experts, recognized for their contributions to art and design education, provided valuable insights based on their extensive experience and expertise. The selection criteria for experts included a minimum of 15 years of experience in the art and design field, extensive teaching or educational experience, expertise related to tactile and sustainable experiences, and active

engagement in practice-based, evidence-supported methods to ensure objectivity and reliability. The selected experts included Expert 1: Ken-Tsai Lee, an Associate Professor at the National Taiwan University of Science & Technology in his 50s; Expert 2: Natalie Laing, an Art Educator and Co-Founder of 60 Degree Design Studio in her 40s; and Expert 3: Li-Fang Huang, a Visual Art Teacher at Taipei First Girls High School, also in her 40s. All experts are based in Taiwan. All experts are based in Taiwan.

Interview Process

Three experts participated in face-to-face interviews, each lasting thirty minutes and consisting of five questions. These interviews were conducted in a co-working space, providing a conducive environment for open and detailed discussions. The data collected from these interviews were systematically analyzed to identify key findings and insights related to the study objectives

Summary of Interviews

These discussions with leading experts were conducted to explore how tactile experiences influence student engagement and creativity within the realm of art and design education. The interviews discussed the challenges and opportunities associated with integrating sustainable materials into educational settings. The interview questions and summarized answers, along with the distilled key findings, are presented in Table 1. The insights from these experts emphasize the vital role of sustainable materials and the significant impact of tactile experiences and textures on art and design education.

Table 1 Interview Questions and Summarized Answers

Question	Expert 1	Expert 2	Expert 3
How do textures enhance tactile experiences in art and design education?	Textures fundamentally create a connection between the material and the user, fostering engagement.	Textures stimulate curiosity and facilitate interaction within educational settings.	Tactile textures enhance students' comprehension of sustainable materials by improving their sensory experiences.
What unique tactile properties do sustainable materials like seashell and eggshell waste, and Jesmonite offer?	These materials provide unique rough and organic textures that cannot be replicated with synthetic alternatives.	Jesmonite offers smooth, versatile, and adaptable textures suitable for a variety of projects.	Educating both students and instructors about the benefits and practical applications of these materials is crucial.
What are the main challenges in integrating sustainable materials in art and design?	Key issues include the availability and cost of sustainable materials, which can limit their use.	Ensuring consistency in the quality of sustainable materials presents a significant challenge.	Educating both students and instructors about the benefits and practical applications of these materials is crucial.

How do tactile experiences with sustainable materials contribute to innovation in art and design education?	These experiences foster a deeper understanding of material properties and strengthen the connection between students and their work.	Tactile experiences encourage creative thinking and innovative engagement in student projects.	They promote sustainability awareness and inspire students to integrate these concepts into their design projects.
How can the use of sustainable materials influence long-term sustainability practices in art and design?	Using these materials promotes resource consciousness and environmental responsibility among students.	It encourages the adoption of green materials and sustainable techniques within the educational curriculum.	These practices inspire students to incorporate sustainability into their future professional endeavors.

Participatory Workshops

Workshops are interactive, hands-on sessions designed to provide practical experience and direct engagement with materials or concepts. The workshops in this study were participatory and experiential, focusing on group-based learning and creation. Numa et al. (2008) explain that these workshops emphasize teamwork and creative problem-solving, organized by a facilitator who sets up tasks and the environment to encourage collaboration, competition, and the expression of opinions and ideas. This type of workshop format is widely employed in disciplines such as creative arts, community planning, and academic education. This study followed a structured experiential learning approach, comprising three distinct participatory workshops: the first workshop was held at Dhurakij Pundit University on January 15, 2024, attended by 40 first-year students, organized into ten groups of four students each; the second workshop was conducted on January 16, 2024, also at Dhurakij Pundit University, featuring a smaller session with five senior students; and the third workshop took place at SUPH Art Space during Bangkok Design Week 2024 on February 3, 2024, with three graduate students from other universities attending. The workshops were conducted in an environment conducive to experiential learning, tactile experience engagement, and detailed discussions (see Figure 4).






Figure 4 Participatory workshops
Source: Photography by the author

Workshop Procedure

The participatory workshop began with a 15-minute initial setup, where an introductory document outlined the procedure, including the introduction of sustainable materials such as Jesmonite, seashell waste, eggshell waste, coffee bean grounds, and stucco, along with fundamental sustainability principles and case studies. Sustainable textures were demonstrated through specific examples, material introductions, and an understanding of tactile sensations. In the next 30 minutes, students practiced using these materials, experimenting with various textural effects using substances like rice husk, bamboo fiber, and small natural pebbles to create diverse tactile textures. This was followed by a 60-minute learning practice stage where each group collaborated on experimental solutions, exploring color combinations, mixing sustainable materials, and using coaster silicon molds to shape the materials. The workshop concluded with a 25-minute discussion period where each group presented their creations and engaged in discussions about their tactile experiences, interactions with various textures, and perceptions of sustainability, reflecting on their objectives and the knowledge and insights gained throughout the workshop. The workshop procedure is detailed in Table 2.

Table 2 Detailed Workshop Procedure

Stage	Objective	Duration	Activities	Materials Needed	Expected Outcomes	Workshop Photos
Stage 1: Initial Setup	Introduce sustainable materials and fundamental sustainability principles.	15 minutes	Introductory document outlining four steps, demonstration of sustainable textures.	Jesmonite, seashell waste, eggshell waste, coffee bean grounds, stucco.	Understanding of sustainable and Sustainability principles.	

Stage 2: Material Experiments	Practice using sustainable materials and experimenting with textural effects.	30 minutes	Detailed instructions, experimentation with various textural effects.	Rice husk, bamboo fiber, small natural pebbles.	Creation of diverse tactile textures.	
Stage 3: Learning Practice	Collaborate on experimental solutions and explore material combinations.	60 minutes	Group work on experimental solutions, exploring color combinations, mixing materials, using coaster silicon molds.	Sustainable materials, coaster silicon molds.	Integration of tactile textures and sustainable materials in the creative process.	
Stage 4: Discussions	Reflect on tactile experiences and sustainability.	25 minutes	Presentation of creations, group discussions on tactile experiences, interactions with textures, and perceptions of sustainability.	Creations made from sustainable materials.	Enhanced understanding of sustainability, tactile experiences, and insights gained.	

Demographic Characteristics

Utilizing descriptive statistical techniques, the analysis evaluated the demographic characteristics of the student participants. Males comprised 42% of the participants, while females accounted for 58%. The majority of participants were below 20 years old (54%), followed by those aged 20-25 years (40%), and those aged 25 and above (6%). Educational background analysis showed that 94% of the participants had a college education, with 6% possessing education beyond college. Participants' academic disciplines were primarily in Art (54.17%) and Design (35.42%), with a smaller proportion in other fields (10.42%). Overall, these demographics indicate a predominantly younger population with a strong focus on Art and Design disciplines, as illustrated in Figure 5.

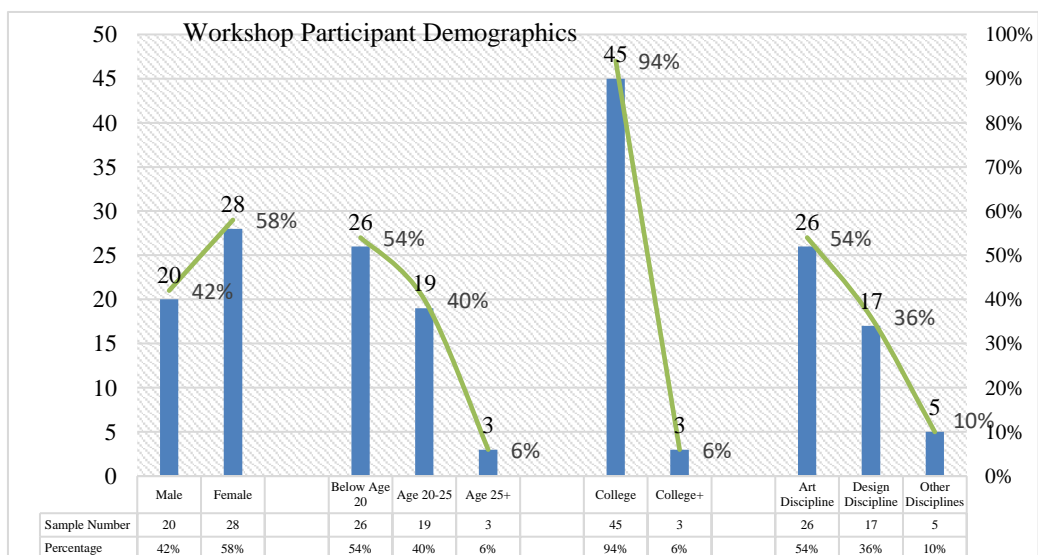


Figure 5 Workshop participant demographics
Source: Constructed by the author

Data Collection and Analysis

To collect data, this study employed an online questionnaire distributed among student participants from the aforementioned workshops. The questionnaire aimed to gather information on preferences and levels of agreement regarding three key aspects: tactile experiences, sustainable materials, and art and design education. Utilizing a 5-point Likert scale, where a score of 5 indicated extremely strong agreement and a score of 1 signified extremely strong disagreement, the data collection was structured into three parts:

Tactile Experiences: Students evaluated their perception of tactile sensations related to sustainable materials and the importance of texture.

Sustainable Materials: This section concentrated on specific features of sustainable materials, assessing their role in sustainability and their impact on tactile experiences.

Art and Design Education: The final part examined the impact of tactile experiences with sustainable materials on art and design education, including aspects such as knowledge of sustainable materials.

Utilizing descriptive statistical techniques, the analysis measured the student participants' consensus on different aspects of tactile experiences, sustainable materials, and art and design education. This comprehensive approach provided insights into the preferences and agreement levels among students, highlighting the importance of tactile experiences and sustainable materials in the context of art and design education.

Table 3 Frequency, Mean, and Agreement Level Exploring Tactile Experiences through Sustainable Materials in Art and Design Education (N=48)

N=48			
Statement	Mean	Agreement level	Standard Deviation
1. Tactile Experiences			
- Tactile experiences with sustainable materials are significant	4.34	high	0.73
- There is a relationship between tactile experiences and sustainable materials.	4.27	high	0.82
- The tactile properties (smoothness, roughness) influence tactile experiences	4.36	high	0.89
- Texture is a key aspect of tactile experiences	4.42	highest	0.77
- There is a correlation between tactile experiences and texture	4.12	high	0.89
Total	4.30	high	0.82
2. Sustainable Materials			
- Sustainability is crucial in Art and Design education	3.67	medium	0.92
- Sustainable materials significantly shape the art and design field	3.97	medium	0.96
- Sustainable materials enhance emotional engagement	3.68	medium	0.66
- Tactile experiences with sustainable materials benefit both the environment and communities	4.23	highest	0.79

- Designs using sustainable materials are increasingly preferred for purchase	3.65	medium	1.01
Total	3.84	medium	0.87
3. Art and Design Education			
- Integrating sustainable materials into the study	3.70	medium	0.51
- Recognizing the importance of sustainability in art and design education	3.79	medium	0.83
- Implementing participatory workshops to understand sustainable materials and tactile experiences	4.53	highest	0.62
- Utilizing sustainable materials into art projects	3.40	medium	0.65
- Prioritizing sustainable material knowledge in art and design education	3.96	medium	0.72
Total	3.88	medium	0.67

Table 3 summarizes the students' assessment of the level of agreement regarding tactile experiences, sustainable materials, and art and design education. The analysis showed that the tactile element, texture, played a pivotal role in tactile experiences, with the highest average score of 4.42 (standard deviation=0.77), highlighting its importance. The impact of tactile properties on texture, with an average score of 4.36, underscores their vital contribution to tactile experiences. Tactile experiences with these materials not only benefit the environment but also communities, receiving an average score of 4.23. The student participants liked sustainable designs, as indicated by a moderate agreement score of 3.65. However, this suggests that while designing with sustainable materials is valued, it is not the key purchasing factor. In the realm of art and design education, the majority of student participants deemed knowledge of sustainable materials as crucial, evidenced by the highest category score of 3.96. In contrast, art projects garnered a moderate score of 3.40, along with a standard deviation of 0.65, highlighting it as the least impactful with diverse viewpoints on its influence. Furthermore, the implementation of participatory workshops received high praise, as evidenced by an exceptionally high average score of 4.53, highlighting the effectiveness of these workshops as an experiential learning method, enhancing students' understanding of sustainable materials, as well as tactile experiences.

Research Conceptual Framework

The research framework is structured into four distinct phases Definition, Divergence, Transformation, and Convergence. Each phase investigates the crucial role of tactile experiences with sustainable materials in art and design education. The first phase, Definition, establishes the foundation of the research by defining the research topic, key problems, objectives, and scope. This phase focuses on identifying the significance of tactile experiences in art and design education, highlighting gaps in the existing literature, and setting specific research questions and objectives to guide the study. The second phase, Divergence, explores a wide range of information and perspectives through an extensive literature review. This phase aims to understand tactile experiences and the importance of sustainability, covering sustainable materials. It includes conducting a comprehensive literature review from past to present, gathering insights from various sources such as journals, academic articles, books, and websites, and adopting a mixed-method approach to build a robust theoretical framework. In the third phase, Transformation, the gathered insights are converted into actionable knowledge through multi-method data collection. This includes conducting in-depth interviews with three art and design experts, setting up participatory workshops with sustainable materials to facilitate tactile experiences, and distributing questionnaires to gather data on student participants' tactile experiences, perceptions, and practical implications regarding textures and sustainable materials in art and design education. The fourth phase, Convergence, integrates the research findings to draw conclusions and suggestions. This final phase involves analyzing and assessing the results collected from primary data, integrating these findings with insights from the literature review, and offering suggestions for art and design education. This provides a holistic understanding of how tactile experiences with sustainable materials can be effectively incorporated into educational practices. The research framework is illustrated in Figure2.

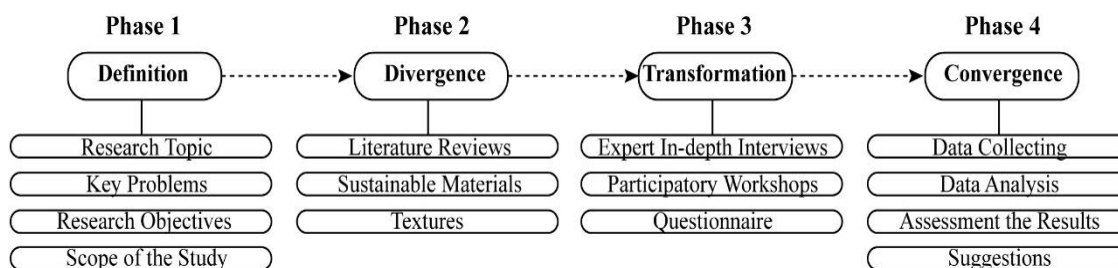


Figure 2 Research Conceptual Framework
Source: Constructed by the author

Research Results

From the first objective, it was discovered that tactile experiences are inherently complex and multifaceted, involving both physical interaction with materials and tactile connections. This complexity arises from touch being an interactive experience where the actions of touching and being touched are equally significant, highlighting tactile experiences through the skin, such as textures. The importance of passive touch and active manipulation in evaluating the textural aspects of materials emphasizes the intricate nature of tactile experiences in art and design education. These findings align with the research work of Atkinson et al. (2016), who argue that touching is inherently interactive; Gallace & Spence

(2011), who emphasize the broad spectrum of tactile or haptic sensations; and Rognoli (2010), who defines tactile experiences by the expressive-sensorial characteristics of materials.

The second objective focused on utilizing experiential learning practices to explore the potential of sustainable materials in enhancing the creative process. The integration of sustainable materials into educational settings was found to significantly foster creativity among students, as these materials provide unique sensory experiences that challenge conventional perceptions and encourage innovative thinking. This approach not only enriches the educational experience but also fosters a deeper understanding of sustainability in art and design, challenging the traditional perception of sustainability learning as an exclusive domain of luxury or fashionability. This is supported by the findings that participatory workshops, a key component of experiential learning, are pivotal in facilitating this enhanced creativity. Workshops offer hands-on learning opportunities that allow students to engage directly with materials, thereby deepening their understanding and appreciation of material properties and their environmental impacts.

From the research results of the third objective, it was found that tactile experiences with sustainable materials significantly enhance students' understanding and appreciation of sustainability in art and design education. This enhancement is largely because students recognize the critical importance of tactile elements, such as textures, and the value of sustainable materials for environmental and community well-being. Moreover, the depiction of participatory workshops as intensive educational experiences supports the study's findings, emphasizing that experiential learning is a transformative process, where knowledge is derived from active and emotional engagement with the material (Kolb, 1984). These insights underscore the importance of participatory workshops in providing active and experiential learning, which is crucial for fostering an understanding and appreciation of sustainability and tactile experiences in the educational context.

Discussion

This research shows that tactile experiences are not just about physical touch but also involve both physical interaction with materials and tactile engagement. This finding is similar to what Gallace and Spence (2011) described when they discussed the wide range of tactile experiences involved in feeling different materials. Rognoli (2010) also pointed out how important the sense of touch is in understanding what materials are made of, which this research further supports, particularly in how textures can deepen these experiences. In addition, the research found that using sustainable materials can enhance creativity in students, as they offer unique tactile experiences that challenge their usual ways of thinking. This finding aligns with what Parisi et al. (2017) discussed regarding the value of hands-on learning in encouraging creative and innovative thinking in art and design. Hofverberg and Westerlund (2021) also noted how sustainable materials can make the learning process more engaging and inspiring.

However, the research also uncovered some challenges that earlier studies might have overlooked. For instance, while Umezawa et al. (2014) saw the integration of sustainable materials into education as beneficial, this research found that issues like cost and availability could limit students' use in schools. Moreover, while Stevens and Culén (2024) suggested that students are increasingly interested in using sustainable materials, this study found that although students appreciate sustainable materials, they're not applying them in their projects as much. This suggests that there is a need for more efforts to educate and expose students to

the benefits and practical uses of sustainable materials through more hands-on experiences, such as participatory workshops and art projects.

Conclusion

This study explored the impact of tactile experiences with sustainable materials on outcomes in art and design education by examining the complex interplay between tactile engagement and sustainability awareness. The methodology included literature reviews, expert interviews, participatory workshops, questionnaires, and data analysis, which together illuminated the intricate nature of tactile experiences. The findings revealed significant improvements in students' experiential learning processes and their understanding of sustainable practices through direct interaction with materials such as Jesmonite, seashell waste, and eggshell waste. Additionally, participatory workshops were shown to be an effective method for enhancing students' familiarity with sustainable materials, underscoring the critical role of tactile experiences and textures in promoting sustainability within art and design education.

In conclusion, the research highlighted the indispensable value of integrating tactile experiences with sustainable materials into art and design education. Figure 6 presents the overall findings, illustrating how this study thoroughly investigated tactile experiences and textures using sustainable materials to deepen the understanding of their significance. This comprehensive approach not only enhances tactile engagement but also cultivates a greater appreciation of sustainability among students, thereby supporting the broader objective of promoting sustainable practices within the context of art and design education.

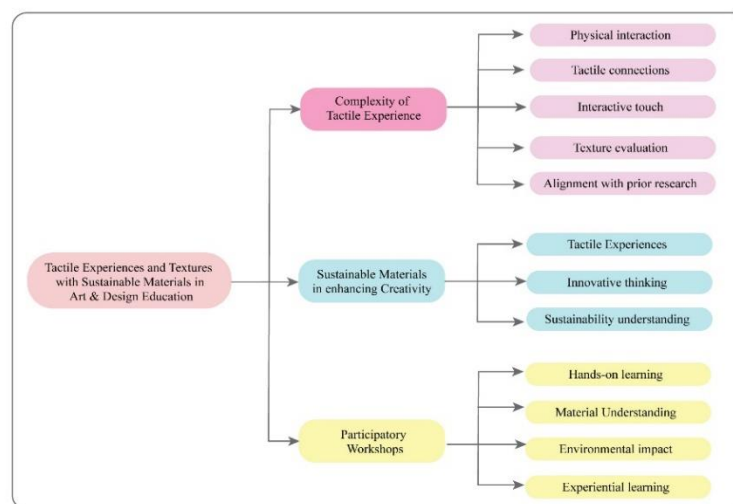


Figure 6 The overall findings

Suggestions

The research suggests that tactile experiences with sustainable materials significantly enhance the educational journey by fostering a deeper understanding and appreciation of sustainability among students. Therefore, educational institutions, especially those focused on art and design, are encouraged to incorporate these experiences into their curriculum through participatory workshops, hands-on sessions, and project-based learning. Further investigation into the psychological and emotional effects of tactile interaction with sustainable materials is recommended, as understanding these deeper cognitive and affective responses could offer valuable insights into enhancing educational strategies for art and design education. Additionally, exploring digital and virtual reality technologies to simulate tactile experiences with sustainable materials could be beneficial. This approach could extend the reach of experiential learning in art and design education to long-distance learners and provide scalable solutions for institutions facing resource limitations.

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