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Article

Students' Perception of Using Salvaged Materials within the Built Environment Programme

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Abstract: Salvaged materials hold significant potential as educational resources and sustainable solutions for higher education institutions. According to UCSI University's Sustainability Report (2023), the university experienced a 7.54% increase in total waste collected over six years, from 2018 to 2023. A considerable portion of this waste stems from mismanaged materials produced by Built Environment students, leading to critical issues such as space constraints, safety hazards, and aesthetic concerns. The lack of awareness regarding the value of salvaged materials, coupled with limited understanding of their reuse potential, inhibits resource optimization and sustainable practices. This study investigates the integration of salvaged materials as educational resources within Built Environment programmes. A literature review was conducted to identify reusable material types, explore sustainability concepts, and examine strategies for material salvage. A quantitative research approach was employed, utilizing a questionnaire survey distributed to 325 students. The collected data were analysed using frequency and mean value methods to achieve the research objectives. The findings of this study offer valuable insights into the revaluation of materials, strategies to prolong their lifecycle, and the feasibility of establishing a circular material resource centre. These contributions aim to enhance awareness, promote sustainable practices, and foster a culture of resource efficiency within higher education institutions.

Keywords: Salvaged Materials; Sustainable Campus; Education Access; Solid Waste; Resource Reuse; Resource Efficiency

1. Introduction

The old proverb, "One man's trash is another man's treasure," encapsulates the idea that what one person considers worthless may hold value for another. Although the exact origin of this saying is unknown, its meaning has evolved to reflect the growing potential of salvaging and reusing waste materials. In reality, what is often labelled as "waste" can instead be viewed as misplaced, valuable resources (Brewer and Mooney, 2008; Merino et al., 2010).

In the modern era of relentless consumerism and rapid development, waste production has become inevitable. However, waste is far from "treasured" by those who generate it. To move beyond seeing waste purely as a technical, environmental, or health-related issue, it is essential to reframe our understanding. Waste, as Nygren (2014) highlights, is often attributed characteristics such as "unusable, unwanted, leftover, by-product, dirty, or disgusting." These negative perceptions obscure its latent value and potential for reuse.

According to UCSI University's Sustainability Report (2023), which outlines the institution's progress toward aligning with the United Nations' Sustainable Development Goals, the total volume of collected waste at the university increased by 7.54% over six years, from 2018 to 2023 (refer to Table 1). This statistic underscores the urgent need for more effective waste management strategies and the integration of salvaging practices to revalue these resources.

Table 1. UCSI University waste collection data from 2018 to 2023 (UCSI University, 2023).

Year	Number of Waste Bags Collected (per month)	Weight per Waste Bag (kg)	Average Weight of Waste Collected (kg)	Total Waste Collected (tonne)
2018	26	5	93	12.09
2019	26	5	68	8.84
2020	8	5	30	1.2
2021	12	5	30	1.8
2022	20	5	80	8
2023	26	5	100	13

University campuses function as small communities where daily activities of students and employees generate significant amounts of waste. It is imperative to mitigate the environmental impact of these activities by implementing innovative solutions to manage and reduce waste. Higher Education Institutions (HEIs), with their substantial populations, contribute notably to environmental challenges. In Malaysia, waste generated by academic institutions is estimated at approximately 1,500 tonnes per day, representing 5%–10% of the nation's total waste (Universiti Malaya, 2021). While many HEIs have established policies and visions on sustainability, it is crucial to examine their current sustainable practices and explore strategies for reusing salvaged materials.

This research focuses on the integration of salvaged and reused materials as educational resources and explores the feasibility of adopting a "material resource" model within academic curricula. The study underscores the need for strategies that promote the reuse of materials in educational contexts, aligning with the sustainability goals of HEIs.

Students, particularly those in architecture and built environment programs, often lack awareness of how to repurpose leftover or off-cut materials from previous projects. Despite the availability of reusable materials, many students prefer to purchase new materials, perpetuating a wasteful cycle. Discarding materials after their perceived usability expires is often seen as the simplest method of disposal. However, as Makov (2019) and Cooper and Gutowski (2017) emphasize, every product is composed of substances that hold value, whether for reuse or repurposing (Moalem and Kerndrup, 2023; Zimring, 2016).

Incorporating sustainability issues into the curricula of built environment programs has become increasingly essential for instilling awareness at an early stage in the education of future architects and built environment professionals (Shari and Jaafar, 2012). This research focuses on the significant waste generated by the School of Architecture and Built Environment (SABE) at UCSI University, Malaysia. The primary issue examined in this study is the considerable amount of waste left behind after each assignment, which accumulates semester after semester. This build-up creates challenges such as space constraints, safety hazards, and visual discomfort, as illustrated in Figure 1. Addressing these challenges requires a comprehensive strategy that encourages material reuse and sustainable practices within the academic environment.

Figure 1. Off cut materials and left-over models (wood/boards/paper) by SABE students from July 2021–July 2023 semester.

2. Literature Review

According to the Oxford Learner's Dictionary, "salvage" is defined as "the act of saving things that have been, or are likely to be, damaged or lost" (Oxford Learner's Dictionary, n.d.). Various scholars have also offered definitions of salvage, contextualizing it within different fields. In architecture, salvage refers to an alternative method of conservation that repurposes a structure's materials for new purposes while preserving their historical and material significance. Through reinterpretation, salvaged materials can be reassembled into new forms that align with sustainable principles (Rote, 2023; Josefsson and Thuvander, 2020; Prest and Linebaugh, 2011; Gorgolewski and Morettin, 2009).

In the fields of engineering and construction, salvage typically pertains to components or resources that have been previously utilized and subsequently recovered from waste streams, decommissioned structures, or discarded products. These materials are repurposed for new applications, thereby reducing their environmental impact (Creba and Hutton, 2021; Ross and Angel, 2020; Zimring, 2016). Similarly, in arts and design, salvaged materials contribute to sustainability by conserving natural resources, minimizing waste, and mitigating the environmental impact of producing new materials. Such materials also often carry unique aesthetic and cultural value, enriching their new applications with character and historical significance (Dew et al., 2018; Robb, 2017; Mathias, 2017).

The term "salvaged materials," also known as reclaimed materials or reclaimed resources, encompasses items or components recovered from waste streams, demolition sites, or discarded products and repurposed for reuse, recycling, or upcycling. Typically rescued from landfills, these materials are processed or refurbished to extend their lifespan, thereby reducing environmental impact. Salvaged materials span a wide range of applications, including building materials (e.g., wood, metal, and brick), furniture, appliances, electronics, textiles, and other items. Their reuse aligns with principles of sustainability, resource conservation, and waste reduction, as it promotes the repurposing of existing resources rather than relying solely on new production.

In academic research, salvaged materials are often studied within the contexts of sustainable design, the circular economy, environmental conservation, and innovative waste management solutions. While scholars may define salvaged materials differently, the underlying principle remains the same: salvaging and reusing discarded materials reduce the ecological footprint and contribute to sustainability (Josefsson and Thuvander, 2020). Though terms like upcycling, scavenge, and reuse are sometimes used interchangeably, they share similar principles. As highlighted by proponents of salvage, the focus should not necessarily be on producing new resources but on fostering a mindset of resourcefulness.

2.1. Strategies for Salvaged Materials

Since the early 20th century, Victor Papanek has criticized design as a "harmful profession," emphasizing that when all boundaries are removed and anything becomes possible, design risks devolving into an endless pursuit of novelty. In such cases, "newness for the sake of newness" may become the sole standard, leaving designers increasingly disconnected from functional complexity and societal needs (Papanek, 1991). This critique underscores the need for designers and educators to shift their focus from merely creating objects to becoming solution providers who guide future generations toward sustainable practices.

According to UNESCO (2008), education for sustainability must go beyond merely appreciating nature and engaging in conversations about environmental issues. It requires opportunities for active intellectual dialogue about environmental and social sustainability, combined with hands-on participation in activities that positively impact the environment. The rapid depletion of natural and primary resources further highlights the urgency of developing waste management strategies that reduce environmental harm and promote resource conservation (Moalem and Kerndrup, 2023).

Creating value from salvaged materials involves repurposing and redesigning them for new uses. This approach allows these materials to achieve a higher perceived value, sometimes exceeding their market worth or even the value of the original product they were intended for (Crabbe, 2012). The process requires designers to possess expertise, experience, and creativity to assess the material value and determine the appropriateness of components for reclamation, refurbishment, and reuse (Yeap et al., 2012). Although "upcycling" has gained popularity in recent years, its potential to transform the reuse of discarded materials has yet to be fully realized (Pizarro, 2014).

To align with sustainable principles, the role of designers must evolve, placing greater emphasis on resourceful, innovative solutions that maximize the potential of salvaged materials and contribute to environm ental preservation.

Figure 2. Precious Plastic (Precious Plastic website, accessed 27.07.2024).

Dedicated to addressing the plastic pollution crisis, Precious Plastic is an international community that promotes innovative solutions through open-source machines designed to recycle waste plastic into unique and functional products, as illustrated in Figure 2. These machines, collaboratively developed by hundreds of individuals worldwide, empower local communities to process plastic waste effectively. Precious Plastic provides detailed blueprints and instructions for constructing various recycling machines, such as shredders, extruders, and injection machines. The shredder processes plastic into flakes, which are then melted and transformed by the injection machine into products such as tiles, coasters, and keychains. Similarly, the extruder melts flakes into strips that can be repurposed into items like building materials (Chandran, 2023). These localized recycling solutions foster creativity while addressing environmental challenges.

In contrast, the Goldmine initiative by the European Commission (2019) represents a different approach to resource recovery and the circular economy. The Goldmine was a warehouse located within the Vasbygade Genbrugsstation (recycling station) in Copenhagen, designed to facilitate storage and promote innovative business models within the circular economy. Its primary objective was to increase reuse rates in public recycling stations through temporary pilot projects. By August 2018, the Goldmine successfully managed to recycle or reuse approximately 1% of the total waste streams delivered by private individuals and small businesses. Though the Goldmine closed in November 2018, its legacy transitioned to the Sydhavn Genbrugscenter, which opened in 2019.

The Sydhavn Genbrugscenter aims to scale up successful circular economy models developed during the Goldmine initiative. Its mission includes increasing the reuse, recycling, and upcycling of materials while fostering green growth. The centre's quantitative target is to elevate the direct reuse rate of materials delivered to its recycling station from Copenhagen's average of 4% to 20% by 2024. These initiatives exemplify innovative strategies to address waste management challenges while simultaneously creating opportunities for sustainable economic development (European Commission, 2019), see Figure 3.

Figure 3. Workshop view of Sydhavn Genbrugscenter (European Commission, 2019).

The European Commission has implemented to "Promote Urban Resource Centres for waste prevention, re-use and recycling" where 'Urban Resource Centres' are physical centres that help facilitate sustainable consumption, waste prevention, re-use, repair and recycling in urban areas (European Commission, 2019). These centres can be designated multi-functional places, following and implementing the waste hierarchy. Urban Resource Centres (including re-use centres and recycling stations) bring together a wide community of stakeholders to find alternatives for managing key waste streams generated at municipal/inter-municipal/regional level. Recycling stations in cities receive, sort, and recycle vast amounts of resources eligible for new uses. Some of these resources can be re-used, repaired, and re-furbished in local systems, stimulating the local economy and job creation. Based on the Urban Agenda for the European Union (EU), it states that cities play an essential role in the development of a circular economy; they act as enablers of potential measures by which they can influence both consumers and business. The transition to a circular economy requires multi-level governance and new visions of what the future city could look like. Therefore, involvement at a local level is crucial for the transformation from the traditional linear approach to a circular strategy.

3. Methodology

According to Creswell (2013), a research methodology was established. The initial response from the questionnaire through an online Google Forms and physical forms were collected and tabulated using Microsoft Excel. After data screening and removal of the outliers, the files were transferred to a statistical software SPSS (Statistical Package for the Social Sciences Ver. 25) is a comprehensive software tool widely utilized in quantitative research across various disciplines. With SPSS, descriptive statistics can summarise the main characteristics of the data such as measures of central tendency and variability. Overall, comprehensive reporting of quantitative research conducted using SPSS ensures the validity and reliability of the findings and understanding the implications within the broader context of the research.

3.1. Define Sample

This research will be conducted in UCSI University, a private campus situated on a 20-acre piece of land located in Cheras, Kuala Lumpur, consisting of approximately 12,000 students spread across 14 faculties. Given the university's population density, it is expected to generate a significant volume of waste, making it a suitable focus for this study. The scope of the research will be focusing on the School of Architecture and Built Environment (SABE), under the Faculty of Engineering. This research focus on the January 2023 intake comprises of approximately 850 active students, both local and international students, across 9 programmes - Doctor of Philosophy in Architecture, Master of Philosophy in Built Environment, Master of Architecture, BSc (Hons) Architecture, BA (Hons) Interior Architecture, Bachelor (Hons) of Quantity Surveying, Diploma in Architecture Studies, Diploma in Interior Architecture and Foundation in Arts (Built Environment).

The study aims to examine the policies currently in place at both the university and SABE levels, with a particular focus on identifying the parties responsible for waste disposal and classification. This will provide a clearer understanding of current sustainable practices and how the university views waste sustainability. Moreover, the research will explore strategies and benefits of using salvaged materials in the teaching process. A key component of this analysis will involve gathering insights into how students and academicians perceive salvaged materials and examining how sustainability is integrated into the curriculum. This study will also assess how the university's sustainability policy aligns with the incorporation of the UN's Sustainable Development Goals (SDGs) into its higher education initiatives.

3.2. Data Collection

This research was carried out within the School of Architecture and Built Environment (SABE) at UCSI University, targeting 853 registered students as respondents. The structured questionnaire was directed to students across 9 programs offered by the university, consist across all 7 semesters. To obtain accuracy and consistency, the questionnaire has gone through screening process to check for outliers (Pallant, 2020). As a result, the questionnaire surveys returned a total of 325 respondents; 17 outliers were deleted after screening process. This resulted in the clean data having a total of 308 respondents and will be analysed to check on its reliability. According to Saunders et al. (2019), 300 is sufficient to represent a big population for research.

3.3. Analysis Method

Data analysis is the compilation of the collected data. The purpose of the data analysis was to analyse the collected data and transfer it into useful information. SPSS software was used to analyse the collected data. In data analysis, descriptive statistics was used to generate the results with the summaries and related graphics information. Based on DeVellis and Thorpe (2021), the Likert scale is an effective instrument for capturing a range of opinions, perceptions, and behaviours across dimensions such as frequency, significance, and agreement. This scale provides nuanced feedback, making it particularly valuable for measuring attitudes and perceptions in research.

Likert 5-point scale was used in the data analysis for section B, C and D in the questionnaire. Section B consist the 'Level of frequency' that are calculated based on where; 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Always. Next, section C uses 'Level of significant' which is calculated based on; 1 = Not Significant, 2 = Slightly Significant, 3 = Moderately Significant, 4 = Significant, and 5 = Strongly Significant. Then, section D is calculated based on the 'Level of agreement' where is rated; 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

The collected data was organized using Microsoft Excel, then spreadsheet was imported into SPSS software. The subsequent calculations were then analysed and interpreted in SPSS software. Through SPSS software, the percentage and mean were calculated. Furthermore, SPSS software was also utilized to determine the reliability. Cronbach's Alpha was used to measure the reliability (Glen, 2021). Cronbach's alpha ranged from 0 to 1. Table 2, shows the reliability value of Cronbach's alpha. The higher the Cronbach's alpha value, the higher the reliability.

Table 2. Reliability value.

Cronbach Alpha Value	Level Consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

3.4. Analysis Method

The questionnaire survey consists of four (4) sections; which one (1) section is for demographic survey and three (3) sections utilising Likert scale consisting of a series of statements or items to which respondents indicate in each sections their 'level of frequency', 'level of significant' and 'level of agreement'. According to DeVellis and Thorpe (2021), the Likert scale is a widely used psychometric instrument in survey research that measures attitudes, opinions, or perceptions by providing respondents with a series of ordered response options. With this scale, it can be analysed accordingly using statistical software, which will be used to measure patterns and relationships among the variables (DeVellis and Thorpe, 2021).

Section A is to identify the demographic of respondents; the respondents were solicited to fill in the requirement for gender, age, academic level, programme of study, current batch and expenditure per semester. Following that section B was to investigate the 'level of frequency' of usage by the respondent towards the category of materials. There are there (3) categories in this section – Material often purchase for assignments, Materials often discard after assignments and Material salvaged after assignment. Each category will consist of eleven (11) types of commonly used materials terms in architecture and built environment related programme; Paper/Cardboard, Wood/Timber, Acrylic/Plastic (Polymer), Foam/foamboard, Glass, Concrete, Metal, Fabric, E-waste, Nails/Screws/Fittings and Glue/Paints/Adhesive.

Next, section C is to identify the factor of use by the respondents towards salvaged materials. DeVellis and Thorpe (2021) explains that the 5-point Likert scale as a commonly used rating system that provides respondents with five response options, allowing the respondents to express a range of opinions about a given statement or question. In regards to the factor of use, there are six (6) questions consists of a 5-point Likert scale to answer the 'level of significant' for – Cost saving, Accessibility, Time saving, Aesthetic, Environmental, and Self-willingness to use salvaged materials. Finally, section D is to determine the encouragement of use by the respondent towards salvaged materials. There are eight (8) questions utilising Likert scale for this section, where the respondents will need to rate the 'level of agreement' based on – Lecturer awareness, Stated in Assignment brief, Effective planning, Workshop, Tools and equipment provided, Collection centre provided, and Storage facility provided.

4. Finding

The quantitative data gathered from the survey questionnaires were analysed using SPSS software to calculate the mean scores. The use of mean scores offers a clear visual representation of the data distribution, allowing researchers to detect patterns, trends, and any outliers present in the dataset (Pallant, 2020). Interpreting mean item scores involves assessing the average response level for each item, which helps in identifying areas of strength or weakness. This process is crucial for evaluating the effectiveness of individual items in accurately reflecting the intended constructs, and it can inform decisions regarding item retention, revision, or removal. Overall, the interpretation of mean item scores enhances the validity and reliability of the measurement instruments, contributing to a deeper understanding of the constructs assessed within both research and assessment contexts (DeVellis and Thorpe, 2021). The mean score interpretation is shown in Table 3.

Table 3. Mean score interpretation (Moidunny, 2009).

Mean Score Value	Interpretation
4.21–5.00	Very High
3.21–4.20	High
2.61–3.20	Medium
1.81–2.60	Low
1.00–1.80	Very Low

Frequency analysis systematically counts and organizes the occurrences of specific values or categories within a dataset, offering an effective way to describe and summarize categorical or discrete data (Pallant, 2020). This analysis helps in understanding the distribution and prevalence of different responses or observations. The results are typically presented in frequency tables, which display how often each value or category appears, along with relative frequencies (percentages) and cumulative frequencies (running totals). Frequency analysis is crucial for identifying patterns, trends, and anomalies, facilitating comparisons between groups, and serving as a basis for further statistical exploration. By offering a clear visual representation of data distribution, it aids researchers in making informed decisions and interpreting results accurately (DeVellis and Thorpe, 2021).

4.1. Respondent Demographic Analysis

Through this survey, the respondents' demographics such as gender, age, academic level, programme undertaking, semester and expenditure, were collected. The findings were then analysed and interpreted using SPSS software. The breakdown of the respondent background and data was tabulated into table charts.

Based on the data analysis, Table 4 shows that 41.2% are male respondents and 58.8% are female respondents. The higher percentage of female respondents may reflect within the student population, potentially influencing attitudes toward sustainability practices and the use of salvaged materials.

Table 4. Number of respondents based on gender.

Gender	Frequency	Percentage (%)
Male	127	41.2%
Female	181	58.8%
Total	308	100%

Table 5 displays that the majority of respondents are between the ages of 21 and 30, comprising 61.2% of the total, while respondents under the age of 21 account for 38.8%. This age distribution highlights a slightly more mature student demographic in the research while ensuring representation across different age groups.

Table 5. Number of respondents based on age group.

Age Group	Frequency	Percentage (%)
Below 21 years old	120	38.8%
21 – 30 years old	188	61.2%
31 – 40 years old	0	0
Above 41 years old	0	0
Total	308	100%

Table 6 shows that the majority of respondents are undergraduates, comprising 94.5%, while postgraduates account for only 5.5%. This suggests that the study primarily reflects undergraduate are more actively engaged in hands-on projects involving materials. Despite the smaller postgraduate representation, the insights still contribute to understanding how salvaged materials can be integrated into both practical and research-based academic contexts, ensuring that sustainability efforts address the needs of students at different academic levels.

Table 6. Number of respondents based on academic level.

Academic Level	Frequency	Percentage (%)
Undergraduate	291	94.5%
Postgraduate	17	5.5%
Total	308	100%

The respondents' programs of study were collected and presented in Table 7. The data spans across all academic levels, from undergraduate to postgraduate. The Bachelor of Science in Architecture program has the highest ratio at 51%, primarily because their coursework requires students to produce models for every assignment. Second is the Bachelor of Arts in Interior Architecture at 32.1%, followed by the combined Diploma courses accounting for 8.1%, with the Diploma in Architecture Studies at 5.8% and the Diploma in Interior Architecture at 2.3%. Next, the Master of Architecture program accounts for 5.5%, and lastly, the Bachelor of Quantity Surveying at 3.2%, as the course have less assignments involving model making.

Table 7. Number of respondents based on Programme of study.

Programme Study	Frequency	Percentage (%)
Doctor of Philosophy in Architecture	0	0
Master of Architecture	17	5.5%
Master of Philosophy in Built Environment	0	0
Bachelor of Science in Architecture	157	51%
Bachelor of Arts in Interior Architecture	99	32.1%
Bachelor of Quantity Surveying	10	3.2%
Diploma in Architectural Studies	18	5.8%
Diploma in Interior Architecture	7	2.3%
Foundation in Arts	0	0
Total	**308**	**100%**

Table 8 illustrates the distribution of respondents across various semesters, revealing a relatively balanced representation among students at different stages of their academic journey. This even distribution suggests that the study captures a comprehensive range of perspectives, from those in the early stages of their coursework to those nearing completion.

Table 8. Number of respondents based on semester.

Current Semester	Frequency	Percentage (%)
Semester 1	42	13.6%
Semester 2	41	13.3%
Semester 3	55	17.9%
Semester 4	50	16.2%
Semester 5	48	15.6%
Semester 6	43	14.0%
Semester 7	29	9.4%
Total	**308**	**100%**

Based on Table 9, which displays the respondents' expenditures per semester, the highest ratio of 49.7% of respondents spent over RM 200 per semester. This could be due to the students' lack of awareness, leading them to purchase new materials instead of reusing or salvaging existing ones. The obtained data covers all the levels of the students and increases the reliability of the results of this research project.

Table 9. Number of respondents based on expenditure per semester.

Age Group	Frequency	Percentage (%)
Below RM 50	12	3.9%
RM 51–RM 100	36	11.7%
RM 100–RM 150	56	18.2%
RM 151–RM 200	51	16.6%
Above RM 200	153	49.7%
Total	**308**	**100%**

4.2. Category of Salvaged Materials

Table 10 exhibits the overall responses regarding respondents' purchasing of new materials for assignments and projects. Respondents were asked to rate their 'level of frequency' based on how often they purchased new materials for their coursework.

Table 10. Overall respondents purchased materials.

Material	Never	Rarely	Sometimes	Often	Always	Total
Paper/Cardboard	3	18	61	119	107	308
Wood/Timber	3	37	97	106	65	308
Acrylic/Plastic	25	94	125	45	19	308
Foam	14	74	102	81	37	308
Glass	142	95	57	13	1	308
Concrete	138	103	51	14	2	308
Metal	107	104	73	18	6	308
Fabric	78	107	88	33	2	308
E-waste (Discarded Appliances)	168	82	43	13	2	308
Screws, Nails & Fittings	65	101	88	39	15	308
Adhesive/Paints	5	19	48	110	126	308
Total	748	834	833	591	382	3388
Percentage (%)	22	25	25	17	11	100

Table 11 shows the frequencies in which students often purchase new materials for their coursework based on material category. The respondents were asked to rate their level of frequencies according to their current semester. The material that is frequently purchase by students are adhesive and paint with the highest percentage of 76.6%. The next frequently purchased materials are paper and cardboard with 73.3% followed by wood and timber with 55.5%. From this, we can observe the 3 main materials often used by students are generally used for scale model making in their projects.

Table 11. Frequencies of respondents purchase materials.

Material	Percentage (%)
Paper/Cardboard	73.3
Wood/Timber	55.5
Acrylic/Plastic	20.8
Foam	38.3
Glass	4.5
Concrete	5.1
Metal	7.7
Fabric	11.3
E-waste (Discarded Appliances)	4.8
Screws, Nails & Fittings	17.6
Adhesive/Paints	76.6

Table 12 presents the overall responses regarding the discarding of materials by respondents. The respondents were asked to rate their 'level of frequency' in disposing of salvaged materials during their coursework period.

Table 12. Overall respondents discard materials.

Material	Never	Rarely	Sometimes	Often	Always	Total
Paper/Cardboard	29	46	83	92	58	308
Wood/Timber	55	66	94	58	35	308
Acrylic/Plastic	78	79	76	47	28	308
Foam	54	60	73	69	52	308
Glass	148	49	54	34	23	308
Concrete	146	45	53	35	29	308
Metal	139	58	56	30	25	308
Fabric	107	60	67	44	30	308
E-waste (Discarded Appliances)	154	45	51	29	29	308
Screws, Nails & Fittings	127	65	58	29	29	308
Adhesive/Paints	103	44	72	45	44	308
Total	1140	617	737	512	382	3388
Percentage (%)	34	18	22	15	11	100

Table 13 shows the frequencies in which students discard materials after their coursework based on material category. The respondents were asked to rate their level of frequencies according to their current semester. The material that is frequently discarded by students are paper and cardboard with the highest percentage of 48.7%. The next frequently discard materials is foam with 39.3% followed by wood and timber with 30.2%. This shows that the highest category for purchased materials have equally high rate of discard.

Table 13. Frequencies of respondents discard materials.

Material	Percentage (%)
Paper/Cardboard	48.7
Wood/Timber	30.2
Acrylic/Plastic	24.4
Foam	39.3
Glass	18.5
Concrete	20.8
Metal	17.8
Fabric	24.0
E-waste (Discarded Appliances)	18.8
Screws, Nails & Fittings	18.8
Adhesive/Paints	28.9

Table 14 shows the overall responses regarding the salvaging of materials by respondents. The respondents were asked to rate their 'level of frequency' in using salvaged materials within their current educational environment.

Table 14. Overall respondents salvaged materials.

Material	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**	**Total**
Paper/Cardboard	10	22	77	105	94	308
Wood/Timber	12	32	72	98	94	308
Acrylic/Plastic	37	43	92	71	65	308
Foam	52	53	82	73	48	308
Glass	113	54	66	37	38	308
Concrete	152	62	48	24	22	308
Metal	107	57	74	39	31	308
Fabric	89	49	83	51	36	308
E-waste (Discarded Appliances)	127	59	63	32	27	308
Screws, Nails & Fittings	81	52	69	52	54	308
Adhesive/Paints	61	33	73	65	76	308
Total	841	516	799	647	585	3388
Percentage (%)	25	15	24	19	17	100

Table 15 exhibits the materials which respondents often salvaged and reused for future assignments or for the next project's purpose. Paper and cardboard are often salvaged with the highest percentage of 64.6%. Next often salvaged material is wood and timber with 62.3%, then adhesive and paint with 45.8%. These are the main 3 materials often purchased, therefore many left over and remaining materials can be salvaged and reused again.

Table 15. Frequencies of respondents salvaged materials.

Material	**Percentage (%)**
Paper/Cardboard	64.6
Wood/Timber	62.3
Acrylic/Plastic	44.2
Foam	39.3
Glass	24.3
Concrete	14.9
Metal	22.8
Fabric	28.3
E-waste (Discarded Appliances)	19.2
Screws, Nails & Fittings	34.4
Adhesive/Paints	45.8

4.3. Factor of Use by Respondent's Analysis

Reusing materials have always been more sustainable than recycling (Potting et al., 2017), Table 16 illustrates the mean score analysis of respondents' factors towards salvaging materials. Accessibility and the convenience of obtaining the materials is the highest factor by students with a mean of 3.57. The next factor is the students concerns in regards to the finishing, appearance, and aesthetic of the materials used with a mean of 3.56. Following that is the cost saving aspects with a mean of 3.55. In summary, these 3 factors are the main aspects for students towards reusing salvage materials.

Table 16. Respondents' factors of use towards salvaging materials.

Factors	Mean
Cost saving (Reduce expenditure)	3.55
Accessibility (Easy to obtain)	3.57
Time saving (Reducing the amount of time needed to find / purchase material)	3.54
Time wastage (Not able to use directly use / Need to resize)	3.31
Aesthetic (Concern of the finishing and outlook)	3.56
For the environment (awareness on nature and living being)	3.44
Overall factor of use	**3.50**

4.4. Encouragement Analysis

Based on Table 17, the mean and the standard deviation for each item related to the encouragement of using salvaged materials is indicated. According to the mean score interpretation (Moidunny, 2009), the findings revealed that the encouragement of using salvaged materials in this research is at a high level.

Table 17. Respondents' encouragement analysis.

Item	Analysis	Mean
1.0	**Encouragement by Lecturer**	
1.1	Inspire student creative ways of using salvaged materials	3.76
1.2	Provide support and awareness to plan design effectively to minimize wastage	3.72
	Overall Encouragement by Lecturer	**3.74**
2.0	**Encouragement by Course**	
2.1	Stated inside assignment brief	3.48
2.2	Promote the use of salvaging materials	3.51
	Overall Encouragement by Course	**3.50**
3.0	**Encouragement by Facilities**	
3.1	Workshop is available for exploration and usage of salvaged material (eg; Make Lab)	3.94
3.2	Tools and equipment are provided / available to use	3.99
3.3	A collection centre is provided for material sorting	3.80

3.4	A storage facility is provided for selecting materials	3.85
	Overall Encouragement by Facilities	**3.90**

Item 1.0 Encouragement by Lecturer provided with a mean of 3.76 for inspiring students on creative ways to use salvaged materials. Providing support and awareness to plan designs effectively to minimise wastage has a mean of 3.72.

Item 2.0 Encouragement by the Programme in the student's coursework; where salvaging materials should be stated inside the assignment brief with a mean of 3.48 and promoting the use of salvaging materials with a mean of 3.51.

Item 3.0 Encouragement in Facilities present the highest among all encouragements. Workshop for exploration and usage of salvaged materials shows a mean of 3.94, hence the availability of tools and equipment with a mean of 3.99 is very significant. In terms of environment, providing a collection centre for sorting comes with a mean of 3.80 and storage facilities for selecting materials with a mean of 3.85.

Table 18 shows the ranking of factors and encouragement of using salvaged material based on the collected data in this research. Facilities play a crucial role in supporting students in their efforts to utilize salvaged materials. Based on the analysis revealed that 'Encouragement by Facilities' received the highest mean score of 3.90, highlighting its significance and emphasizing its pivotal role in promoting the use of salvaged materials within educational settings. The results are collected from various levels and programmes of study in the Built Environment, including undergraduates and postgraduates, which increases the accuracy of the result.

Table 18. Ranking for factors and encouragement of using salvaged materials.

Ranking		**Mean**
1	Encouragement by facilities	3.90
2	Encouragement by lecturer	3.74
3	Factor of use	3.50
4	Encouragement by course	3.50
Overall		**3.66**

4.5. Reliability

Table 19 exhibit the purpose of the reliability test is to measure the consistency of data. In this research, Cronbach's alpha in SPSS is used to measure the reliability. If the result value of Cronbach's alpha is lower than 0.6, then the research is unacceptable and considered as poor. The maximum value available for Cronbach's alpha is 1, which indicates the higher the value Cronbach's alpha, the higher the reliability of the research project. Table 10 presents the results of reliability test by using Cronbach's alpha for this research project. The Cronbach's alpha generated from SPSS is within the range of 0.799 to 0.942, and the overall Cronbach's alpha is 0.900, which is higher than 0.7 (Glen, 2021). Thus, the research project is considered excellent.

Table 19. The reliability test.

Description	**Cronbach Alpha Value**	**Level**
Category of Salvaged Material: Materials often purchased for assignments/projects.	0.810	Good
Category of Salvaged Material: Materials often discarded after assignments/projects.	0.928	Excellent
Category of Salvaged Material: Materials can be reused for future assignments/projects.	0.886	Good
Factor of use of salvage materials.	0.884	Good

Encouragement of Use: From Lecturer/Academic Staff	0.841	Good
Encouragement of Use: In Course	0.799	Acceptable
Encouragement of Use: Facilities	0.942	Excellent

5. Discussion

Based on the findings, three primary materials—cardboard/paper, timber, and adhesive/chemical products—are identified as the most commonly used by students, particularly for assembling scale models in academic projects. This insight provides a foundational basis for introducing sustainable practices within the School of Architecture and Built Environment (SABE). Prioritizing the collection, sorting, and storage of these materials for reuse could significantly improve resource efficiency and reduce waste. Although other materials listed in the survey are less frequently reused, allocating smaller storage spaces for them may still be valuable. Establishing standardized procedures for material categorization, inventory management, and storage could not only streamline the reuse process but also empower students to independently manage these salvaged materials. These findings underscore the critical role of proper storage and organization, as material analysis, cataloguing, and inventory management are integral components of an effective reuse strategy (Josefsson and Thuvander, 2020).

A central consideration is the standardization of material sorting and preparation for reuse, a fundamental element of any sustainable initiative (Moalem and Kerndrup, 2023). Categorizing salvaged materials facilitates a more structured and efficient approach to their reuse, as outlined below:

1. Pre-measured materials: Common materials such as cardboard, timber, acrylics, and foam sheets, often used in student projects, generate significant waste due to irregularly shaped off-cuts. These remnants, which vary widely in size and shape, contribute to clutter and inefficiency. Secondary processes, such as cutting or resizing, may be necessary to standardize these off-cuts and improve their usability in future projects.
2. Pre-packaged loose items: Materials such as screws, nails, and fittings are typically sold in predetermined quantities, resulting in leftover items that are insufficient for a full subsequent project. Centralized collection and redistribution of these small materials could extend their utility across multiple projects, preventing unnecessary waste.
3. Materials with a limited shelf life: Items such as paints, adhesives, and other liquids require special attention due to their expiration dates. Students often use these materials for coursework, but if not managed properly, they may expire before they can be reused. Educating students about shelf life and encouraging timely use can minimize waste and reduce costs.
4. E-waste and multi-component materials: E-waste, including items composed of metals, plastics, and screws, represents a growing waste stream due to evolving technological lifestyles. Reusing these materials is more complex as it often requires disassembly. Providing the tools and knowledge to facilitate this process can enable students to repurpose these components effectively.

The case of “The Goldmine” in Copenhagen, Denmark, serves as an exemplary model for implementing such practices. Developed by the city’s Technical and Environmental Administration, the initiative fosters collaboration among NGOs, businesses, and individuals, offering access to workshops and storage spaces for salvaged materials. This facility not only promotes waste prevention but also provides educational opportunities for schools, demonstrating the potential of salvaged resources when supported by appropriate infrastructure (European Commission, 2019).

These findings highlight the importance of creating an enabling learning environment to encourage sustainable practices. Students require both adequate space and resources to experiment with salvaged materials. When such an environment is provided, it significantly enhances creativity and innovation. The connection between a well-designed learning atmosphere and positive student outcomes is well-documented; Yeap et al. (2012) emphasize that an optimized learning environment can stimulate creativity among students. This is particularly relevant in the context of incorporating salvaged materials into academic projects. Equipping students with the tools, guidance, and opportunities to explore sustainable design alternatives fosters a mindset oriented toward sustainability and innovation, ultimately reshaping their approach to design and construction practices.

6. Conclusion

This research examines the potential integration of salvaged materials as an educational resource and a sustainable practice within Higher Education Institutions (HEIs), with a specific focus on Built Environment programs. A critical challenge identified in the study is the mismanagement of waste generated by students in these programs, which results in several adverse outcomes, including spatial inefficiencies, safety concerns, and aesthetically unappealing environments. Furthermore, the lack of awareness regarding the reuse of salvaged materials, combined with limited recognition of their inherent value, impedes effective resource management and sustainable reuse practices. This research seeks to address these issues by exploring the use of salvaged materials as educational resources, thereby fostering sustainable practices within Built Environment curricula.

A key recommendation emerging from this study is the establishment and operation of a Material Resource Centre within the institution. Such a centre would play a pivotal role in facilitating the collection, sorting, storage, and reuse of salvaged materials, while also enhancing the educational experience and aligning with the institution's sustainability objectives. The proposed centre would not only promote the efficient reuse of materials but also support broader sustainability, conservation, and waste management initiatives. Its successful implementation would require active collaboration and support from university management and various faculties.

To ensure the long-term viability of the Material Resource Centre, dynamic and adaptive processes for maintaining the resource bank would need to be established. These processes would aim to provide equitable access to salvaged materials, thus enabling continuity in resource utilization across diverse academic projects. Beyond serving educational objectives, the centre would directly contribute to advancing the United Nations Sustainable Development Goals (SDGs), particularly SDG 4: Quality Education and SDG 12: Responsible Consumption and Production. By fostering awareness, innovation, and sustainability in resource management, the centre would position itself as a model for integrating sustainable practices into the core functions of HEIs.

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