UNIVERSITY OF BIRMINGHAM

CONSUMER ATTITUDES AND BEHAVIOURS TOWARD PLASTIC WASTE AMONG UNIVERSITY OF BIRMINGHAM STUDENTS

Submitted by

LUCIA SALCIANU
2887511

A candidate for the degree in MSc Environmental Health

School of Geography, Earth and Environmental Science
University of Birmingham
2025

Abstract

Plastic pollution is an ongoing global challenge due to the pervasiveness, durability, and convenience of plastic, with evidence of microplastics appearing in ecosystems and humans increasing. Universities, as impactful microcosms, are well placed to stimulate pro-environmental change but can struggle with an attitude–behaviour gap. This study explored awareness, attitudes, and behaviours of University of Birmingham students towards plastic waste, and barriers and levers to enabling action on campus. A mixed-methods design was implemented, framed by the Value–Belief–Norm (VBN) theory, Education for Sustainable Development (ESD), and the COM-B model: a cross-sectional survey (N=225) and semi-structured interviews (n=10). Quantitative analyses were conducted using nonparametric statistics; interview data was subject to inductive thematic analysis mapped to contexts of the COM-B model.

Awareness in general was high, but uneven: students studying science were significantly more aware of microplastics (83.2% vs. 63.2%; χ^2=11.25, p<.001, V=0.22) and biodegradable plastics (χ^2=4.10, p=.043), whereas there was no significant difference in concern about major environmental issues by discipline. Most importantly, awareness specific to plastic related to behaviours: students who were aware of microplastics reported recycling a higher proportion of plastic bottles ($\chi^2(4)$=21.93, p<.001; ρ=.29). Structural frictions inhibited action: lack of convenient, clearly marked recycling infrastructure for mixed recyclables) and time/cost pressures. Strong support was recorded for a deposit-return scheme (M=4.35; 88% agree). The majority of responsibility for plastic reduction was attributed to companies and government, with individuals deemed less responsible. Qualitative insights underscored decision-making as contingent on context, convenience, peer influence, and the visibility of current initiatives.

Acknowledgment

I would like to start by acknowledging God, Whose guidance, strength, and mercy have never let me down throughout this journey. As it is written: “I can do all things through Christ which strengtheneth me.” (Philippians 4:13) I am also grateful for the prayers and intercession of the Blessed Virgin Mary and all the saints, whose prayers sustained me throughout.

I am deeply thankful to my supervisor, Dr. Daniel Drage, for his guidance and patience throughout. I also thank Dr. Surindar Dhesi for her steady support and trust. My thanks go to Dr. Veronica Schacht and Dr. Ian Phillips for their help with the statistical analysis.

To the professors in GEES: Thank you for the skills, knowledge, and motivation I gained across the modules. In difficult moments, the Wellbeing Team offered exceptional support. I am especially grateful to Evan Cragg for his steady kindness and timely help.

I’m grateful to all survey respondents and interview participants. Your time, trust, and insights made this project possible. I also want to acknowledge my colleagues in GEES. We shared ideas and supported one another throughout this process. Heartfelt thanks to everyone I’ve met since beginning the course. Each of you has helped shape my growth, and I’m thankful for the academic and personal insights I’ve gained this year.

Finally, to my family and friends: I could not have achieved this without your love, support, and incredible faith in me. I feel truly blessed to have you in my life.

Table of Contents

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW 1

1.1 Plastic waste and its environmental impact 1

1.2 Global Perspectives on Plastic Waste 2

1.2.1 Public Attitudes toward Plastics in Australia 3

1.2.2 Household Participation in Plastic Waste Reduction in Malaysia 3

1.2.3 University Students and Recycling Behaviour in Spain and the United States 4

1.2.4 Knowledge, Perception, and Behaviour of University Students in Italy 4

1.2.5 Plastic Consumption and Waste Management in the United Kingdom 5

1.3 Statement of the Problem and Research Gap 6

1.4 Theoretical Framework 7

1.4.1 Value–Belief–Norm (VBN) Theory 7

1.4.2 Education for Sustainable Development (ESD) Framework 8

1.4.3 The Capability-Opportunity-Motivation-Behaviour (COM-B) Model 8

1.4.4 Integration and Justification 9

1.5 Research Aim and Objectives 10

1.6 Research Questions and Hypotheses 11

1.7 Significance of the Study 13

1.7.1 Academic Significance 13

1.7.2 Practical and Policy Significance 13

1.7.3 Contribution to Local and Global Sustainability Efforts 14

CHAPTER 2: METHODOLOGY 15

2.1 Research Design 15

2.2 Quantitative Method 16

2.2.1 Survey Instrument Development 16

2.2.2 Sampling Strategy and Participants 17

2.2.3 Data Collection Procedures 18

2.2.4 Data Analysis 18

2.3 Qualitative Method 19

2.3.1 Semi-Structured Interviews 19

2.3.2 Thematic Analysis 20

2.4 Overarching Themes 21

2.5 Ethical Considerations 21

CHAPTER 3. RESULTS 22

3.1 Demographics 22

3.1.1. Quantitative 22

3.1.2. Qualitative sample 23

3.2 Awareness and Perceptions of Plastic Waste's Impact 24

3.2.1 Quantitative 24

3.2.2 Qualitative 33

3.3 Attitudes and Behaviours toward Plastic Waste 36

3.3.1 Quantitative 36

3.3.2 Qualitative 37

3.4 Barriers, Motivations and Responsibility 38

3.4.1 Quantitative 38
3.4.2 Qualitative 41

3.5. University Context and Targeted Recommendations 43
3.5.1 Quantitative 43
3.5.2 Qualitative 44

CHAPTER 4. DISCUSSION 46

4.1 Research questions 47
4.1.1 Does studying a science-related degree influence students' environmental awareness compared with studying a non-science degree? 47
4.1.2 Does a higher level of environmental awareness influence individuals' plastic-waste behaviours? 50
4.1.3 How the convenience and accessibilty of recycling bins influence students' waste sorting habits? 53
4.1.4 How incentives influence students' participation in plastic waste reduction? 54

4.2 Limitations of the Study 56

4.3 Recommendations 57

4.1 Recommandations for Policy and Practice 57

4.2 Recommendations for Further Research 59

4.4 Conclusions 60

REFERENCES 62

APPENDICES 67

Appendix A 67
Table A1. Survey Questionnaire 67

Appendix B 75
Table A2. Interview Questions 75

Appendix C 79
Informed consent 79

Appendix D 81
Figure D1. Poster 81

Appendix E 82
Table E1. Codebook with description, exemplar quotes, subthemes, and final themes 82
Table E2. Extra quotations organised by themes and sub-themes 85

List of Figures

Figure 1. Students' associations with "plastic" (N=225; 3 choices/student) 25

Figure 2. Perceived presence of microplastics in everyday consumables, by science background.....26

Figure 3. Ratings of plastic food packaging on bipolar descriptors (−2 to +2) 31

Figure 4. Relationship Between Paper and Glass 32

Figure 5. Word cloud illustrating students' associations with "plastic." 34

Figure 6. Perceived responsibility for reducing the use of disposable plastic 41

Figure 7. Perceived barriers to reducing plastic use at the University of Birmingham 44

Figure 8. Student recommendations to reduce plastic waste at the University of Birmingham 45

List of Tables

Table 1. Distribution of demographic variables.....23

Table 2. Association between perceived presence of microplastics in everyday consumables and science background/residency.....27

Table 3. Awareness of biodegradable plastic by student background (N = 225).....27

Table 4. Association between awareness of biodegradable plastics and science background/residency.....28

Table 5. Descriptive statistics of the seriousness of seven different environmental issues...29

Table 6. Friedman test statistics for differences in Mean Ranks across topics.....29

Table 7. Frequency distribution of Q25 ratings of plastic food packaging on bipolar adjective pairs (N = 225; invalid = 0).....30

Table 8. Descriptive statistics (mean, median, SD) for Q25 ratings of plastic food packaging on bipolar adjective pairs (N = 225).....30

Table 9. Mann–Whitney comparisons of environmental awareness measures between science and non-science students.....33

Abbreviations

COM-B — Capability–Opportunity–Motivation–Behaviour (behaviour change model)

ESD — Education for Sustainable Development

IBA — Incinerator Bottom Ash

IBAm — Incinerator Bottom Ash metal

MNPs — micro- and nanoplastics

NVivo — Qualitative analysis software (QSR NVivo)

PCE — Perceived Consumer Effectiveness

PGT — Postgraduate Taught

PhD — Doctor of Philosophy

RVMs — Reverse-vending machines

SDGs — UN Sustainable Development Goals

SPSS — IBM SPSS Statistics

UG — Undergraduate

UNESCO — United Nations Educational, Scientific and Cultural Organization

VBN — Value–Belief–Norm theory

WfH — Waste from Households

WRAP (UK) — Waste and Resources Action Programme (United Kingdom)

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

1.1 Plastic waste and its environmental impact

Plastic pollution is considered to become one of the most significant environmental challenges of the 21st century, with a projected increase in global emissions to 53 million metric tonnes each year by 2030 (Borrelle et al., 2020). The main contributing factor to plastic pollution is the global applications of plastic across several industries, made possible due to its cheap, versatile and durable nature. The impact this has on natural and human environments cannot be understated, given the resilience of plastic to natural degradation and the amount of plastic accumulating in landfills, rivers, and oceans. Instead of being naturally broken down, plastic pieces are reduced into microplastics, becoming part of the ecosystem and eventually the food chain (Chowdhury et al., 2023). These have negative impacts on both marine and terrestrial life, and, due to bioaccumulation and ingestion, they can also impact humans. It has been identified that there are microplastics in freshwater streams and even within human blood samples, which calls for better and robust waste management and remediation processes (WRAP, 2022; Peake, 2020). It has been noted that policymakers, environmental organisations and industries are trying to combat the effects of plastic waste. In the UK's 25-year environment plan and Resources and Waste Strategy, there is an aim to reduce the levels of waste and improve the recycling infrastructure (UK Government, 2024). However, the recycling rates in the UK have stagnated**,** with household plastic recycling rates reaching 44.1% in 2022 (UK Government, 2024). These numbers highlight ongoing difficulties in developing policy intentions to achieve real-life outcomes. Educational institutions will often occupy an important and influential position. Universities are microcosms of their communities and generate new ideas that will influence how our future leaders think and act (Smyth, Fredeen and Booth, 2010).

Known as the largest university in Birmingham and the 5th largest in the UK, the University of Birmingham will provide opportunities to examine how students engage with sustainability in a rich and vibrant context (UK University, 2023). Understanding university students' knowledge, attitudes, and behaviours is constructive for informing the design of interventions that aim to mitigate plastic waste and establish long-term pro-environmental change.

This study will explore the University of Birmingham students' knowledge, perceptions, and behaviours regarding plastic waste. Discussed within the wider implications of global and national responses to the challenges of plastic pollution, theoretical models, including the Education for Sustainable Development (ESD) approach (UNESCO, 2021) and a Capability–Opportunity–Motivation–Behaviour (COM-B) model, were used to effectively promote the development of sustainability practices in higher education.

1.2 Global Perspectives on Plastic Waste

The negative impacts of plastic waste are a topic that has received significant international attention, as reflected in various studies, which demonstrate the widespread nature of attitudes, recycling behaviour, and the efficacy of policy interventions across different global contexts. These perspectives are not only useful for providing comparative insights but will also be valuable in explaining how similar issues can exist among students at the University of Birmingham.

1.2.1 Public Attitudes toward Plastics in Australia

The study by Dilkes-Hoffman et al. (2019) is a comprehensive research on a nationwide perception of plastics in Australia, which provides insight into the perception of plastics on a global scale. A survey involving 2,518 respondents online found that plastics as a whole are not liked at all, although they are generally seen as convenient, especially in food packaging. Remarkably, the most prominent environmental issue that appeared in the sample of respondents was ocean plastic pollution. Although 80% of people said they would be willing to reduce their plastic use and favoured alternatives like paper and glass, there were limited changes in behavioural levels. The respondents regularly placed the central role in the process of plastic waste management on both industry and governmental services, excluding the role of the individual (Dilkes-Hoffman et al., 2019). This separation highlights the relevance of policies within behavioural and structural interconnected approaches to managing plastic waste.

1.2.2 Household Participation in Plastic Waste Reduction in Malaysia

Afroz et al. (2016) investigated household participation in Kuala Lumpur's "No Plastic" campaign and the key drivers and impediments to participation in recycling. The research used a logistic regression model to analyse the data obtained from local households, leading to finding that around 35% of the respondents answered in favour of participating in the campaign. Higher environmental awareness and self-efficacy regarding recycling knowledge were significantly associated with recycling attitude. Notably, “reducing landfill use” was the most influential motivator, while “raising funds for charity” was judged least influential. These findings suggest that campaigning based on motive salient technical facilitation can especially encourage the adoption of recycling campaigns by households (Afroz et al., 2016).

The insights gained provide a deeper understanding of how knowledge, attitudes and practical motivators shape sustainable behaviours and provide lessons that could be used to guide waste management strategies in similar urban contexts.

1.2.3 University Students and Recycling Behaviour in Spain and the United States

The work of Izagirre-Olaizola, Fernandez-Sainz and Vicente-Molina (2014) on recycling behaviours of university students in Spain and the US, leads to an international comparative lens, very suitable for the present research. Drawing upon the Value-Belief-Norm (VBN) theory, the study involved 640 students in Spain and 597 students in the United States in order to evaluate how people's personal values, beliefs and moral obligations motivate recycling behaviours. Findings suggested that altruistic motivations and perceived consumer effectivenesss (PCE) played the most powerful role, over and above environmental knowledge, which was traditionally overlooked in VBN applications. Despite cultural differences, the internal drivers of recycling behaviour were notably similar for both populations of students. These insights highlight the feasibility of VBN-informed educational strategies to promote pro-environmental behaviour among university students across the world and therefore a critical theoretical footing for the present research.

1.2.4 Knowledge, Perception, and Behaviour of University Students in Italy

Righi et al. (2024) investigated the knowledge, perceptions, and behaviours of university students in Modena, Italy, regarding micro- and nano plastic (MNP) pollution. Conducting a questionnaire-based survey with science-oriented undergraduate students, the study found that while students were generally aware of the ecological impacts and global prevalence of MNPs, their understanding of specific types and associated health risks was limited. Interestingly, there was a positive correlation between students' environmental concern and their recycling-related behaviours, although this did not always translate into concrete waste

reduction efforts. These findings emphasise the importance of targeted environmental education programmes that bridge the gap between knowledge and action, fostering more robust pro-environmental behaviours within academic communities (Righi et al., 2024).

1.2.5 Plastic Consumption and Waste Management in the United Kingdom

The United Kingdom faces similar challenges with plastic waste, as shown by recent national data. The recent recycling statistics show a minor drop in the recycling rate of Waste from Households (WfH), including Incinerator Bottom Ash metal (IBAm), and came to 44.1% in 2022 (UK Government, 2024). Wales demonstrates a high national level of recycling (56.9 per cent). In contrast, operations in England rank lower, and England continues to be the source of most of the commercial and industrial waste (33.6 million tonnes), and of large quantities of construction and demolition waste (63.0million tonnes) in 2022 alone includes 59.4 million tonnes recovered (UK Government, 2024). The situations on the market with respect to plastic-related packaging described in the 2022 Plastics Market Situation Report (WRAP, 2022) stated a reduction in the volume of plastic packaging introduced onto the UK market primarily through the incorporation of rigid plastic packaging with light and flexible packaging, or just lighter packaging. Plastic packaging recycling rates rose in country up to 53, with the assistance of improved collection infrastructure in the form of kerbside collections. Nevertheless, these results are too small in proportion to the amount of plastic packaging waste creation, meaning that the further programme of increasing the quantity of recycling facilities and reorganising the policy is essential, WRAP (2022). Also emphasised by Peake (2020), increasing social and political questions about the effects of plastic waste on the environment have been of concern in the UK, particularly with regards to single-use plastics and marine pollution. However, the research did not take into account the reaction of the stakeholders, particularly government, business, environmental non-governmental organisations and research institutions, with respect to these challenges, especially since

already some countries are tightening their regulations on exporting low-quality plastic waste. Specifically, Peake (2020) observed effective strategies related to mitigating plastic consumption, such as alternatives based on bio-based substances and systemic changes in the policy that favour waste management and reuse. However this remain open to discussion until the UK implements such changes in its practice of handling plastic waste.

1.3 Statement of the Problem and Research Gap

Despite increasing awareness of the environmental impacts of plastic pollution, significant challenges remain in turning this awareness into consistent, pro-environmental behaviours (Schultz, Oskamp and Mainieri, 1995; Miafodzyeva & Brandt, 2012). Research has shown that factors such as convenience, social norms, and personal motivation often limit the adoption of sustainable practices, even among those with high levels of environmental knowledge (Tabernero et al., 2015; Afroz et al., 2016). This gap between knowing and acting is significant in universities, where social and institutional factors intersect with individual decision-making.

At the University of Birmingham, a range of recycling and sustainability initiatives have been implemented to reduce plastic waste (UK Government, 2024; WRAP, 2022). However, it is not well understood how students perceive these efforts, if they are aware of them or how effectively they support students in adopting more sustainable behaviours. As universities are both significant users of plastic materials and key places where future leaders form their values, this understanding is essential (Smyth, Fredeen and Booth, 2010).

Without a detailed understanding of students' perceptions, behaviours, and the barriers and motivators that shape them, it is difficult to design interventions that work in practice (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014; Righi et al., 2024). This study seeks to address this gap by investigating the University of Birmingham students'

awareness, knowledge, attitudes, and behaviours regarding plastic waste use. Guided by the VBN theory (Stern, 2000), ESD framework (UNESCO, 2021), and the COM-B model, the research examines how personal values, social norms, and education interact to influence pro-environmental behaviour.

The insights from this study will support the development of more effective sustainability policies and practices at the University of Birmingham. In doing so, the research aims to contribute to broader efforts to reduce plastic waste in higher education and beyond.

1.4 Theoretical Framework

This study is informed by three complementary theoretical frameworks: the VBN theory and the (ESD framework and the COM-B model. Together, these frameworks provide a comprehensive understanding of the psychological, social, and educational factors that shape pro-environmental behaviours among university students.

1.4.1 Value–Belief–Norm (VBN) Theory

The VBN theory, developed by Stern (2000), posits that pro-environmental behaviours arise from a chain of psychological processes that link personal values, environmental beliefs, and personal norms of moral responsibility. According to this theory, individuals are more likely to engage in environmentally sustainable behaviours when they:

- Hold strong bio-spheric, altruistic, or self-transcendent values,
- Recognise that environmental conditions present significant risks (awareness of consequences), and
- Feel a personal moral obligation to act (activation of personal norms).

This theoretical approach has been widely applied to understand recycling and sustainable consumption behaviours (Steg et al., 2014; Izagirre-Olaizola, Fernández-Sainz and Vicente-

Molina, 2014). In the context of plastic waste reduction, the VBN theory is particularly relevant for exploring how students' core values and beliefs translate into decisions about reducing, reusing, and recycling plastic materials within their daily lives.

1.4.2 Education for Sustainable Development (ESD) Framework

The ESD framework, supported by UNESCO (2021), highlights the central role of education in building the knowledge, skills, and attitudes required for sustainable development. It identifies three interconnected dimensions of learning:

- **Cognitive learning**, which focuses on deepening understanding of environmental issues,
- **Social and emotional learning**, which promotes a sense of responsibility and collective action, and
- **Behavioural learning**, which encourages the practical application of sustainable practices (Wals, 2015).

Within the university setting, the ESD framework provides a valuable lens for evaluating how sustainability education initiatives and awareness campaigns influence students' behaviours and engagement. Prior research has shown that sustainability-focused educational programmes can positively impact students' environmental attitudes and waste management practices (Tilbury, 2011; Keryan et al., 2020).

1.4.3 The Capability-Opportunity-Motivation-Behaviour (COM-B) Model

Understanding behaviour through the COM-B model involves examining three foundational elements: capability, opportunity, and motivation. Capability refers to an individual's psychological attributes, such as knowledge, memory, and decision-making, and physical attributes, including physical strength and stamina. Opportunity involves external conditions, either social, such as cultural norms, or physical, including the objects and environmental

contexts encountered. Motivation encompasses automatic processes like habits and instincts, as well as reflective processes involving intentions and evaluations (Allison et al., 2021).

Applying the COM-B model allows for an exploration of specific behavioural factors influencing students' plastic waste behaviours and provides a structured approach to identifying facilitators and barriers to sustainable practices.

1.4.4 Integration and Justification

Integrating the VBN theory, ESD framework, and COM-B model enables a comprehensive analytical framework for this study. The VBN theory illuminates the psychological determinants by highlighting the role of individual values, environmental beliefs, and moral norms in influencing pro-environmental decisions. The ESD framework extends this analysis by situating these psychological elements within educational contexts, demonstrating the significance of educational initiatives and institutional environments. Additionally, the COM-B model explicitly considers the behavioural components, namely capability, opportunity and motivation, that facilitate or impede sustainable behaviours. Together, these frameworks offer robust theoretical support, facilitating detailed data analysis and guiding the development of practical recommendations to enhance plastic waste reduction efforts at the University of Birmingham and comparable academic institutions.

1.5 Research Aim and Objectives

Aim

The primary aim of this study is to explore the level of awareness, attitudes, and behaviours of students at the University of Birmingham about plastic waste. This aim fits within a wider aim to understand how students' knowledge, perceptions, and motivations influence their engagement in sustainability initiatives within the University context.

Objectives

To achieve this aim, the following research objectives have been formulated:

1. **To assess students' awareness of plastic waste and its environmental impact**

This involves examining how well students understand the ecological and health consequences of plastic waste, including the issues of microplastics and long-term environmental degradation (Chowdhury et al., 2023).

2. **To explore students' attitudes toward recycling and other sustainable plastic consumption behaviours.**

This includes exploring how students' personal values and beliefs, as described by the Value–Belief–Norm theory (Stern, 2000; Steg et al., 2014), influence their attitudes towards reducing, reusing, and recycling plastics.

3. **To analyse behaviour in plastic waste disposal among University of Birmingham students.**

This objective intends to explore common behaviours, how they differ by demographic and academic groups (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014).

4. **To identify key barriers and motivators influencing students' participation in sustainable waste practices.**

This includes understanding personal and situational barriers and drivers of recycling and waste recycling (Afroz et al., 2016; Tabernero et al., 2015).

5. **To provide evidence-based recommendations for improving plastic waste reduction strategies and sustainability initiatives at the university.**

By integrating findings with the ESD framework (UNESCO, 2021; Wals, 2015), this objective aims to generate practical recommendations to improve the effectiveness and reach of sustainability policies and practices.

These objectives are designed to offer a comprehensive understanding of students' roles in reducing plastic waste and to support the development of more targeted and impactful sustainability initiatives within higher education.

1.6 Research Questions and Hypotheses

Research Questions

This study seeks to address the following research questions:

1. **Does studying a science-related degree influence students' environmental awareness compared with studying a non-science degree?**

   This question explores the extent of students' knowledge about plastic waste and its environmental and health impacts, including microplastics. (Chowdhury et al., 2023; WRAP, 2022).

2. **Does a higher level of environmental awareness influence individuals' plastic-waste behaviours?** (Khan et al., 2019)

3. **How the convenience and accessibilty of recycling bins influence students' waste sorting habits?** (Stern, 2000; Steg et al., 2014).
4. **How incentives influence students' participation in plastic waste reduction?** This question identifies how incentives influence in shaping students' decisions in relation to waste reduction (Afroz et al., 2016; Tabernero et al., 2015)

Hypotheses

Based on the theoretical frameworks and previous research, the following hypotheses have been formulated:

H1: Students pursuing science-related degrees demonstrate higher environmental awareness than those in non-science fields (Situmorang, Liang and Chang, 2020)

(Steg et al., 2014; Izagirre-Olaizola, Fernández-Sainz, and Vicente-Molina, 2014).

H2: Higher environmental awareness leads to responsible behaviour (Afroz et al., 2016; Tabernero et al., 2015).

H3: Convenience and accessibility of recycling bins significantly improve students' waste-disposal habits (Schultz, Oskamp, and Mainieri, 1995; Miafodzyeva and Brandt, 2012).

H4: Social and institutional incentives increase students' willingness to engage in sustainable waste practices (Izagirre-Olaizola, Fernández-Sainz, and Vicente-Molina, 2014; Keryan et al., 2020).

These research questions and hypotheses provide a clear structure for the data collection and analysis in this study. They are designed to explore both the personal motivations and the broader institutional and situational factors that shape students' engagement with plastic waste reduction initiatives.

1.7 Significance of the Study

This study addresses a critical gap in understanding how university students engage with plastic waste reduction efforts and how educational institutions can support more sustainable behaviours. While previous research has explored general public attitudes and household recycling practices, fewer studies have focused on the unique environment of higher education institutions where young adults are simultaneously consumers, future professionals, and agents of change.

1.7.1 Academic Significance

Academically, this study contributes to the growing body of literature on environmental psychology and sustainable behaviour, particularly within the higher education context. By applying the VBN theory, the ESD framework and the COM-B model, the research provides new insights into how these theories can explain and predict student behaviours related to plastic waste. The mixed-methods approach also offers a methodological contribution, demonstrating how quantitative and qualitative data can be integrated to deepen understanding of complex sustainability issues.

1.7.2 Practical and Policy Significance

From a practical perspective, the findings of this study have the potential to inform the design and implementation of more effective sustainability initiatives at the University of Birmingham and similar institutions. By identifying the key factors that either enable or impede student engagement in plastic waste reduction, this research can provide valuable insights for university policymakers, sustainability coordinators, and student organisations, enabling them to design interventions that more effectively address the needs and motivations of their student communities.

Furthermore, the insights gained from this research may inform broader sustainability strategies within the UK higher education sector. As universities strive to align their practices with national and global sustainability goals, such as those outlined in the UN Sustainable Development Goals (SDGs) and the UK government's waste reduction targets, understanding student engagement is crucial for achieving lasting change.

1.7.3 Contribution to Local and Global Sustainability Efforts

At a wider level, this study contributes to ongoing discussions about how to reduce plastic waste and promote responsible consumption within communities. By highlighting the challenges and opportunities faced by students, the research underscores the importance of integrating environmental education and behavioural support into policy and practice. These insights are not only relevant to the University of Birmingham but also to local councils, environmental agencies, and other stakeholders working to promote sustainability in urban and educational contexts.

CHAPTER 2: METHODOLOGY

Methodology provides a detailed explanation of the research design. It outlines the methods chosen for the study, the process used to select participants, the tools and procedures for collecting data, the techniques applied to analyse the results, and the ethical considerations addressed (Wals, 2015; UNESCO, 2021).

2.1 Research Design

This study adopts a mixed-methods approach to provide a comprehensive analysis of students' awareness, attitudes, and behaviours regarding plastic waste reduction. Quantitative and qualitative data were collected during the same research phase, analysed separately, and then integrated to provide a holistic interpretation of the findings. This design was chosen to capture both statistical trends and contextual explanations regarding students' plastic consumption and recycling behaviours.

As Oranga (2025) notes, the integration of qualitative and quantitative techniques within a single study enhances both the depth and reliability of research by facilitating triangulation. This approach is particularly relevant to socially and behaviourally complex issues, such as plastic use, where individual beliefs are closely intertwined with broader environmental structures. McKim (2017) similarly found that students perceived mixed methods research to be more valuable than single-method approaches, appreciating its capacity to capture lived experience alongside empirical analysis. However, Almeida (2018) observes that the application of mixed methods in published research often lacks sufficient depth. This study responds to that concern by aiming to achieve rigorous theoretical and methodological integration. Theoretical underpinnings were drawn from the VBN theory, the COM-B behavioural model, and the ESD framework. These models provided conceptual coherence across both the quantitative and qualitative strands, informing the design of instruments and guiding interpretation.

2.2 Quantitative Method

2.2.1 Survey Instrument Development

The survey instrument (Appendix A) was designed to examine consumer attitudes and behaviours toward plastic use and waste among students at the University of Birmingham. It combined validated items from previous studies with original questions developed to address the specific scope and objectives of this research and was organised into four main sections: (A) respondent information, (B) awareness, (C) attitudes and behaviours, and (D) opinions.

The instrument comprised yes/no items, Likert-scale questions, multiple-choice options, ranking tasks, and questions addressing recycling frequency, avoidance of single-use plastics, knowledge of soft plastics, and attitudes toward bioplastics. Open-ended questions were placed at the beginning to elicit spontaneous associations with the term “plastic” (Dilkes-Hoffman et al., 2019), a technique shown to surface salient concerns and underlying mental models (Chilvers et al., 2014; Sherry-Brennan et al., 2010).

Section A collected demographic information, including age, gender, education (UG/PGT/PhD), subject area, and student status (home or international), with a follow-up on country of origin where applicable. These variables enabled subgroup analyses by age, gender, discipline (science and non-science), student status, and level of study.

The survey content was based on instruments from studies conducted in Australia and India (Dilkes-Hoffman et al., 2019; Dowarah, Duarah, & Devipriya, 2022), which were adapted to fit the context of this research, as presented in Appendix A. Additional original items were included to address aspects of the research objectives not covered in the existing literature.

2.2.2 Sampling Strategy and Participants

The required sample size was calculated using the standard formula:

$$\boldsymbol{n = \frac{Z^2 \cdot P(1-P)}{ME^2}} \quad \textbf{(1)}$$

where n = minimum sample size,

Z = confidence level (1.96 at 95%),

P = expected prevalence (0.5),

and ME^2 = margin of error (0.05) (Hammami et al., 2017).

Based on equation (1), the ideal target sample size at a 95% confidence level with a 5% margin of error would have been approximately 384 respondents.

In practice, 225 responses were obtained, which corresponds to a margin of error of approximately 6.5% at the same confidence level. While this is acceptable for the purpose of the present research, it is acknowledged that some differences may be harder to demonstrate as statistically significant compared to the ideal sample size.

Participants were recruited from the University of Birmingham, because it is the largest in the area and the fifth-largest in the UK (UK University, 2023). A convenience sampling strategy was used, with efforts made to ensure diversity in gender, academic discipline, and nationality.

2.2.3 Data Collection Procedures

Data were collected over a four-week period starting on 10 July, and the demographic composition of the achieved sample was influenced by time constraints during the data collection period. Participation from UK home students was limited, with 58 respondents (25.8%), as many were on holiday at the time of recruitment. Consequently, the sample was dominated by international students (74.2%), which could introduce bias into the demographic results.

2.2.4 Data Analysis

Data were analysed using IBM SPSS Statistics version 30. The choice of statistical tests was determined by variable type and measurement level. As the dataset comprised categorical and ordinal variables, normality assumptions were not applicable and nonparametric methods were used throughout. Categorical variables (e.g., residency, science vs non-science, yes/no items) were summarised as frequencies and percentages; survey items were summarised descriptively using counts and percentages, and results were presented with cross-tabulations and box plots where informative.

Associations between categorical variables were examined with the chi square test of independence, with Fisher's exact test applied when expected cell counts were below five; effect sizes were reported as Cramér's V (Effect size for chi-square)and agreement, where appropriate, as Cohen's kappa. Ordinal variables (e.g., education level, Likert type scales) were analysed with tests for ranked data: the Mann Whitney U test for two independent groups, the Kruskal Wallis test for more than two groups, and Spearman rank correlation to assess associations. For related samples, the Friedman test was used; for related dichotomous outcomes, Cochran's Q test was applied. Statistical significance was set at $p < 0.001$. Where

means are reported, they are presented as the mean with the 95% confidence interval. Unless otherwise noted, analyses were conducted on the full sample (N = 225).

2.3 Qualitative Method

To complement the quantitative findings, the qualitative phase consists of semi-structured interview. This provides an opportunity to investigate the motivations, perceived barriers, and personal experiences that influence students' plastic waste reduction behaviours. By incorporating the voices of students, the study seeks to understand how values, social norms, and situational factors interact within the university context (Tabernero et al., 2015; Steg et al., 2014).

2.3.1 Semi-Structured Interviews

The qualitative interview sample consisted of ten students who had expressed interest during the survey phase. A purposive sampling strategy was used to ensure diversity in academic discipline, demographic background, and levels of engagement in sustainable behaviour. This approach allowed for the inclusion of both students who were highly involved in plastic waste reduction and those who were less engaged, supporting a more comprehensive exploration of the research question.

The interview schedule (Appendix B) was developed using both original and adapted items from peer-reviewed literature. The development of the guide was supported by the COM-B model, a well-established framework for understanding behaviour change (Michie et al., 2011). Specific sources used to construct the interview items included Roy, Berry and Dempster (2022) and Roy et al. (2023), Dilkes-Hoffman et al. (2019, Janzik et al. (2023), and Steinhorst and Beyerl (2021), alongside original questions formulated by the researcher, ensuring alignment with the study's objectives and contributing to the research questions.

Questions explored students' daily habits, perceptions of plastic, recycling challenges, reactions to media coverage, and opinions on policy interventions such as deposit schemes and bio-based plastics. The prompts allowed for personal reflection and elaboration while ensuring thematic consistency across interviews.

Interviews were conducted remotely via Zoom and typically lasted between 20 and 40 minutes. Prior to each interview, participants provided informed consent (Appendix C), including agreement to audio recording. All interviews were recorded for transcription purposes. Transcripts were produced verbatim, and all identifiable data were removed during transcription to preserve anonymity. Further details regarding ethical procedures related to consent, confidentiality, data protection, and ethical approval are provided in Section 2.4.

2.3.2 Thematic Analysis

Thematic analysis was conducted to identify recurring patterns and insights within the interview data, following the six-phase process of analysis (Braun & Clarke, 2019; Byrne, 2021). This process involved familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. Coding was carried out inductively, allowing themes to emerge directly from participants' accounts. These emerging themes were later mapped onto the COM-B framework to maintain alignment with the study's theoretical foundation.

The data were manually coded, allowing for a detailed analysis, though less structured compared to using a software tool like NVivo. Nevertheless, this process helped identify key patterns influencing student behaviour, in line with Wals (2015). The identified themes included emotional dissonance between environmental values and actual behaviours, perceived limitations within institutional structures, self-efficacy related to recycling, the impact of social norms, and the influence of knowledge and habitual practices. These

findings offered additional context to the quantitative results by illustrating how students interpret their behaviours and the barriers they encounter.

2.4 Overarching Themes

For transparency, the analysis was organised under five overarching themes that structure the subsequent Results. Final sub-themes, quotations, and quantitative triangulation are reported in the Results section : (1) Awareness and Perceptions of Plastic Waste's Impact, (2) Attitudes and Behaviours toward Plastic Waste, (3) Barriers, Motivations and Responsibility, (4) University Context and Targeted Recommendations.

2.5 Ethical Considerations

Ethical considerations were carefully taken into account throughout this research. All participants were clearly informed about the aim of the study through posters (Appendix D), verbal explanations, or written materials, including their right to withdraw at any time without giving a reason. Written informed consent (Appendix C) was obtained from each participant before the interviews took place. To ensure confidentiality, personal data was anonymised, and no real names or identifying details were included in the final report. All collected data was stored securely in password-protected files, following data protection regulations and the guidelines set by the University of Birmingham.

Interviews were conducted via Zoom using audio only, in a manner that prioritised respect and participant comfort, to help protect participants' privacy. Participants were informed that they could skip any questions they did not feel comfortable answering. The study received ethical approval from the University of Birmingham's Research Ethics Committee, confirming that all procedures met the required ethical standards. These steps helped to protect the participants' rights and well-being, while also ensuring the integrity and trustworthiness of the research.

CHAPTER 3. RESULTS

This chapter begins by describing the study's demographic profile (Section 3.1) to contextualise subsequent analyses. It then presents findings across five overarching themes, aligned with the research aims and coding framework: (1Awareness and Perceptions of Plastic, (2) Attitudes and Behaviours, (3) Barriers, Motivations and Responsibility and (4) University Context and Targeted Recommendations (Sections 3.2–3.5). Within each theme, quantitative and qualitative findings are integrated, followed by a brief summary. In the Discussion Chapter, we interpret these findings relative to the research questions and hypotheses.

3.1 Demographics

3.1.1. Quantitative

The survey included 225 University of Birmingham students with full demographics presented in Table 1. Most respondents were aged 23–27 (59.6%), with 23.1% aged 18–22 and 17.3% over 27, reflecting a predominantly early postgraduate profile. Gender distribution was 53.8% female and 46.2% male. By study level, the sample was largely postgraduate taught (PGT 72.0%), alongside undergraduates (UG 18.2%) and PhD students (9.8%). Two-thirds were enrolled in science-related degrees (66.2%) and one-third in non-science programmes (33.8%). Degree programmes were classified as science (coded 1) or non-science (coded 2) based on the student's College. "Science" included the College of Medical and Dental Sciences, the College of Engineering and Physical Sciences, and the College of Life and Environmental Sciences."Non-science" included the College of Arts and Law and the College of Social Sciences.

International students comprised 74.2% of the sample (n = 167), with 25.8% home students (Table 1). Among international respondents, the vast majority came from Asia (about 91%).

Within the Asian group, China was the largest contributor (approximately 53% of all international students), followed by India (around 12%) and Indonesia (around 10%), with smaller proportions from Saudi Arabia, Malaysia, Hong Kong, and other countries in the region. Smaller proportions overall came from Africa (about 4.2%), Europe (about 3.6%), and North America (about 1.2%). One international response was coded as N/A and retained for consistency with the official dataset.

Table 1. Distribution of demographic variables

		Frequency (N=225)	**Percentage (%)**
Age	18-22	52	23.1
	23-27	134	59.6
	>27	39	17.3
Gender	Male	104	46.2
	Female	121	53.8
Education	UG	41	18.2
	PGT	162	72
	PhD	22	9.8
Degree type	Science related	149	66.2
	Non-science	76	33.8
Status	Home	58	25.8
	International	167	74.2

3.1.2. Qualitative sample

The qualitative component involved ten participants. Ages ranged from 23 to 28 years, with a median of 25. The gender distribution was six females and four males. Participants included

both domestic (UK) and international students, representing countries such as the UK (e.g., London, Birmingham, Shrewsbury), India, China, Saudi Arabia, and the United Arab Emirates. Study areas and levels were diverse, covering MSc programmes in Management, Public and Environmental Health Sciences, Air Pollution, Urban and Regional Planning, and Physiotherapy, plus PhD programmes in Sport and Exercise Rehabilitation and Law.

Participants' names were coded by gender and science background as follows: FS denotes a female participant studying a science related degree.MS denotes a male participant studying a science related degree and FN denotes a female participant not studying a science related degreeand MN denotes a male participant not studying a science related degree.

3.2 Awareness and Perceptions of Plastic Waste's Impact

3.2.1 Quantitative

3.2.1.1 Associations with plastic

In Question 9, students were asked to choose three product categories that they most immediately associate plastic materials with (Figure 1).

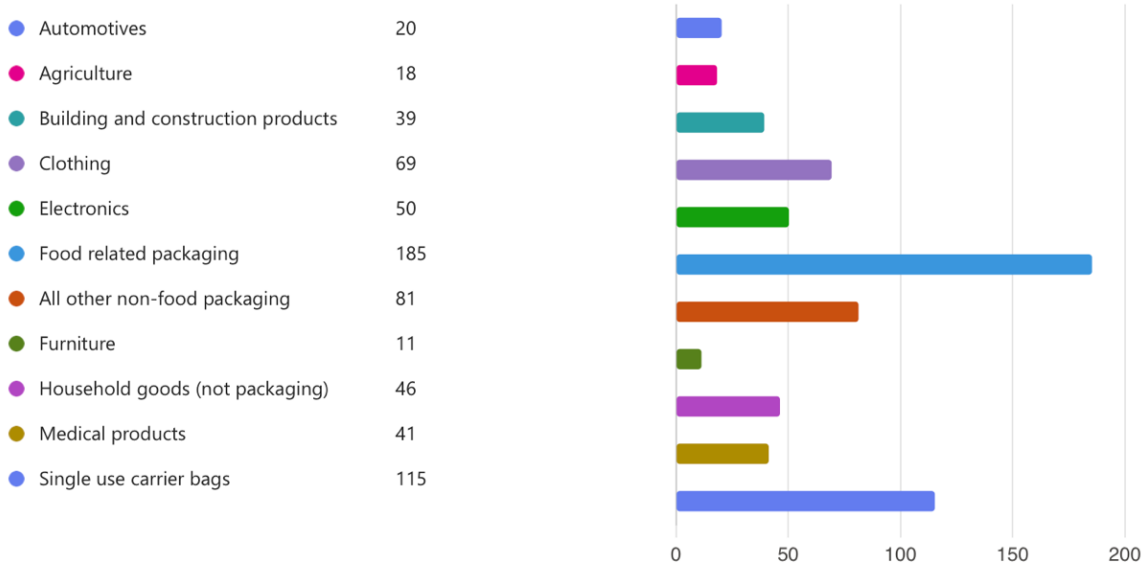

Figure 1. Students' associations with "plastic" (N=225; 3 choices/student)

Results show that the most frequently cited categories were food-related packaging (n = 185; 82.2%), followed by single-use carrier bags (n = 115; 51.1%) and other non-food packaging (n = 81; 36.0%). Less frequently mentioned categories included automotive (n = 20; 8.9%), agriculture (n = 18; 8.0%), and furniture (n = 11; 4.9%).

3.2.1.2 Awareness of microplastics

In Question 11, respondents were asked whether they had heard of microplastics; 76.4% answered "Yes," and the rest answered "No." Crosstabulation showed that awareness was 124/149 (83.2%) among science students and 48/76 (63.2%) among non-science students. A chi-square test of independence examined the association between discipline (science vs. non-science) and awareness of microplastics. All expected cell counts exceeded five. The association was significant, $\chi^2(1, N = 225) = 11.25$, $p < .001$, Cramér's $V = 0.22$.

Using the same method, awareness by residency was 54/58 (93.1%) among home students and 118/167 (70.7%) among international students. The association between residency (home vs. international) and awareness of microplastics was significant, $\chi^2(1, N = 225) = 12.04$, $p < .001$, Cramér's V = 0.23; all expected cell counts exceeded five.

Most students (159/225; 70.7%) believed microplastics are present in salt, bottled water, and seafood; 1 (0.4%) said "No," 31 (13.8%) said "Maybe," and 34 (15.1%) were unsure.

Figure 2 shows responses by science background (1 = science, 2 = non-science). In both groups most students answered "Yes" (microplastics are present), but the science group endorsed "Yes" more often and showed less uncertainty.

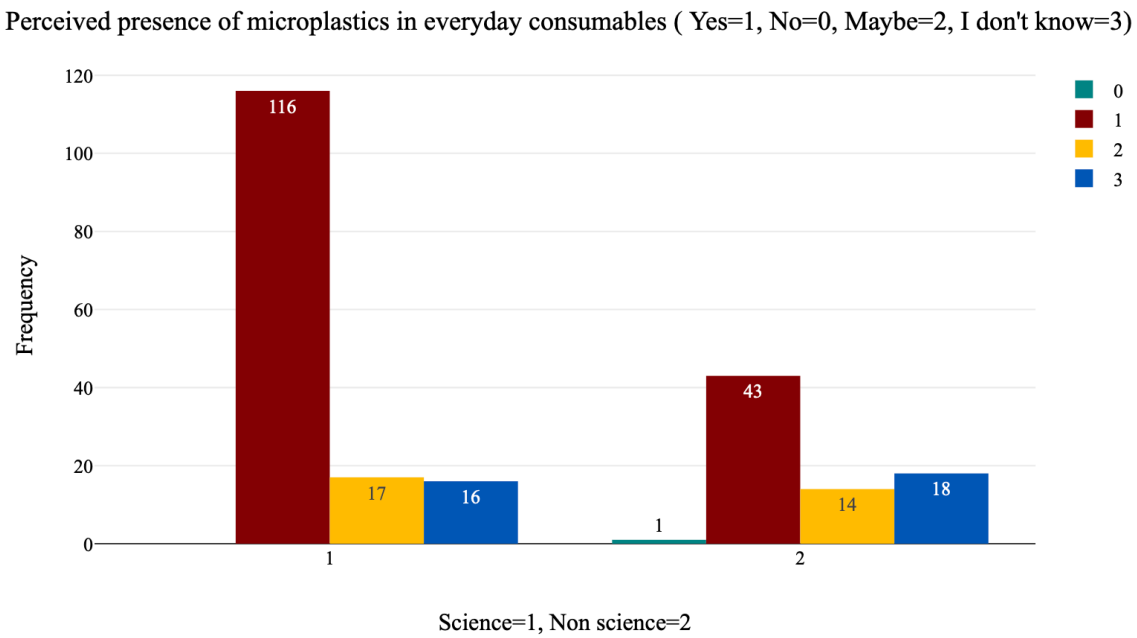

Figure 2. Perceived presence of microplastics in everyday consumables, by science background

A Pearson chi-square test of independence was used to examine the relationship between science background and awareness of microplastics in everyday consumables, as well as between residency and this awareness (2×4 tables; df=3). The likelihood-ratio chi-square (G^2) and effect size (Cramér's V with Cohen benchmarks) are also presented, as shown in Table 2.

In both crosstabs, two expected counts were less than 5 (minimums of 0.34 and 0.26), so likelihood-ratio p-values are reported alongside Pearson p-values. Table 2 indicates that awareness varies clearly by science background and weakly by residency; the effect of science is statistically significant but modest in size.

Table 2. Association between perceived presence of microplastics in everyday consumables and science background/residency

Comparison	χ^2 (df=3)	p	Likelihood-ratio p	Cramér's V	Cohen interpretation
Science background x perceived presence of microplastics in everyday consumables	12.56	0.006	0.006	0.236	small–moderate
Residency × perceived presence of microplastics in everyday consumables	7.32	0.062	0.042	0.180	small

3.2.1.3 Awareness of biodegradable plastic

Question 15 asked respondents whether they had heard of biodegradable plastic, and 82.20% answered positively.

Table 3 presents awareness of biodegradable plastic by student background (N=225; science n=149, non-science n=76). Science students reported higher awareness (128/149, 85.9%) than non-science students (57/76, 75.0%), a difference of 10.9 percentage points.

Table 3. Awareness of biodegradable plastic by student background (N = 225)

		Science background **(Science=1, Non-science=2)**		
Awareness biodegradable plastic		1	2	Total
(No=0, Yes-1)	0	21	19	40
	1	128	57	185
	Total	149	76	225

In Table 4 Pearson's chi-square tests of independence (2×2, two-sided, $\alpha = 0.05$) were used to assess whether awareness of biodegradable plastics differed by science background and by residency. Assumptions were satisfied (all expected counts ≥ 5). Fisher's exact p-values are reported as a robustness check. Effect sizes are given as Cramér's V (equivalent to φ in 2×2 tables).

Table 4. Association between awareness of biodegradable plastics and science background/residency

Comparison	χ^2 (Pearson chi-square) (df=1)	p	Fisher p	Cramér's V	Cohen interpretation
Science background × awareness of biodegradable plastics	4.10	0.043	0.064	0.13	small
Residency × awareness of biodegradable plastics	0.85	0.357	0.429	0.06	negligible

Awareness of biodegradable plastics appears modestly higher among those with a science background, though the evidence is weak and should be interpreted cautiously. Residency shows no meaningful relationship with awareness in this sample.

3.2.1.4 Plastic disposal and perception of harm from burning plastics

Question 10 asked the respondents about the best disposal method for plastic. Their answers were: recycling 51.11%, reuse/repurpose 46.22%, incineration 1.78%, landfill 0.89%.

Question 12 asked respondents about their perception of harm from burning plastics. The responses were Yes 94.22%, No 0.44%, Maybe 3.56%, and I don't know 1.78%.

3.2.1.5 Perception of the seriousness of seven different environmental issues

Question 8 asked them to rate the seriousness of different environmental issues on a scale from 1 to 5, where 1 is Not serious and 5 is Extremely serious. Descriptive statistics are

calculated in Table 5 for N=225, with 0 invalid. Means were highest for ocean plastic, plastic waste amount, and climate change, and lowest for landfill waste and air pollution.

Table 5. Descriptive statistics of the seriousness of seven different environmental issues

Variable	Mean	Median	Mode	SD
Plastic in the ocean	4.27	4.00	5	0.830
The amount of plastic waste produced	4.26	4.00	5	0.858
Climate change (global warming)	4.26	5.00	5	0.938
Water pollution	4.23	4.00	5	0.921
Endangered species and biodiversity	4.12	4.12	5	1.013
Air pollution	3.98	4.00	5	1.056
The amount of general waste going to landfill	3.91	4.00	5	0.998

Because the seven seriousness items were rated on 5-point ordinal scales by the same respondents, the Friedman test was used (nonparametric repeated-measures ANOVA) to assess whether central tendency differed across issues (Table 5).

This test showed significant differences in ranks across the seven topics, $\chi^2(6) = 51.62$, $p < 0.001$ ($N = 225$); Kendall's W (Coefficient of concordance) = 0.038, indicating a small effect. (χ = Pearson chi-square)

Table 6. Friedman test statistics for differences in Mean Ranks across topics

Variable	Mean Rank
Plastic in the ocean	3.70
The amount of plastic waste produced	4.15
Climate change (global warming)	4.23
Water pollution	4.19
Endangered species and biodiversity	3.44
Air pollution	4.37
The amount of general waste going to landfill	3.92

The seven-item scale showed good internal consistency, Cronbach's α = 0.79; corrected item–total correlations ranged from 0.45 to 0.60, and alpha decreased for all items if deleted (0.75–0.78), indicating that each item contributes to the overall scale.

3.2.1.6 Perception of plastic waste packaging

In Question 25 (Q25), students rated plastic food packaging on bipolar adjective pairs (semantic differential; −2 to +2), where −2 indicated strong agreement with the left-hand descriptor (e.g., Harmful) and +2 indicated strong agreement with the right-hand descriptor (e.g., Beneficial); 0 = neutral and frequency distribution is presented in Table 7

Table 7. Frequency distribution of Q25 ratings of plastic food packaging on bipolar adjective pairs (N = 225; invalid = 0)

Descriptor	-2	-1	0	1	2
Harmful/Beneficial	82	78	39	16	10
Bad/Good	65	83	42	27	8
Inconvenient/Convenient	16	19	25	77	88
Not useful/Useful	13	12	45	104	51
Bad for the environment/Good for the environment	131	55	15	14	10

Table 8 introduces the descriptive statistics for Q25: mean, median, and standard deviation for each descriptor pair. Positive values indicate a tilt toward the right-hand descriptor.

Table 8. Descriptive statistics (mean, median, SD) for Q25 ratings of plastic food packaging on bipolar adjective pairs (N = 225)

Descriptor	Mean	Median	Standard deviation
Harmful/Beneficial	-0.92	-1	1.1
Bad/Good	-0.76	-1	1.11
Inconvenient/Convenient	0.9	1	1.21
Not useful/Useful	0.75	1	1.05
Bad for the environment/Good for the environment	-1.26	-2	1.11

Figure 3 shows boxplots for Q25, where students rated plastic food packaging. Boxes mark the interquartile range with the median line. Whiskers show non-outlier ranges; dots are outliers (N = 225). Medians lean positive for convenience and usefulness, but negative for harmful/bad and especially environmental impact.

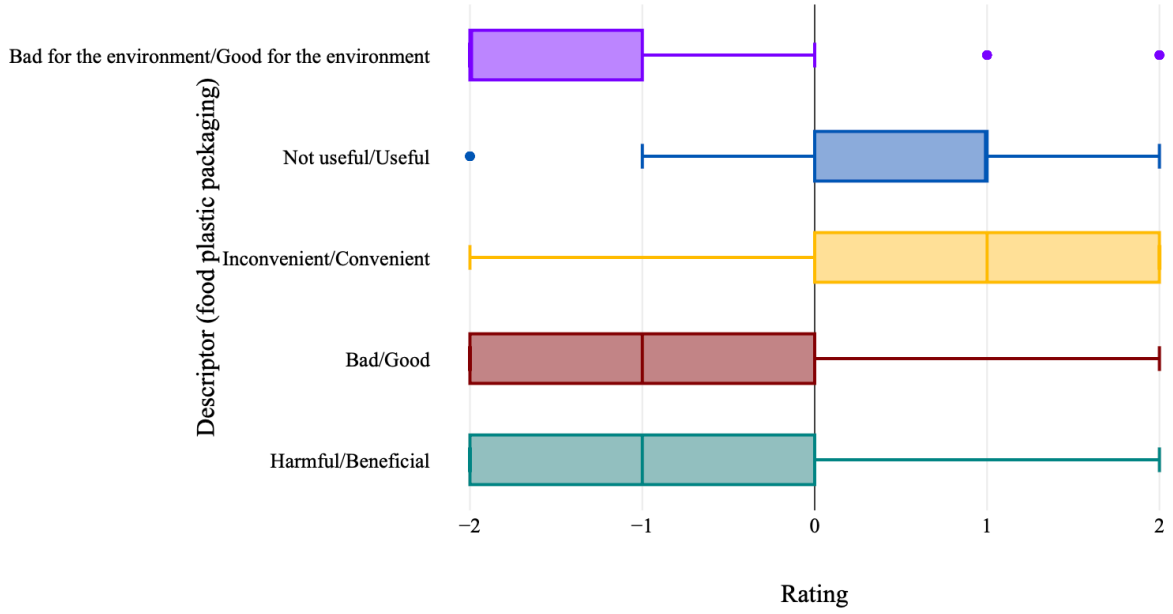

Figure 3. Ratings of plastic food packaging on bipolar descriptors (−2 to +2)

3.2.1.7 Food packaging alternatives (Paper and Glass)

Question 22 asked participants to rate, considering food packaging applications and bags, whether each material is better or worse for the environment compared with normal plastic (1 = much worse, 5 = much better); the mean ratings were Paper M = 3.78 (Mdn = 4, SD = 0.94) and Glass M = 3.76 (Mdn = 4, SD = 1.03), indicating participants saw paper and glass as, on average, environmentally better than plastic , where M, Mdn, SD represent Mean, median, standard deviation.

Figure 4 shows a scatterplot of Paper versus Glass. The points rise slightly from left to right, indicating a small positive association. A Spearman rank correlation confirms this ($\rho = 0.34$, $p < 0.001$, N = 225).

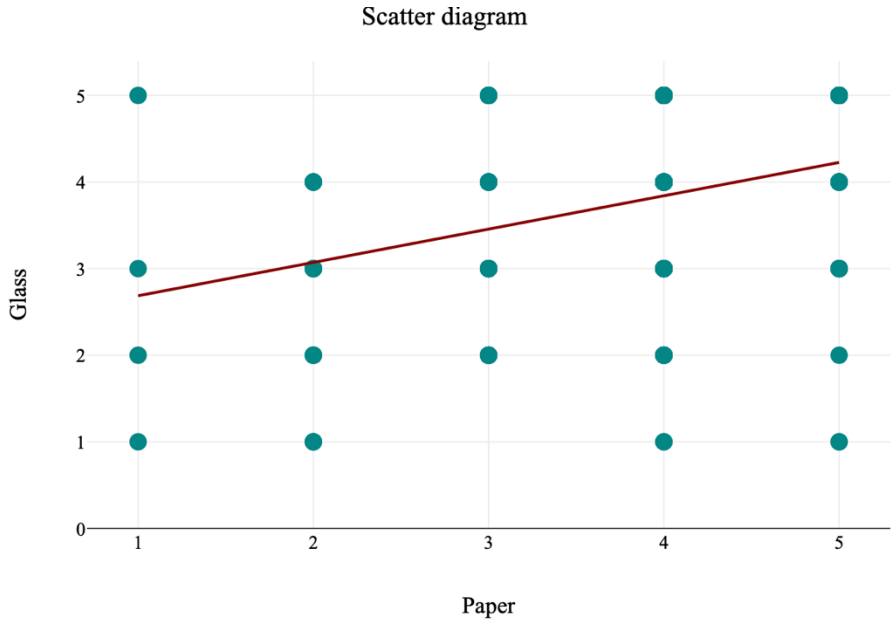

Figure 4. Relationship Between Paper and Glass

3.2.1.8 Concern about plastics in the ocean, the amount of plastic used, and landfill

Three items (concern about plastics in the ocean, the amount of plastic used, and landfill) were analysed with N = 225. Means were 3.92, 3.80, and 3.60; Medians were 4 for all three; standard deviations were 0.97, 1.07, and 1.15, indicating high concern with somewhat greater dispersion for landfill. Correlations were strong and positive: ocean with amount r = 0.66, amount with landfill r = 0.66, ocean with landfill r = 0.56, all $p < 0.001$. Reliability was good with Cronbach's $\alpha = 0.83$; corrected item total correlations ranged from 0.65 to 0.74, and α if item deleted was lower for every item (0.80 ocean, 0.71 amount, 0.77 landfill). Overall the results indicate consistently high and coherent concern, highest for plastics in the ocean.

To test the first hypothesis, environmental issues from Sections 3.2.1.5 and 3.2.1.8 were analyzed, and the results are presented in Table 9. Science students showed slightly higher medians on three measures (5 vs. 4) and the same median for concern (4 vs. 4). However, none of these differences were statistically significant at $\alpha = 0.05$ (smallest $p = 0.055$).

Table 9. Mann–Whitney comparisons of environmental awareness measures between science and non-science students

Variable	Median – Science (n=149)	Median – Non-science (n=76)	Mann–Whitney U	p-value	Significant (α = 0.05)
Knowledge about plastic in oceans	5.00	4.00	5156.00	0.274	No
Perceived amount of plastic pollution	5.00	4.00	4921.50	0.109	No
Belief/awareness about climate change	5.00	4.00	5175.00	0.293	No
Concern about plastic in the ocean	4.00	4.00	4773.00	0.055	No (borderline)

Note. Group 1 = Science students (n = 149); Group 2 = Non-science students (n = 76). Medians are on 1–5 Likert scales. Mann–Whitney U tests are two-tailed; p-values unadjusted for multiple comparisons. Results: Knowledge about plastic in oceans (U = 5156.00, p = .274), Perceived amount of plastic pollution (U = 4921.50, p = .109), Belief/awareness about climate change (U = 5175.00, p = .293), Concern about plastic in the ocean (U = 4773.00, p = .055).

3.2.2 Qualitative

Qualitative analysis used thematic analysis of open-ended responses with manual coding. All responses were coded and grouped into initial categories. Subthemes were then developed within each category and subsequently consolidated into five overarching themes. Due to space limitation, this chapter some of the subthemes will be mentioned. Further details and supplementary quotations are provided in Appendix E (Tables E1 and E2).

3.2.2.1 Associations with plastic

The survey used a quantitative design and included three open ended questions. Question 7 asked participants to provide the first two words that came to mind when they heard “plastic.”

Responses were visualised in a word cloud (Figure 8), where word size reflects frequency. Negative associations predominated, such as waste, pollution, bottle, environment, and bag, while positive associations, such as useful and recycle, were present but less frequent.

Figure 5. Word cloud illustrating students' associations with "plastic."

During the interviews, students recognise functional benefits (storage, shelf life, low cost) but contrast them with a culture of single-use items.

> *"People use plastic to store food… some kinds of food you can't store in paper."* [FS1]
>
> *"Plastic is cheap… longer shelf life… but… awful for the environment in the long term."* [MS9]
>
> *"Convenience is the first thing that comes to mind… at a detriment to our ecosystem."* [MN4]

3.2.2.2 Microplastics, persistence and knowledge gap

Participants were asked whether they knew about microplastics and, specifically, what plastic is made from, how long it persists in the environment, and what the relationship is between plastic and microplastics. It was widely acknowledged by participants that microplastics result from the breakdown of larger plastics and are able to travel through food systems and the environment, though some still reported that they were unsure of the extent of this contamination and associated health effects.

"Microplastics are a by-product… break down over time or from heat or friction… end up in food… oceans… within humans." [MS9]

"Microplastic… is invisible and may get into the land, soil, and air… we could not handle it." [FN10]

"When I heat [plastic] in the microwave… release of microplastics… potentially harmful." [MN4]

Plastics were also described as exceptionally durable materials that, under the right circumstances, could fragment into microplastics over time.

"Plastics… eternal… There isn't a way of escaping plastics turning into microplastics." [MS3]

"Invisible and may get into the land, soil, and air… we could not handle it." [FN10]

Alongside this, a minority had limited or no prior awareness, underscoring uneven understanding within the sample:

"Have you heard of microplastics before? No, no, no—sorry, what's that?" [FN10]

"No, I don't know what plastic is made from, but I know it lasts hundreds of years." [FN8]

3.2.2.3 Environmental harm and emotions

Participants were asked how they feel when they see reports of plastic bottles washing up on beaches and plastic waste floating in the oceans. They expressed broad agreement that plastics harm marine life and ecosystems, noting the long persistence of waste in landfills and the ocean as a significant factor.

"Affecting wildlife… problem is the plastic deep inside the ocean." [FS1]

"Hundreds of years to degrade… ocean killing the fish… looks terrible." [MN2]

"Highly polluting… affects marine life and… humans (blood cells… sperm)." [MS3]

While feelings of sadness, upset, and defeat appeared widespread, some participants indicated they felt a bit hopeful whenever they witnessed tangible solutions or company efforts.

"Very upsetting." [FS5]

"I feel defeated… but also a bit optimistic… companies dealing with microplastics." [MS3]

3.3 Attitudes and Behaviours toward Plastic Waste

3.3.1 Quantitative

3.3.1.1 Recycling practices

Q24 asked respondents to indicate the percentage of plastic bottles recycled in the last year (five ordered categories; treated as ordinal). Overall recycling sat around the midpoint (M = 2.99, SD = 1.34; Mdn = 3; N = 225). A χ^2 test between awareness of microplastic and the percentage of plastic bottle recycled met assumptions (all expected cells > 5) and showed a significant association, $\chi^2(4) = 21.93$, $p < .001$, Cramér's V = 0.31; those aware of microplastics reported higher recycling on average (M = 3.20, SD = 1.35, n = 172) than those not aware (M = 2.30, SD = 1.07, n = 53), consistent with a convergent Spearman's $\rho = .29$, $p < .001$. By contrast, academic discipline (science vs non-science) showed no reliable association with recycling, $\chi^2(4) = 3.75$, $p = .441$, Cramér's V = 0.13; the null hypothesis was not rejected.

3.3.1.1 Littering behaviour

Litter was rated on a 1–4 scale (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Always) and treated as ordinal. Overall self-reported littering was low (M = 1.70, Mdn = 1, SD = 0.89; n = 225). Age showed no monotonic association with litter, $r_s(223) = .07$, $p = .306$.

By discipline, science students reported less litter than non-science students (Mdn 1 vs. 2; means 1.62 vs. 1.86), but this difference was not statistically significant (Mann–Whitney U = 4967, $n_1 = 149$, $n_2 = 76$, $p = .133$).

3.3.2 Qualitative

3.2.3.1 Pro-environmental habits

Respondents described everyday routines directed at minimising plastic use, including carrying reusables, switching product formats, and searching for bins for appropriate disposal. These actions were often referred to as normalised behaviours rather than extraordinary actions.

> *"I try to reduce plastic: I use cloth bags, my own cup, and my own straw."* [FS6]
>
> *"I choose loose vegetables… glass rather than plastic."* [FS7]

3.2.3.2 Convenience and cost

While participants had good intentions, behaviours were constrained by price sensitivity, time pressure, limited access to facilities, and doubts about the integrity of recycling systems. Perceived inconvenience and mistrust neutralised their motivations, even for those who had been committed to recycling actions.

> *"I care about my budget first… not going to pay more to save something I have no control over."* [FS1]
>
> *"I would collect soft plastic from home if the drop-off is close; if it's far away, probably I won't."* [FN10]
>
> *"Would I take soft plastic there? If I had a large quantity maybe, but probably not. It's extra effort and I'm not sure they really recycle it."* [FS7]
>
> *"Challenges for students are cost and time; cheaper things usually come in plastic; in Aldi, everything's in plastic."* [FS7]

3.2.3.3 Recycling practices

Sorting behaviours varied depending on the visibility and availability of bins and the level of local enforcement. When rules were strict or infrastructure was clear, participants reported

higher compliance; where bins were less specific and clearly labelled (e.g. “black” bins only), even good intentions to recycle often fell away.

> *“Recycling is a massive part of my life. I keep a soft-plastic bin at home and once or twice a week I drop it at the supermarket. I don’t buy crisps because the packets aren’t recycled.”* [MS3]

> *“When you’re out and there are only black bins, it’s difficult to recycle.”* [FS7]

3.2.3.4 Context-dependent behaviour

Respondents explained how their actions depend on the place where they are situated (home country versus the UK; campus versus home), and how the context they find themselves busy means they will choose differently. Facilities, social norms, and time scarcity and urgency impacted choices that were more about the now.

> *“If I’m very busy… I throw it in the normal bin.”* [MN2]

> *“It depends where you are. When I was in Saudi, because there were no recycling facilities, it wasn’t my priority. Here it’s a bit better, because there are facilities and the government cares, but I’ll be honest: recycling is the least impactful thing. I don’t think that will save our world.”* [FS1]

> *“In my home country (China) I did better. Here in the UK, we don’t divide kitchen garbage and general garbage, so I combine them.”* [FN10]

> *“I’ll be honest: it’s not a priority. On campus, if I see separate recycling bins, I’ll use them. At home, I use one bin for everything.”* [FS5]

3.4 Barriers, Motivations and Responsibility

3.4.1 Quantitative

3.4.1.1 Barriers

Q17 (“Lack of convenient recycling bins prevents me from recycling more often”) and “I find it hard to change my plastic use habits due to lack of motivation or time” were rated on 1–5 Likert scales and treated as ordinal; associations were therefore assessed with Spearman’s ρ and group differences with Mann–Whitney tests.

Overall, perceived lack of convenient bins was high (M = 3.80, Mdn = 4, SD = 0.93), while difficulty changing habits was moderate (M = 3.08, Mdn= 3, SD = 1.12; n = 225). A low, positive monotonic association emerged between the two items, $r_s(223) = .19$, $p = .005$, indicating that students who reported greater difficulty changing habits also tended to agree (slightly) that inconvenient bin access limits their recycling. By discipline (1 = science, 2 = non-science), medians for Q17 were identical (both Mdn= 4), and a Mann–Whitney test showed no difference, $U = 5397.00$, $n_1 = 149$, $n_2 = 76$, $p = .567$. Study level (UG/PGT/PhD, coded ordinally) was not related to Q17, $r_s(223) = -.06$, $p = .374$. Therefore, inconvenience of bins is commonly endorsed and modestly aligned with self-reported motivational/time barriers, but it does not vary meaningfully by discipline or study level.

3.4.1.2 Motivations

3.4.1.2.1 Incentives

Q28 assessed willingness to reduce plastic use if a deposit-return scheme were offered (1–5 Likert; 1 = strongly disagree, 5 = strongly agree). Because responses are ordinal, associations were evaluated with Spearman's ρ and group differences across the five categories with χ^2 tests (Cramér's V as effect size). Overall endorsement was high (M = 4.35, SD = 0.83; 88% answered 4–5; n = 225). The item correlated moderately and positively with "measures should be taken," $r_s(223) = .47$, $p < .001$, indicating that stronger support for general measures coincided with greater willingness under a deposit-return scheme. Response distributions did not differ reliably by discipline (science vs. non-science), $\chi^2(4) = 7.40$, $p = .116$, $V = .18$ (small), despite slightly higher means among science students (M = 4.43, SD = 0.80, n = 149) than non-science (M= 4.20, SD = 0.86, n = 76).

By study level (UG/PGT/PhD), a small but statistically significant difference emerged, $\chi^2(8) = 16.03$, $p = .042$, $V = .19$, with PhD respondents marginally less favorable than UG/PGT, though endorsement remained high across groups.

3.4.3 Responsibility

Respondents in 225 ratings per group put more responsibility. that of companies (M=3.84, Md=4) and government (M=3.72, Md=4) to individuals (M=3.32, Md=3). The mean of all the actors is higher than the mean of the neutral (3), which means that all actors are perceived to be somewhat to blame, whereas opinions regarding individuals are more polarized (SD=1.17 vs. approximately 1.0 in other cases).

Respondents in 225 ratings per group put more responsibility. that of companies (M=3.84, Md=4) and government (M=3.72, Md=4) to individuals (M=3.32, Md=3). The mean of all the actors is higher than the mean of the neutral (3), which means that all actors are perceived to be somewhat to blame, whereas opinions regarding individuals are more polarized (SD=1.17 vs. approximately 1.0 in other cases).

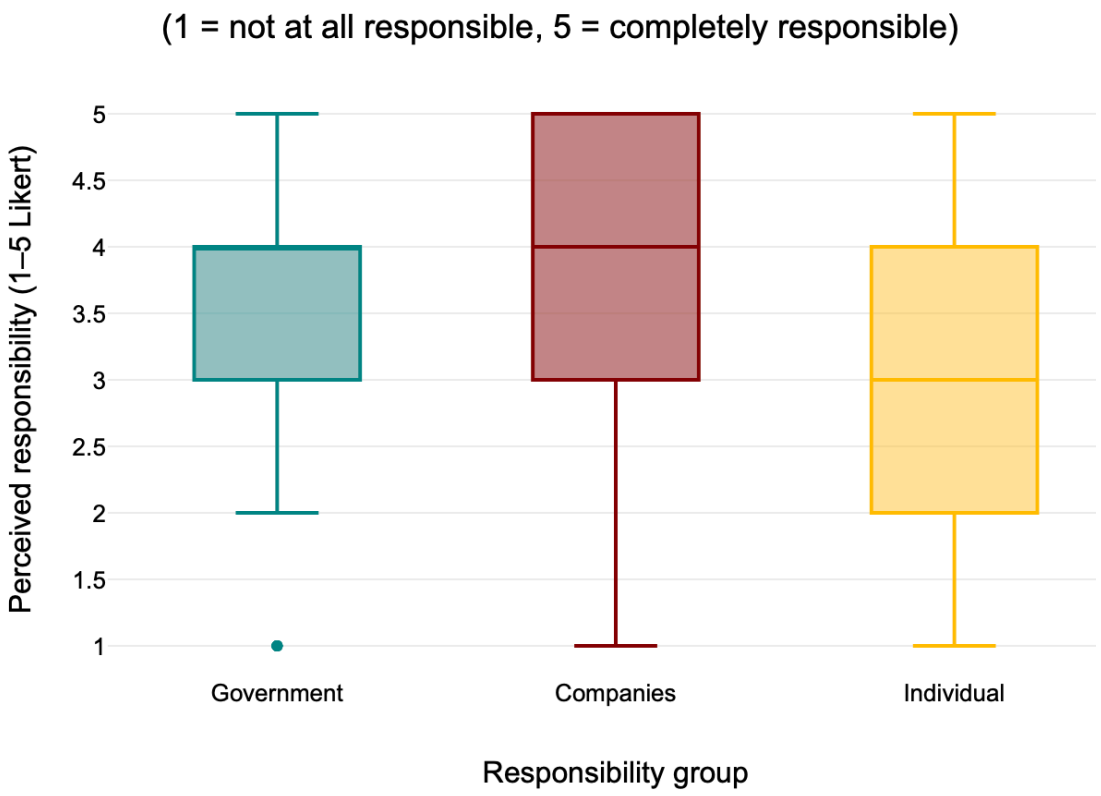

Figure 6. Perceived responsibility for reducing the use of disposable plastic

3.4.2 Qualitative

3.4.2.1 Barriers

Participants identified logistical and structural barriers: cost, limited access to practice, lack of signage, and perceived gaps in policies that inhibit otherwise positive motivation. Several noted that the threat of weak enforcement further reduces the likelihood of following through on the motivations.

> *"Not all students are aware how recycling works in the UK." [MS3]*
>
> *"Students can't afford more." [MS9]*
>
> *"If it's the same price… I would; if more, I will not." [FS5]*

> *"It's my responsibility, but city policy matters. Everyone is lazy; if no one checks, maybe we will not do it well. If staff or volunteers check and give a small punishment, maybe we will do it better."* [FN10]

3.4.2.2 Motivation

Participants pointed to more tangible motivational levers like discounts, deposit return schemes, and campaigns that are visible and communicated effectively.

> *"Deposit schemes and small incentives motivate people."* [MN2]
>
> *"I like deposit schemes… getting 50p back." [*FS6]
>
> *"I would love to get discounts; for example, if I return my old clothes and they give me a discount because I'm recycling."* [FS1]

3.4.2.3 Responsibility

There was strong emphasis on shared responsibility across individuals, universities, local authorities, and industry, with calls for clearer leadership and stronger policy frameworks that make responsible choices easier and more consistent.

> *"Government and companies… should take action."* [FS1]
>
> *"Every person should be responsible, but… government is responsible for awareness and laws."* [FS5]
>
> *"Travelers should take responsibility."* [FN10]

3.4.2.4 Education as motivation

Education was acknowledged as both a catalyst, and sustaining force. It enables knowing why action matters, and maintains cultural community norms through relied engagement with local groups.

> *"Education is very important so we know why we are doing this."* [MN2]
>
> *"Raise awareness for students and keep the university engaged with local sustainability groups."* [MS3]

3.5. University Context and Targeted Recommendations

3.5.1 Quantitative

3.5.1.1 Need for education and Peer influence

A Friedman test compared five related Likert items from Q13 and Q27 (ordinal, within-respondent; 1=strongly disagree to 5=strongly agree; N=225), and Spearman correlations assessed monotonic associations. Items: peer influence; educational campaigns make a difference; awareness of plastic waste reduction initiatives; university provides enough facilities; university efforts motivate me. The Friedman test showed overall differences, $\chi^2(4)=60.53$, $p<.001$. Mean ranks: peer influence 3.60 > educational campaigns 3.12 > university provides enough 3.02 > university efforts motivate me 2.72 > awareness of plastic initiatives 2.53.

Descriptives (M/Med/SD) aligned: peer influence 3.98/4/0.79; campaigns 3.68/4/0.99; university provides enough 3.62/4/0.95; motivation 3.43/4/1.03; awareness 3.29/3/1.08. Correlations: peer influence with campaign effectiveness $\rho=.46$, $p<.001$; awareness with campaign effectiveness $\rho=.19$, $p=.004$; university provision with personal motivation $\rho=.51$, $p<.001$. Overall, agreement is highest for peer influence, moderate for campaigns/provision, and lower for awareness for UOB plastic waste reduction initiatives; associations are meaningful but not causal, meaning that students are being influenced yet many are not fully aware of the initiatives. This points to a need for clearer education and tighter integration of existing campaigns with everyday student touchpoints.

3.5.2 Qualitative

3.5.2.1 What is missing?

Participants identify of the existing a lack of awareness campaigns or facilities and the need for a campus recycling map, onboarding for international students about UK waste streams, visible posters and workshops, supermarket partnerships for refills, and on-site deposit return. Examples include:

> *"make a map so students know where to bring things to recycle"* [FS1],
>
> *"international students should get information… about how to dispose of plastic"* [FN10].

Question 29 from the survey asked: *"In your opinion, what is the biggest barrier to reducing plastic use at the University of Birmingham?"* The responses were mainly lack of awareness, convenience, cost, and not enough bins, as presented in the Wordcloud from Figure 6.

Figure 7. Perceived barriers to reducing plastic use at the University of Birmingham

3.5.2.2 What helps?

Students recommended several called including more information about recycling/disposal points, clearer signage, additional water refill stations, and the return of deposits.

> *"People aren't going to hold items… put facilities in different locations."* [FS1]
>
> *"Reverse vending machines… would automatically motivate students."* [MN2]
>
> *"More water fountains outdoors to encourage refilling."* [MN4]

Question 30 from survey asked the respondents : *"What could the university do better to support plastic waste reduction? "* The responses are captured in the Wordcloud from Figure , where larger words indicate higher frequency of mention.

Figure 8. Student recommendations to reduce plastic waste at the University of Birmingham Common recommendations include education on the impacts of plastic waste, awareness campaigns, more and better labelled bins, additional water-refill points, deposit-return schemes, incentives, and proportionate enforcement.

CHAPTER 4. DISCUSSION

Discussion will interpret the findings through relevant theoretical frameworks and the existing literature, connect them to prior research, and outline implications for policy, practice, and future sustainability initiatives (Tilbury, 2011; Izagirre-Olaizola et al., 2014).

It is also commonly accepted that plastic waste is a systemic environmental issue, and the current trends are projected to increase the amount of inputs to aquatic systems unless the production and waste management trends are reversed (Borrelle et al., 2020). Also in the UK, household recycling has stagnated at the mid 40 % level, and the review of the sector outlines that there are still bottlenecks in the collection and reprocessing infrastructure (UK Government, 2024; WRAP, 2022). The dominant concern over ocean plastics and remaining addicted to the convenience of using plastic packaging are typical findings of public attitude research, which portrays a gap between attitudes and behaviours that only policy can hardly bridge (Dilkes-Hoffman et al., 2019; Peake, 2020). A combined theoretical prism can be used to explain differences in awareness based on disciplines. Value-Belief-Norm (VBN) theory conceptualizes the pro-environmental action as a series of values to beliefs, then to moral obligation to act (Stern, 2000; Steg et al., 2014). Education Sustainable Development (ESD) focuses on cognitive, socio-emotional and behavioural learning as sources of change in the educational context (UNESCO, 2021; Wals, 2015). The conceptualisation of the COM-B model forms the view of behaviour, based on the ability, opportunity and motivation; knowledge is placed within the framework of psychological capability, whereas infrastructure and cues influence opportunity and habits (Allison et al., 2021).

Together, these frameworks indicate a clear hypothesis of H1: Science-related study must raise the cognitive aspect of awareness (ESD; COM-B capability) most easily, and that

general concern, which is already value-laden and social normative at campuses, might be already high, hence without much variation between groups (VBN).

4.1 Research questions

4.1.1 Does studying a science-related degree influence students' environmental awareness compared with studying a non-science degree?

Important statistical evidence concerning this research question relates to knowledge specific to plastics. Awareness of microplastics was generally high at 76.4%, but notably higher among science students at 83.2% compared to non-science students at 63.2%. The difference between disciplines was significant, $\chi^2(1, N = 225) = 11.25$, $p < .001$, Cramér's V = 0.22, indicating a small to moderate effect. Similarly, for awareness of microplastics in everyday consumables, the same pattern was observed, with a significant difference in availability between science and non-science students, $\chi^2(3) = 12.56$, $p = .006$, likelihood-ratio $p = .006$, Cramér's V = 0.236. Overall awareness of biodegradable plastics was 82.2%, with science students being more aware at 85.9% versus 75.0% in non-science students, $\chi^2(1) = 4.10$, $p = .043$, Cramér's V = 0.13. These findings highlight a discipline-related advantage in specific knowledge indicators related to ESD's cognitive domain and the capabilities component of COM-B.

This is supported by Situmorang, Liang, and Chang (2020), who surveyed 98 undergraduates at National Chung Hsing University and found that environmental-science majors had significantly higher plastic-specific knowledge and more frequent plastic-reduction behaviours than social-science majors, with knowledge positively correlated with behaviour.

In contrast to Arshad et al. (2021), which reported significant discipline differences on broad composites of awareness, attitude and behavior with biological sciences highest, the present

study detected no discipline differences in issue-specific concern or seriousness. Mann–Whitney tests for climate change, plastic in the ocean and the amount of plastic pollution produced were non-significant at $\alpha = .05$ (smallest $p = .055$ for plastic in the ocean).

The pattern of high engagement across all the environmental issues supports the VBN expectation that biospheric and altruistic values and awareness of consequences are broadly shared collectively by many university students which produce effects that compress the variance of engagement and limits the scope for discipline to impact attitudinal measures (Steg et al., 2014; Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014).

Qualitative evidence support these quantitative results. All participants who are studying.a degree related to science often provided mechanistic explanations of plastic degradation and microplastic pathways. Examples include:

"Microplastics are a by-product… breakdown over time or from heat or friction… end up in food… oceans… inside humans" [MS9] and

"When I heat up [plastic] in the microwave… the release of microplastics… could be bad for me" [MN4].

Non-science participants included individuals with little prior awareness,

"*Have you ever heard of microplastics before? No, no, no – sorry, what is that?"* [FN10].

At the same time, both groups of participants shared negative affective responses to marine plastic for example,

"Very upsetting" [FS5] *and "Hundreds of years to degrade… ocean kills the fish… just looks horrible"* [MN2].

The convergence of emotion and the divergence of specific knowledge respond to international evidence that shows that packaging is determined to be environmentally harmful

but convenient and useful. This type of configuration can lead participants to maintain usage, despite whatever concern exist (Dilkes-Hoffman et al., 2019).

There are a couple of contextual signals that are important for interpretation. First, residency was correlated with knowledge: awareness of microplastics was 93.1% for home students compared to 70.7 % for international students, $\chi^2(1, N = 225) = 12.04$, $p < .001$, Cramér's V = 0.23. This raises the possibility that discipline differences observed could also reflect prior exposure to educational knowledge and media environments, rather than the discipline curricular alone. Second, the near unanimous agreement that burning plastics is harmful (94.22 per cent "Yes"). Preferred recycling or reuse as disposal options (51.11 % and 46.22 % respectively) implies an alignment of beliefs in accordance with VBN's awareness-of-consequences and personal norms. However, beliefs do not always translate into behaviour without the opportunity and motivational supports denoted by COM-B.

This evidence suggests that H1 is partially supported through domain-specific cognitive awareness, but not general environmental concern. This aligns with ESD's emphasis on the differentiated domains of learning; COM-B's regard for knowledge as merely one necessary environmental factor among: capability, opportunity and motivation; and VBN's recognition of beliefs and personal habits (Stern, 2000; UNESCO, 2021; Allison et al., 2021; Steg et al., 2014). Practically, targeted micro-learning about plastics and microplastics in non-science curricula may improve baseline knowledge, yet conversion of concern into sustained behaviour change will require the adjustment of opportunity structures and adjustment of norms associated with behaviour in accordance with the time analysed in student recycling research in accordance with VBN and educational implications of ESD and COM-B (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014; Wals, 2015).

4.1.2 Does a higher level of environmental awareness influence individuals' plastic-waste behaviours?

The current research question states that greater environmental awareness will lead to more responsible behaviour to manage plastic waste, which is part of a long-standing conversation around the attitude–behaviour gap. There is widespread international evidence that while people show some willingness and concern, "consistent practice" is contingent on situational factors and therefore unreliable, often underpinned by convenience and trust as well as visibility of disposal options (Dilkes-Hoffman et al., 2019; Peake, 2020). The pattern of awareness to action has been documented before, with awareness influencing behaviour when it is relevant, immediate and coupled with the belief that acting would matter.

In the survey, students who had heard of microplastics reported recycling a higher proportion of their plastic bottle waste than those who had not. This is a moderate relationship evidenced in both contingency analysis and rank correlation, $\chi^2(4) = 21.93$, $p < .001$, Cramér's $V = 0.31$, $\rho = .29$, $p < .001$. This is consistent with the comparative work among university students in Spain and the United States where perceived consumer effectiveness affected recycling behaviour more than diffuse environmental awareness, demonstrating that a firm belief that the behaviour mattered for consequence and utility, is a more important driver of behaviour than simple concern (Izagirre-Olaizola, Fernández-Sainz & Vicente-Molina, 2014). Once the awareness is linked to an object that is handled on a daily basis, a plastic bottle, and in turn linked to a pathway with credible risk, that being microplastics in one's consumables, the script for behaviour is clear and actionable. Disciplinary background did not predict recycling behaviour, $\chi^2(4) = 3.75$, $p = .441$, while there was higher plastic-specific knowledge among science students elsewhere in the instrument. The Australian data provide some explanation for the disconnect between knowing and doing.

Dilkes-Hoffman et al. found high stated willingness to reduce plastic and genuine concern about ocean plastics contamination from the public, yet behaviour demonstrated a lag in willingness and responsibility was predominantly ascribed to government and industry rather than the individual (Dilkes-Hoffman et al., 2019). The students' narratives reflect that ambivalence between concern and convenience. One participant noted, "I care about my budget first, I'm not about to spend more to save something I have no control over", and another noted, "When you're out and they're only black bins you're not going to bother recycling". These voices show how price, time pressures, and obscured infrastructure can extricate good intentions at the moment of choice.

The Malayan campaign study foregrounds the mechanism. Afroz et al. found that awareness and recycling self-efficacy mapped onto pro-recycling attitudes, and that the most compelling means to motivation was, however, laudable, the concrete aim of landfill use reduction, and not more abstract appeals or charitable framing (Afroz et al, 2016; Mielinger and Weinrich, 2024). The same direction is observable in the students' accounts, where willingness will be heightened with iconic drop off points, clear labels, and visible signage for the rules, where distrust of the fate of recyclables lowers motivation. One participant expressed, “It is more work, and I’m not sure they actually recycle it.” In other words, awareness leads to behaviour when there is salient evidence in their environment that the action is also easy and effective.

The Italian data adds some more detail about boundary conditions. Righi et al. noted that science focused students in Modena had a high level of awareness of micro and nanoplastics and greater engagement in recycling behaviours, although this capacity did not always translate to waste reduction upstream, which involves more effort and less evidence based on the immediacy of the waste stream and recycling infrastructure (Righi et al., 2024). Student testimonies in Birmingham describe a similar contextual condition.

Behaviour improved when bins are put out of sight, and the waste stream was visually clear, but degraded when the students faced time pressure or the lack of faculty. [MN5] noted, “If I am very busy, I throw it in the normal bin,” succinctly captures this situational pull.

From the perspective of Value–Belief–Norm theory, awareness of consequences seems to ignite personal norms, only when the link between risk and a plausible adaptation is made relevant. Microplastic knowledge and awareness of microplastics provides that link: recycling a bottle is a morally significant and doable action. On the other hand, education for sustainable development provides observations of the institutional responsibility of cognitive and social learning that made that link legible and shared, and through a COM-B lens, demonstrates the reasons awareness alone does not get far without opportunity and motivation. Capability rises with targeted information, opportunity rises with proximal and clearly identifiable streams, and affordable and socially acceptable alternatives, motivation increases with evidence, norming, and incentives that the act is meaningful - evidence of diversion and contamination, plus small and immediate incentives.

In conclusion , this hypothesis it is confimed that greater awareness of environmental impact will lead to greater responsible behaviour, but with qualifications. Awareness is specific, it needs to relate to efficacy, for example knowledge of everyday consumables that carry microplastics, is related to increased recycling. Awareness without either of the other two contributers, or even interest as an independent criteria, are not reliable predictors of recycling behaviour.

The literature has produced findings in Australia, Malaysia, Spain and the USA, and Italy, which consistently demonstrate evidence to the same point. Where awareness relates to a plausible action script, and subsequent and clear opportunity, and accountability for the returns of action are made credible, the action will follow.

4.1.3 How the convenience and accessibilty of recycling bins influence students' waste sorting habits?

The premise that improving the convenience and accessibility of recycling bins leads to an improved waste-sorting disposition assumes that infrastructure is the one decisive condition transitioning concern to practice. Public attitudes research suggests awareness does not lead to changes in routines when systems are not clear, and responsibility is seen to lie outside of oneself or institutions; if it is to be different then visible, contextual and proximate options to reduce effort at the point of action are needed (Dilkes-Hoffman et al., 2019).

Campaign evidence seems to suggest, similarly to the previous findings, recycling arrangements incorporating technical facilitation are more evocative than simply appealing to the abstract; again suggesting that infrastructure and signage are the active ingredients (Afroz et al., 2016).

The survey findings are consistent with these assumptions. Across the responses, students agreed that lack of convenient bins inhibits their recycling frequency, and average responses were clustered in levels of agreement ($M = 3.80$, $Mdn = 4$, $SD = 0.93$).

Perceived inconvenience was modestly and positively related to difficulty changing behaviour (habits) because of motivation or time, $r_s(223) = .19$, $p = .005$, which is exactly the type of pattern we would expect when opportunity constraints affect behaviour in a busy setting. The absence of differences by discipline or study level suggests a structural barrier rather than a dispositional one. The interviews provide texture to this mechanism: "When you are out and there are only black bins, it is hard to recycle," (A4) "If I am really busy, I will just throw it in the normal bin," A4. When cues were strong and locations known, students reported consistent sorting behaviour; where cues were weak or ambiguous, intentions collapsed to convenience and doubt. Even among a highly aware student population frictions have been seen where knowledge does not lead to upstream waste reduction without

supportive context (Righi et al., 2024). Perceived consumer effectiveness also matters at the point of disposal, and measures of clear system for bins serve as a behavioral script, signifying both what to do and that it matters (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014).

Altogether, the quantitative and qualitative evidence supports H3: Convenience and accessibility of recycling bins significantly improve students' waste-disposal habits.

Convenience and clarity are likely the proximal levers that convert intention to sorting in corridors, canteens and outside. As one participant mentioned: "As long as the bin is there, and it is clear, I will use it."

4.1.4 How incentives influence students' participation in plastic waste reduction?

The assumption that social and institutional incentives enhance student willingness to engage in sustainable waste practices (H4) is built on a simple premise. When the immediate pay-off of the pro-environmental option is clear and tangible, hesitation subsides, and the action follows. An international body of evidence suggests that motives framed in concrete terms, and combined with practical facilitation, are more compelling than abstract appeals.
In Kuala Lumpur, for example, participation increased when campaigns highlighted the specific outcome of reducing landfill and when individuals felt more confident about what to do and were oriented toward linking incentive with self-efficacy and clear means (Afroz et al., 2016). Among university students in Spain and the United States, perceived consumer effectiveness was a stronger driver of recycling than diffuse knowledge. This suggests incentives function effectively when they signify and permit the belief that one acts will count (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014). All of these threads

converge on the same mechanism. Incentives do not replace values, they translate them into a simple script at the relevant moment of decision.

The survey pattern fits this logic. Willingness to reduce plastic under a deposit-return scheme was decidely high, (M = 4.35, SD = 0.83) where 88 % normative selected agree or strongly agree. The willingness marched in-step with support for broader measures, $rs(223) = .47$, $p < .001$. Disciplinary differences were not significant, $\chi^2(4) = 7.40$, $p = .116$, $V = .18$, and while there was small variance by study level, the core message remained broad support, $\chi^2(8) = 16.03$, $p = .042$, $V = .19$. The interviews provided important explanations. Specifically, the students pointed to small and immediate returns as the nudge that moves intention into action - "*Deposit schemes and small incentives motivate people."* Another voice said, "*I like deposit schemes - I got back 50p."* Others pointed to discounts as a way of making a greener action feel like the normal action, instead of a luxury, while cost pressure was mentioned several times - *"Students cannot afford more,"* as one participant said. If cost is the major barrier, even small incentives could neutralise the cost of single-use plastic.

The nature of how incentives work could be described using COM-B. Incentives strengthen reflective motivation as beneficiaries make the return of a bottle or refusal of a bag, clearly visible and immediate. An incentive also increases automatic motivation by increasing a small habit loop of return (= bottle) and reward. The same action can be seen through a Value-Belief-Norm. A deposit cue at the moment of disposal activates the personal norm already in existence, and at least minimises (if not nullifies) the temptation to rationalise a less sustainable choice. Education for Sustainable Development also helps to explain why schemes that simply inform and advertise how a scheme works (and where) are as important as the cash in hand (or up front). By having that clear information, capability is provided to build shared understanding - the same small incentive could diffuse through a community, rather than just one-off uptake.

The qualitative data also provide additional boundary conditions. First, trust must be built into the approach. Some students were doubtful of whether the returned materials were actually recycled. In these cases, a payment may produce a one-off action, but it will not suggest routine. Second, incentives are more effective if their use involves visible infrastructure. Calls for reverse vending machines and on-site points to return clearly indicate that a reward not connected to a place to act nearby tells no one, in a moment of time pressure. As one participant said, "Having a reverse vending machine would automatically motivate students." These are also consistent with evidence shows incentives are taken up when they are part of a simple, technically facilitated system, telling a person both what to do and why it matters (Afroz et al., 2016). This also fits the findings in that students were also be more responsive when they felt their behaviour was effective, exactly the premise of a good incentive (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014).

Therefore, the quantitative and qualitative data support the hypothesis. Social institutional incentives, particularly deposit-return incentives, enhance the willingness to be involved in plastic waste reduction (and positively) when they are easy to use, clearly supported, and trusted. (Afroz et al., 2016; Izagirre-Olaizola et al., 2014)

4.2 Limitations of the Study

There are a number of limitations within the study. First of all, the study used self-reported questionnaires and interviews. Self-reports of behaviours may elicit biased responses, particularly social desirability bias, where people feel pressured to report more pro-environmental behaviour than they actively participate in (Schultz, Oskamp & Mainieri, 1995). Second, the interview sample was small. The results cannot be generalized to the entire university (Izagirre-Olaizola et al., 2014).

Third, the survey ran during the university's holiday period, which impacted the sample, as many home UK undergraduates were away from university, and it did not reflect the typical mix of students. The tried methodology ultimately led to a sample where many of the students identified internationally, and predominately from Asia, which influenced the outcome of the project.

Fourth, the focus of the study was limited only to reducing plastic waste and did not address other sustainability areas, such as energy reduction and composting.

Fifth, there were a limited number of statistical tests. The limited number of tests limits inference and can make real effects a little more difficult to discern, and should be treated with caution. However, these limitations were kept in mind through the design process, so that the project remained true to its aims while still contributing relevant knowledge on student engagement with plastic waste.

If I were to replicate the study, I would collect data from all participants at term period to avoid holiday bias in the timing of the survey and aim for a more balanced sample across courses, as well as level-UG, PGT, PhD and across nationalities to test for subgroup differences.

4.3 Recommendations

4.1 Recommandations for Policy and Practice

Reducing plastic waste on campus is ultimately about daily behaviour and clear infrastructure. Other research shows that people will act when the low-waste option is apparent, straightforward and inexpensive. Our students requested practical changes that are similarly valuable in this regard.

First, the disposal system needs to be simple and consistent. Use the same colours, icons, and labels on bins across campus and place multi-stream stations in locations that students are

likely to utilise, such as outside classrooms and in food courts. This aligns with previous studies in various contexts, which demonstrate clear, consistent cues at the decision point increases sorting and minimises mistakes (Miafodzyeva & Brandt, 2012). Students consistently requested more obvious labels and more stations in busy areas.

Second, make refill and rinse the default choice. Add water-refill stations, offer borrow-cup or reusable container schemes, and ensure its cheaper to refill than to buy pre-packaged disposable waste. Universities who have implemented this reported consistent decreases in disposable packaging, and our students explicitly requested more fountains and visible reuse options at points of purchase. Policies to secure procurement processes should support this by including preference for low-waste formats as is encouraged more broadly by these sectors to increase recycling beyond current stagnation (WRAP, 2022; UK Government, 2024).

Third, include simple incentives and visible feedback. Deposit-return programs and reverse-vending machines function better when there is an immediate reward such as a credit added to a student card or donation to charity. The students suggested reverse-vending with little rewards. Short messages at bin stations, site-specific, showing what has been diverted, or indicating how contamination has degraded, can help student action be leveraged, which is known to encourage participation from populations on university campuses (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014).

Fourth, improve communication through existing student channels. Several student groups expressed that many do not know what the practice is, especially for international students, let alone that each of the other campaigns exist. One clear example given was "I only use Canvas for assignment - better advertisement" [FN5]. Reviewing the practical degree of implementing "brief slides" at the beginning of a large lecture, targeted Canvas announcements, adding a residence move-in pack, time tables, or using screens in food courts or libraries, wayfinding stickers near bin stations and a simple recycling map accessed via

QR code all seem practical. Similar things found in education for sustainable development also advise very short context-based guidance that can be related to meaningful action (Tilbury, 2011; Wals, 2015).

Fifth, leverage peer influence. Programs that recruit students to serve as ambassadors in Schools and or residences, with short and highly accessible materials, generally shift everyday norms because the message/screens are coming from someone you already know! Prior evidence noted the importance of social norms and perceived effectiveness compared to information wealth, which supports our peer-led suggestion (Izagirre-Olaizola, Fernández-Sainz and Vicente-Molina, 2014).

In fact, many of the priorities outlined here, education about impacts, awareness campaigns, more bins and clearer signage, more refill stations, deposit return, incentives and reasonable enforcement came directly from students.

4.2 Recommendations for Further Research

Future research needs to empirically test what specific changes are most effective on this campus. Short field experiments could take place that consider different bin messaging, locations and prompts, all in similarly used buildings. For deposit-return trials, different levels of reward and station features could be varied to establish what promotes sustained, continued participation rather than a short-term spike. More permanent additional refill stations could also be analysed alongside minor changes to pricing to account for what adjustments may lead to purchasing change.

Observation does not have to rely solely on surveys. Periodic waste tracking (audits), contamination monitoring, smart-bin alerts and signal detection on refill stations all offer different, and in some sense more robust basis for evidence to inform practices. Brief walk-along observations in busy buildings can showcase where individuals take shortcuts due to time and layout or where even minor changes would be beneficial.

Examination across faculties, residences and groups in term-time could lead to tailored messages for international students and others who might not be familiar with the local waste system. Reporting methods and findings to other universities will result in a sustained means of building a practical suite of options in parallel to findings in other cases that responsible, willingness, awareness and understanding work well when they appear hand-in-hand with clarity about facilitation and simple motivations for action (Afroz et al., 2016; Righi et al., 2024).

4.4 Conclusions

Plastic waste continues to be a systemic challenge and universities play a key role in converting a very broad concern into very low waste practice within everyday life. In the study, plastic specific knowledge (especially microplastics) was greater among students studying science, while overall environmental concern was similarly high across disciplines, providing only partial support to the first hypothesis. Concrete and actionable awareness was an advantage for higher self reported recycling behaviour, supporting the second hypothesis, while unclear or inconvenient bins, as well as time and cost pressures, prevented sorting behaviour consistent with the third hypothesis.

Deposit return schemes, and small incentive rewards that are immediate, as well noble peer influence and visible campaigns increased the willingness to act and support the fourth hypothesis. Students assigned most responsibility to companies and government indicating the need for institutional leadership to make a preferred choice the easy choice.

In practical terms, targeted micro learning, consistent multi stream bin stations with clear signage, greater refill and return options, and gentle nudges or incentives magnified through peer messaging provide a viable pathway for changing intention into practice. These efforts

represent an evidence based blueprint for the University of Birmingham and transferable guidance for other higher education environments to pursue measurable reductions in plastic waste.

REFERENCES

Afroz, R., Rahman, A., Masud, M.M. and Akhtar, R. (2016). The knowledge, awareness, attitude and motivational analysis of plastic waste and household perspective in Malaysia. *Environmental Science and Pollution Research*, 24(3), pp.2304–2315. doi:https://doi.org/10.1007/s11356-016-7942-0.

Allison, A.L., Lorencatto, F., Miodownik, M. and Michie, S. (2021). Influences on single-use and reusable cup use: a multidisciplinary mixed-methods approach to designing interventions reducing plastic waste. *UCL Open Environment*, 3. doi:https://doi.org/10.14324/111.444/ucloe.000025.

Almeida, F. (2018). Strategies to perform a mixed methods study. *European Journal of Education Studies*, [online] 5(1). doi:https://doi.org/10.46827/ejes.v0i0.1902.

Arshad, H., Saleem, K., Shafi, S., Ahmad, T. and Kanwal, S. (2020). Environmental Awareness, Concern, Attitude and Behavior of University Students: A Comparison Across Academic Disciplines. *Polish Journal of Environmental Studies*, 30(1), pp.561–570. doi:https://doi.org/10.15244/pjoes/122617.

Borrelle, S.B., Ringma, J., Law, K.L., Monnahan, C.C., Lebreton, L., McGivern, A., Murphy, E., Jambeck, J., Leonard, G.H., Hilleary, M.A., Eriksen, M., Possingham, H.P., Frond, H.D., Gerber, L.R., Polidoro, B., Tahir, A., Bernard, M., Mallos, N., Barnes, M. and Rochman, C.M. (2020). Predicted Growth in Plastic Waste Exceeds Efforts to Mitigate Plastic Pollution. *Science*, [online] 369(6510), pp.1515–1518. doi:https://doi.org/10.1126/science.aba3656.

Braun, V. and Clarke, V. (2019). Reflecting on Reflexive Thematic Analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), pp.589–597. doi:https://doi.org/10.1080/2159676X.2019.1628806.

Byrne, D. (2021). A Worked Example of Braun and Clarke's Approach to Reflexive Thematic Analysis. *Quality & Quantity*, [online] 56(1), pp.1391–1412. doi:https://doi.org/10.1007/s11135-021-01182-y.

Cheung, T.Y., Fok, L., Cheang, C.-C., Yeung, C.H., So, W.-M.W. and Chow, C.-F. (2018). University halls plastics recycling: a blended intervention study. *International Journal of Sustainability in Higher Education*, 19(6), pp.1038–1052. doi:https://doi.org/10.1108/ijshe-10-2017-0175.

Chilvers, J., Lorenzoni, I., Terry, G., Buckley, P., Pinnegar, J.K. and Gelcich, S. (2014). Public engagement with marine climate change issues: (Re)framings, understandings and responses. *Global Environmental Change*, [online] 29, pp.165–179. doi:https://doi.org/10.1016/j.gloenvcha.2014.09.006.

Chowdhury, S., Tiwari, M., Mishra, P., Rajeev Singh Parihar, Verma, A., Mehrotra, R., Nidhi Punj and Sharma, A. (2023). Recent trends of plastic waste management for sustainable environment in Indian context. *Materials Today: Proceedings*. doi:https://doi.org/10.1016/j.matpr.2023.06.063.

Coulston, F., Lynch, F. and Vears, D.F. (2025). Collaborative coding in inductive content analysis: Why, when, and how to do it. *Journal of Genetic Counseling*, 34(3). doi:https://doi.org/10.1002/jgc4.70030.

Dilkes-Hoffman, L.S., Pratt, S., Laycock, B., Ashworth, P. and Lant, P.A. (2019). Public attitudes towards plastics. *Resources, Conservation and Recycling*, 147, pp.227–235. doi:https://doi.org/10.1016/j.resconrec.2019.05.005.

Dowarah, K., Duarah, H. and Devipriya, S.P. (2022). A preliminary survey to assess the awareness, attitudes/behaviours, and opinions pertaining to plastic and microplastic pollution among students in India. *Marine Policy*, 144, p.105220. doi:https://doi.org/10.1016/j.marpol.2022.105220.

Hammami, M.B.A., Mohammed, E.Q., Hashem, A.M., Al-Khafaji, M.A., Alqahtani, F., Alzaabi, S. and Dash, N. (2017). Survey on awareness and attitudes of secondary school students regarding plastic pollution: implications for environmental education and public health in Sharjah city, UAE. *Environmental Science and Pollution Research*, 24(25), pp.20626–20633. doi:https://doi.org/10.1007/s11356-017-9625-x.

Izagirre-Olaizola, J., Fernández-Sainz, A. and Vicente-Molina, M.A. (2014). Internal determinants of recycling behaviour by university students: a cross-country comparative analysis. *International Journal of Consumer Studies*, 39(1), pp.25–34. doi:https://doi.org/10.1111/ijcs.12147.

Janmaimool, P. and Khajohnmanee, S. (2019). Roles of Environmental System Knowledge in Promoting University Students' Environmental Attitudes and Pro-Environmental Behaviours. *Sustainability*, 11(16), p.4270. doi:https://doi.org/10.3390/su11164270.

Janzik, R., Koch, S., Giorgia Zamariola, Domagoj Vrbos, White, M.P., Pahl, S. and Berger, N. (2023). Exploring public risk perceptions of microplastics: Findings from a cross-national

qualitative interview study among German and Italian citizens. *Risk Analysis*, 44(3). doi:https://doi.org/10.1111/risa.14184.

Khan, F., Ahmed, W., Najmi, A. and Younus, M. (2019). Managing plastic waste disposal by assessing consumers' recycling behavior: the case of a densely populated developing country. *Environmental Science and Pollution Research*, 26(32), pp.33054–33066. doi:https://doi.org/10.1007/s11356-019-06411-4.

Keryan, T., Mitrofanenko, T., Muhar, A. and Khartishvili, L. (2020). UNESCO's Education for Sustainable Development Framework and the Reality of University–Community Cooperation in the Caucasus Mountain Region. *Mountain Research and Development*, [online] 40(4), pp.D1–D9. doi:https://doi.org/10.2307/27029083.

McKim, C.A. (2017). The Value of Mixed Methods Research. *Journal of Mixed Methods Research*, 11(2), pp.202–222. doi:https://doi.org/10.1177/1558689815607096.

Miafodzyeva, S. and Brandt, N. (2012). Recycling Behaviour Among Householders: Synthesizing Determinants Via a Meta-analysis. *Waste and Biomass Valorization*, 4(2), pp.221–235. doi:https://doi.org/10.1007/s12649-012-9144-4.

Mielinger, E. and Weinrich, R. (2024). Insights into plastic food packaging waste sorting behaviour: A focus group study among consumers in Germany. *Waste management (Elmsford)*, 178, pp.362–370. doi:https://doi.org/10.1016/j.wasman.2024.02.038.

Michie, S., van Stralen, M.M. and West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, [online] 6(42). doi:https://doi.org/10.1186/1748-5908-6-42.

Oranga, J. (2025). Mixed Methods Research: Application, Advantages and Challenges. *Journal of Accounting Research, Utility Finance and Digital Assets*, [online] 3(4), pp.370–375. doi:https://doi.org/10.54443/jaruda.v3i4.213.

Oskamp, S., Harrington, M.J., Edwards, T.C., Sherwood, D.L., Okuda, S.M. and Swanson, D.C. (1991). Factors Influencing Household Recycling Behavior. *Environment and Behavior*, 23(4), pp.494–519. doi:https://doi.org/10.1177/0013916591234005.

Peake, L. (2020). *Chapter 23 - Plastic waste in the United Kingdom*. [online] ScienceDirect. Available at: https://www.sciencedirect.com/science/article/pii/B9780128178805000232.

Righi, S., Bergami, E., Simonini, R. and Prevedelli, D. (2024). Level of Awareness and Attitudes towards Plastic Contamination by Students of an Italian University. *Sustainability*, 16(11), pp.4637–4637. doi:https://doi.org/10.3390/su16114637.

Roy, D., Berry, E. and Dempster, M. (2022). ‘If it is not made easy for me, I will just not bother’. A qualitative exploration of the barriers and facilitators to recycling plastics. *PLOS ONE*, [online] 17(5), p.e0267284. doi:https://doi.org/10.1371/journal.pone.0267284.

Roy, D., Berry, E., Orr, K. and Dempster, M. (2023). Barriers to recycling plastics from the perspectives of industry stakeholders: a qualitative study. *Barriers to recycling plastics from the perspectives of industry stakeholders: a qualitative study*, 20(1). doi:https://doi.org/10.1080/1943815x.2023.2190379.

Schultz, P.Wesley., Oskamp, S. and Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, 15(2), pp.105–121. doi:https://doi.org/10.1016/0272-4944(95)90019-5.

Sherry-Brennan, F., Devine-Wright, H. and Devine-Wright, P. (2010). Public understanding of hydrogen energy: A theoretical approach. *Energy Policy*, 38(10), pp.5311–5319. doi:https://doi.org/10.1016/j.enpol.2009.03.037.

Situmorang, R.O.P., Liang, T.-C. and Chang, S.-C. (2020). The Difference of Knowledge and Behavior of College Students on Plastic Waste Problems. *Sustainability*, 12(19), p.7851. doi:https://doi.org/10.3390/su12197851.

Smyth, D.P., Fredeen, A.L. and Booth, A.L. (2010). Reducing solid waste in higher education: The first step towards ‘greening’ a university campus. *Resources, Conservation and Recycling*, 54(11), pp.1007–1016. doi:https://doi.org/10.1016/j.resconrec.2010.02.008.

Steg, L., Perlaviciute, G., van der Werff, E. and Lurvink, J. (2014). The Significance of Hedonic Values for Environmentally Relevant Attitudes, Preferences, and Actions. *Environment and Behavior*, 46(2), pp.163–192. doi:https://doi.org/10.1177/0013916512454730.

Steinhorst, J. and Beyerl, K. (2021). First reduce and reuse, then recycle! Enabling consumers to tackle the plastic crisis – Qualitative expert interviews in Germany. *Journal of Cleaner Production*, 313, p.127782. doi:https://doi.org/10.1016/j.jclepro.2021.127782.

Stern, P.C. (2000). New Environmental Theories: toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, 56(3), pp.407–424.

Tabernero, C., Hernández, B., Cuadrado, E., Luque, B. and Pereira, C.R. (2015). A multilevel perspective to explain recycling behaviour in communities. *Journal of Environmental Management*, 159, pp.192–201. doi:https://doi.org/10.1016/j.jenvman.2015.05.024.

Tilbury, D. (2011). *Education for Sustainable Development: an Expert Review of Processes and Learning*. [online] Unesco.org. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000191442.

UK Government (2024). *UK statistics on waste*. [online] GOV.UK. Available at: https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste#packaging-waste.

UK Univeristy (2023). *The 10 Biggest Universities by Student Population in the UK in 2023*. [online] studentear. Available at: https://www.studentear.com/single-post/the-10-biggest-universities-by-student-population-in-the-uk-in-2023 [Accessed 17 Mar. 2025].

UNESCO (2021). *Education for sustainable development*. [online] Unesco.org. Available at: https://www.unesco.org/en/sustainable-development/education.

Wals, A.E.J. (2015). *Beyond unreasonable doubt. Education and learning for socio-ecological sustainability in the Anthropocene*. [online] *Research@WUR*. Wageningen University. Available at: https://research.wur.nl/en/publications/beyond-unreasonable-doubt-education-and-learning-for-socio-ecolog [Accessed 19 Oct. 2023].

WRAP (2022). *Plastics Market Situation Report 2022*. [online] WRAP. Available at: https://www.wrap.ngo/resources/report/plastics-market-situation-report-2022.

Zhao, C., Liu, M., Du, H. and Gong, Y. (2021). The Evolutionary Trend and Impact of Global Plastic Waste Trade Network. *Sustainability*, 13(7), p.3662. doi:https://doi.org/10.3390/su13073662.

APPENDICES

Appendix A

Table A1. Survey Questionnaire

Consumer Attitudes and Behaviours Toward Plastic Waste Among UoB Students
Thank you for taking part in this study. This research is being conducted as part of an MSc Environmental Health dissertation. The survey is completely anonymous, and any demographic information you provide will be used solely for grouped data analysis in the study's metadata. Your participation is entirely voluntary. The survey will take approximately **5 to 10 minutes** to complete. Please proceed only if you feel completely comfortable. There are no correct or incorrect answers. Please respond sincerely and as accurately as possible according to your own understanding.
A. Information of the respondent. (Questions 1–5 are based on Dowarah et al., 2022; Question 6 was developed by the researcher.)
1. Age *… **2.** Gender *…. **3.** Course pursuing * : UG/PGT/PhD **4.** Please specify your degree subject area. (ex: Biochemistry, Engineering, Medicine, Art, Political Sciences, etc) * … **5.** Student Status * : Home/ International **6.** If international, please specify your country of origin….
B. Awareness (Questions 7, 8, and 9 are based on Dilkes-Hoffman et al., 2019; Questions 10, 11, 12, 14, and 15 are adapted from Dowarah et al., 2022; Question 13 was developed by the researcher)
7. Please record the first two words/phrases that come to mind when you hear the word 'plastic' *

8. You will now be presented with seven different environmental issues.
For each one, please indicate how serious you believe the issue is, using a scale from 1 to 5, where 1 means *Not at all serious* and 5 means *Extremely serious.

	1	2	3	4	5
Air pollution					
Water pollution					
The amount of plastic waste produced					
Plastic in the ocean					
The amount of general waste going to landfill					
Climate change (global warming)					
Endangered species and biodiversity					

9. Please choose the three product categories you most immediately associate plastic materials with (Please select 3 options*):

Automotives	
Agriculture	
Building and construction products	
Clothing	
Electronics	
Food related packaging	
All other non-food packaging	
Furniture	

Household goods (not packaging)	
Medical products	
Single use carrier bags	

10. What is the best disposal method for plastic? *

Reuse or repurpose it

Recycling

Incinerating

Landfill

11. Have you heard of microplastics? *

Yes

No

12. Burning of plastics is harmful to the environment. *

Yes

No

Maybe

I don't know

13. Please indicate your level of agreement with each of the following statements: *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am aware of plastic waste reduction initiatives					

at the University of Birmingham					
The university provides enough facilities (e.g., bins, awareness posters, workshops) to support waste reduction.					
The university's efforts make me more likely to reduce plastic use.					

14. Microplastics are present in our daily consumables such as salt, bottled water, sea food. *

Yes

No

Maybe

I don't know

15. Have you ever heard of biodegradable plastics? *

Yes

No

C. Attitude and Behaviour (Questions 16 and 17 were developed by the researcher; Questions 18, 20, 21, 22, 23, 24 and 25 are based on Dilkes-Hoffman et al., 2019; Question 19 is adapted from Dowarah et al., 2022.)

16. Please indicate your level of agreement with each of the following statements: *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am willing to spread awareness about plastic pollution to my friends and family					
I take reusable shopping bags with me to the market/shop					

I am willing to pay more for biodegradable plastic alternatives					

17. Please indicate your level of agreement with each of the following statements: *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Lack of convenient recycling bins prevents me from recycling more often					
Plastic-free alternatives are too expensive or hard to find.					
I find it hard to change my plastic use habits due to lack of motivation or time.					

18. Please indicate your level of agreement with each of the following statements: *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
These days, too many items are made out of plastic					
If all plastic is recycled, there is no need to reduce my use of it					
If plastic food packaging reduces food wastage, that justifies its increased use					
Biodegradable plastic bags are easily available in the places I shop.					

19. How often do you litter when nobody is watching? *

Never

Rarely

Sometimes

Always

20.Please indicate your level of concern for each of the following:*					
	Not at all concerned	Slightly concerned	Somewhat concerned	Concerned	Extremely concerned
Plastic pollution in the oceans					
The amount of plastic waste produced daily					
Plastic being disposed of in landfill					
21. Please indicate your level of agreement with each of the following statements:*					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would like to reduce my use of disposable plastic					
I would like to reduce my use of plastic used in longer-term applications (buy items made from alternative materials)					
I have no control over how much disposable plastic I use					
22. Considering food packaging applications and bags: compared to normal plastics, do you think the following materials are better for the environment or worse for the environment?*					
	Much Worse	Somewhat Worse	About the same	Somewhat Better	Much Better
Paper					
Glass					
23. Please indicate how often do you do the following:*					
	Not often	Roughly 30% of the time	Roughly 50% of the time	Roughly 70% of the time	Very often (Roughly 90% of the time or almost always)
Reduce your use of 'on-the-go' plastic (e.g. bring your own take-away coffee cup, bring your own take-away container)					

Reduce your use of packaging (e.g. buy at a 'packaging-free, zero-waste' store; avoid packaged personal care products)					
Reduce your use of non-disposable plastic (e.g. replace plastic containers with glass, buy wooden household goods as opposed to plastic goods)					

24. For the following waste items produced by your household, please indicate what percentage you recycled/composted in the last year.

	0% (None)	25%	50%	75%	100% (As much as possible)
Plastic bottles/containers					

25. Please rate plastic food packaging against the following traits, from strongly agreeing to the left-hand side (-2 on the left- e.g., harmful) to strongly agreeing with the right hand side (2 on the right- e.g., beneficial).*

	-2	-1	0	1	2
Harmful/Beneficial					
Bad/Good					
Inconvenient/Convenient					
Not useful/Useful					
Bad for the environment/Good for the environment					

Opinion (Questions 26 are based on Dilkes-Hoffman et al., 2019; Questions 27, 28, 29, and 30 were developed by the researcher.)

26. Please indicate how responsible you believe each of the following parties (Government, Industry and Individuals) for reducing the use of disposable plastic.*

	Not at all responsible	Somewhat responsible	Moderately responsible	Mostly responsible	Completely responsible
The government (through legislation)					
Companies/industry (through deciding what packaging options to put on the market)					
Individuals (through their consumer choices)					

27. Please indicate your level of agreement with each of the following statements:*					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Peer influence or seeing other recycle motivate me to do the same.					
Educational campaigns or events (talks, posters, emails would improve my plastic-use habits.					
28. Please indicate your level of agreement with each of the following statements:*					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would be more likely to reduce my plastic use if the university offered a deposit-return scheme (e.g., getting money back for returning plastic bottles, like in Germany or Australia).					
Measures should be taken to reduce the use of single- use plastic items (e.g. shopping bags, straws...)					
29. In your opinion, what is the biggest barrier to reducing plastic use at the University of Birmingham?					
30. What could the university do better to support plastic waste reduction?					

Appendix B

Table A2. Interview Questions

Questions **(1)-(13)** (Roy, Berry and Dempster, 2022) ***I.*** *(Dilkes-Hoffman et al., 2019)* ***II-IV (****Janzik et al., 2023)* ***V-VI*** (*Steinhorst and Beyerl, 2021)* **A-I** Researcher generated	**Prompts**
(1) Please tell me a little bit about yourself • What is your age and gender identity? • Where are you from? • What are you studying? *(Encourage reflections on daily living and the role of plastic products).*	**C and O** *Do you have a busy life - do you work for example?* *Do you shop a lot, do you do all the shopping?* *Do you keep to a budget – is that important?* *(Encourage reflections on daily living and the role of plastic products).*
(2) What comes into your mind when you think of plastic and what we use it for? (optional) *I. Please record the first word/phrase that comes to mind when you think about the positive impacts of plastic/ negative impacts of plastic (Dilkes-Hoffman et al., 2019)* **A.** Do you know what plastic is made from and how long it persists in the environment?	**C and O** *If they can't think of anything – suggest thinking of food packaging, containers, children's toys, building materials, window frames etc.*
II. What is in your opinion the relationship between plastics and microplastics? (Janzik et al., 2023)	
(3) Who should do something about the problem of the build-up of plastic waste?	***O M*** *Ask who do you think is responsible, do they feel any personal responsibility*
	M

(4) What is the relevance of recycling in your life - is it a priority for you at all, and, if not why not?	*What would it mean to you if you were unable to recycle for example?* *Identity, values, moral responsibility*
(5) Can you describe your plastic recycling activities? **B.** Do you take the time to rinse things before recycling?	***C O M B*** *Ease with which they can separate waste, frequency, any barriers.(self-efficacy, confidence) local re-cycling service* *Would incentives encourage you to recycle more, should government do more?*
C. Do you know what soft plastic is? Are you aware that some supermarkets collect soft plastics for recycling? Have you ever taken soft plastic there? If not, would you consider doing it in the future? Why or why not?	
D. What factors influence your recycling behaviour (e.g., convenience, access to bins, awareness, peer influence)? *Explore their reasoning, trade-offs, and decision process.* **E.** Have your recycling habits changed since starting this course at university? If so, how? If not, why not? *Probe on success, failure, challenges, and what helped or blocked change.* **F.** Can you walk me through a recent situation where you had to choose between using plastic and avoiding it? What did you do, and why?	
F. What motivates you to reduce your plastic use? What makes it difficult for you to use less plastic, even if you want to? ***(****Environmental concerns, health, social pressure, cost, convenience, etc.)*	
G. Do you think incentives would encourage you to recycle more and should the government be doing more to support or motivate recycling? For example, in Australia there's a deposit scheme where people get money back for returning bottles and cans. Do you think something like that would work in the UK ?	

(6) Do you ever actively seek information that may help you recycle more?	***C M B*** *Have they looked for information on internet, phoned the council, any charity websites?*
(7) How do you feel when you report about plastic bottles washing up on beaches and plastic waste floating in the oceans?	**M** *Awareness of media campaigns and the effects. David Attenborough documentaries etc.*
III. How about human health? Have you ever thought about microplastics in people's bodies? (Janzik et al., 2023) *IV. Do you think people can control whether microplastics end up in the environment? (Janzik et al., 2023)*	
Currently most of the plastic we use is made from oil or petroleum. But the plastic or polymer industry is now pushing to develop alternatives to oil such as agricultural crops etc. They call these 'bio-based plastics.	
(8) What are your thoughts about replacing plastics made from petroleum with products manufactured using materials that are grown naturally such as corn for example?	*What pros or cons do you see with this new approach?* *Do you think we can save resources using these materials?*
(9) Some agricultural materials such as blood, feathers, carcass, and litter actually contain the building blocks for new materials. **How would you feel about using these materials to package food? How would you feel about using these materials for other things like carrying building materials or clothing?**	**M**

(10) As new materials emerge onto the market they are often, initially, more expensive. Would you be willing to pay for a product made from bio-based polymers or plastics?	**C O M** *How much if at all – 5% 10% 15% or more?*
(11) What are your thoughts about the idea that the introduction of bio-plastics will solve the issues related to plastic waste and the pollution it causes?	**COM** *Do you know what bio plastics are?* *What resources do you think might help you and others to do more? (Time, money, education, community initiatives etc.?*
(12) Would you buy, and use, food packaging made from sustainable plastics?	**COM** *Do you know what bio plastics are?* *What resources do you think might help you and others to do more? (Time, money, education, community initiatives etc.?*
V. What would have to change fundamentally in order to reduce the environmental intake of plastic? Imagine an ideal future scenario in 2030 and describe it as detailed as possible. (Steinhorst and Beyerl, 2021) *VI. Which aspects of the plastic topic need to be investigated better? Why? (Steinhorst and Beyerl, 2021)*	
H. What are the primary challenges students face in reducing plastic waste? **I.** Does the university provide sufficient facilities (e.g., bins, awareness posters, workshops) to support plastic waste reduction? If not, what improvements would you suggest?	
(13) Anything you would like to add that we haven't covered?	*If they ask for more information – provide a sheet with internet sites where they can get more information.*

Appendix C

Informed consent

Dear [Participant's Name],

Thank you for your interest in participating in my MSc Environmental Health dissertation study at the University of Birmingham.
You are invited to take part in a **qualitative research interview** titled:
"Consumer Attitudes & Behaviours Toward Plastic Waste"

Please read the information below carefully, keeping in mind that there are no right or wrong answers. The interview is simply meant to understand your experiences and opinions.

If you are happy to take part, kindly **reply to this email with the consent statement** at the end.

Participant Information
What is the study about?
This study explores student attitudes and behaviours regarding plastic waste and sustainable consumption. It focuses on:

- Student views on plastic waste
- Motivators behind consumption and disposal habits
- Attitudes toward sustainable lifestyle choices

Who can take part?
You are eligible if you are a current University of Birmingham student or a 2025 graduate (UG, PGT, or PhD).
University staff are not eligible.

What will participation involve?
- A **30–40 minute one-on-one interview conducted via Zoom**
- The interview will be **audio-recorded**, with your permission, to assist with accurate transcription and analysis
- You may choose not to answer any question and can withdraw at any time without giving a reason

Will my data be confidential?
All personal information will be kept **strictly confidential** and all transcripts and quotes will be **anonymised**.

Recordings and transcripts will be securely stored and accessible only to the researcher and academic supervisor. No identifiable data will be published.
The study complies with the Data Protection Act 1998 and the University of Birmingham's research ethics policies.

Will I be paid?
There is no monetary compensation. However, your contribution will support academic research on sustainability and student behaviour.

How will the results be used?
The findings will be presented in my MSc dissertation and may be shared in academic settings. An anonymised summary can be provided upon request.

Contact for questions:
Lucia Salcianu
MSc Environmental Health, University of Birmingham
lxs1054@student.bham.ac.uk

Consent Confirmation (please reply with this):

I confirm that I have read and understood the information provided about the study titled **"Consumer Attitudes & Behaviours Toward Plastic Waste."**
I understand that my participation is voluntary, and that I may withdraw at any time without giving a reason.
I give permission for the interview to be **audio-recorded** and for my anonymised responses to be used for academic research.
I understand that the interview will be conducted **via Zoom only**.

Name: [Insert Full Name]
Date: [Insert Date]
Availability for Interview: [e.g., weekday afternoons, weekends, etc. and hours]

Appendix D

Figure D1. Poster

Appendix E

Table E1. Codebook with description, exemplar quotes, subthemes, and final themes

Nr	Code	Description	Example quote (speaker)	Subtheme	Theme
AW1	Awareness and Uses of Plastic	Anything related to plastic associations and practical benefits (storage, shelf life, low cost).	"People use plastic to store food… some kinds of food you can't store in paper." (FS1)	Associations with plastic	Awareness and Perceptions
AW2	Marine Environmental Impact	Anything related to harms to oceans/wildlife; ocean litter.	"Plastic waste in the ocean… killing the fish… looks terrible." (MN2)	Environmental harm and emotions	
AW3	Impact on Human Health	Anything related to health effects from plastics/microplastics.	"Food/drinks in plastic bottles can affect people's hormones." (FS1)	Microplastics and persistence	
AW4	Ubiquity and Persistence	Anything related to pervasiveness and long persistence.	"There isn't a way of escaping plastics turning into microplastics." (MS3)		
AW5	Knowledge Gaps	Anything related to not knowing terms/materials/processes.	"Microplastics? … what's that?" (FN10)		
AW6	Emotional Responses	Anything related to sad/disgusted/defeated/optimistic reactions.	"A lecture on microplastics… was eye-opening." (FS5)	Environmental harm and emotions	
AW7	Awareness Pathways (Education/Media)	Anything related to awareness raised by lectures/courses/media.	"I'm more conscious because on the course we learned…" (FS7)	Science vs non-science awareness	
AB1	Pro-Recycling Attitude	Anything related to states recycling as important/priority.	"Recycling is a massive part of my life." (MS3)	Pro-environmental habits	Attitudes and Behaviours
AB2	Recycling Scepticism	Anything related to belief recycling is low-impact/ineffective.	"Recycling is a very tiny part of a huge picture." (FS1)	Convenience, cost and skepticism (negative pulls)	
AB3	Plastic Use Reduction	Anything related to uses reusables; chooses loose/glass; avoids plastic.	"I use cloth bags, my own cup, and my own straw." (FS6)	Pro-environmental habits	
AB4	Recycling Practices	Anything related to sorting; soft-plastic drop-offs; seeks correct bins.	"Soft-plastic bin at home; drop at supermarket weekly." (MS3)		

AB5	Context Dependent Behaviour	Anything related to behaviour varies by setting (uni vs home/country).	"On campus I separate waste; at home (Saudi Arabia) I use one bin." (FS5)	Convenience, cost and skepticism (negative pulls)	
AB6	Orientation to Convenience	Anything related to attitude that convenience matters (or is overcome).	"I don't see convenience as a goal; it's something to overcome." (MS3)		
BMR1	Barrierrs: Convenience and Access	Anything related to distance, signage, time, overflowing/lack of bins.	"Schemes aren't always convenient or well signposted." (FS7)	Barriers (support)	Barriers, Motivations and Responsibility
BMR2	Barriers: Cost	Anything related to cost/budget; won't pay more; price sensitivity.	"I'm not going to pay more… I care about my budget first." (FS1)		
BMR3	Barrier: Trust in Systems	Anything related to doubts that recycling actually happens.	"A proportion of recycling ends up in landfill or incineration." (FS7)		
BMR4	Barrier: Plastic Ubiquity	Anything related to plastic unavoidable in daily contexts.	"If you buy a takeaway, you'll be stuck with a plastic tub." (FN8)		
BMR5	Motivation: Price Signals	Anything related to small nudges (cup discounts, bag charges).	"In the UK I bring my own bag because you pay for plastic bags." (FS5)	Motivations and incentives	
BMR6	Incentive: Deposit Return	Anything related to deposit-return; reverse-vending machines.	"Reverse-vending machines… motivate students." (MN2)		
BMR7	Incentive: Discounts Rewards	Anything related to discounts, app points, take-back rewards.	"I would love to get discounts… returning old clothes." (N1)		
BMR8	Enforcement and Penalties	Anything related to checks/fines/strict sorting enforcement.	"If staff check and give a small punishment, maybe we will do it better." (FN10)		
BMR9	Price Parity Expectations	Anything related to will of act if same price/cheaper; refuses premium.	"If it's the same price I would; if more, I will not." (FS5)		
BMR10	Responsibility: Government	Anything related to government role: laws, funding, leadership.	"Government and companies… should take action." (FS1)	Responsibility (who should act)	

BMR11	Responsibility: Companies University	Anything related to retailers/campus roles in supply/availability.	"Shops and cafés on campus still sell everything in plastic." (FS7)		
BMR12	Responsibility: Individual	Anything related to personal duty/citizenship to act.	"It's my responsibility, but policy matters." (FN10)		
BMR13	Education as Motivation	Anything related to education/lectures motivate action.	"Lecture on microplastics… eye-opening." (FS5)	Motivations and incentives	
UNI1	Campus: More Bins Map	Anything related to more collection points and/or a campus recycling map.	"Put facilities in different locations… make a map." (FS1)	What helps (bins and clarity)	University Context and Targeted Recommendations
UNI2	Campus: Soft Plastic Points and Reverse Vending Machines (RVM)	Anything related to on-campus soft-plastic points or RVMs.	"Have reverse-vending machines on campus." (MN2)	Student-suggested campus interventions	
UNI3	Campus: Water Refill Infrastructure	Anything related to more outdoor water fountains; refill culture.	"Water fountains outdoors to encourage refilling." (MN4)	What helps (bins and clarity)	
UNI4	Campus: Reduce Plastic at Source	Anything related to reduce plastic at source in campus retail; plastic-free defaults.	"Reduce plastic on campus and make plastic-free options easier." (FS7)	Student-suggested campus interventions	
UNI5	Campus: Orientation for International Students	Anything related to onboarding for international students on UK waste streams.	"International students should get information on UK waste streams." (FN10)	What's missing	
UNI6	Campus: Posters Workshops and Email	Anything related to visible posters; workshops; email (beyond Canvas).	"Put something meaningful on big posters… optional workshops." (MS9)		
UNI7	Campus: Events and Community Norms	Anything related to litter-picks; peer modelling; student events.	"Silent litter pick was nice." (FS5)	Student-suggested campus interventions	
UNI8	Supermarkets: Refill/ Bulk Alternatives	Anything related to refill/bulk stations and alternative materials on supermarkets.	"Refill stations for cereal/detergent." (FS7)		

Table E2. Extra quotations organised by themes and sub-themes

Theme	Subtheme	Quotes
Awareness and Perceptions of Plastic Waste's Impact	Associations with plastic	*"People use plastic to store food and products. It's better than paper; for some kinds of food, you can't store them in paper or cardboard, so plastic comes with food products."* [FS1] *"Plastic is cheap to produce and keeps consumer prices low. It's good for keeping food products and giving them a longer shelf life by protecting them, but the caveat is that it's awful for the environment in the long term."* [MS9] *"Plastic is convenient and disposable, but it impacts the environment and sea life."* [FS5] *"Convenience is the first thing that comes to mind. I know plastic use comes at a detriment to our ecosystem."* [MN4] *"Wasteful would be the main thing. Plastic has good purposes—maintaining food for longer and packaging—but it's the sheer volume we use and how we dispose of it: one use and then you get rid of it. It's very unsustainable."* [FS7] *"You can recycle, but it's still going somewhere at the end of the day. The biggest control is to limit plastic use and try other materials like glass or metal."* [FS7] *"Thinking about plastic brings pollution, because a lot of plastics are single-use plastics."* [MN2] *"Thinking about plastic brings pollution, because a lot of plastics are single-use plastics."* [FN8] *"It's just everywhere; if you buy a takeaway, you're going to be stuck with a plastic tub.* [FN8]
	Microplastics	*"From my understanding, maybe microplastic items are more serious than plastic items because plastic items are big and visible so we can collect and recycle them, but microplastic is invisible and may get into the land, soil, and air and we could not handle it."* [FN10] *"Plastic infiltrates everything we have; plastics themselves are eternal and last an infinite amount of time. There isn't a way of escaping plastics turning into microplastics."* [MS3]

		"Microplastics are a by-product of plastics that break down over time or from heat or friction; they end up in food, in the oceans, and within humans, and it's a growing issue." [MS9] *"I use a lot of plastic containers for meal prep. I'm not sure how accurate this is, but when I heat them in the microwave, I think there's some release of microplastics that is potentially harmful."* [MN4] *"I've read research about how consuming food and drinks in plastic bottles can affect people's hormones, so it's better to avoid them if we can."* [FS1]
	Persistance	*"From my understanding, maybe microplastic items are more serious than plastic items because plastic items are big and visible so we can collect and recycle them, but microplastic is invisible and may get into the land, soil, and air and we could not handle it."* [FN10] *"Plastic infiltrates everything we have; plastics themselves are eternal and last an infinite amount of time. There isn't a way of escaping plastics turning into microplastics."* [MS3] *"Microplastics are a by-product of plastics that break down over time or from heat or friction; they end up in food, in the oceans, and within humans, and it's a growing issue."* [MS9] *"I use a lot of plastic containers for meal prep. I'm not sure how accurate this is, but when I heat them in the microwave, I think there's some release of microplastics that is potentially harmful."* [MN4] *"I've read research about how consuming food and drinks in plastic bottles can affect people's hormones, so it's better to avoid them if we can."* [FS1]
	Environmental harm	*"It's really sad, because without knowing we are affecting wildlife and animals in the ocean. The plastic floating on the surface is better because we can take it away; the problem is the plastic deep inside the ocean and in the middle of the water that can cause huge damage."* [FS1] *"It's not good for the environment, especially the air and the sea, because plastic is not easy to be absorbed, so maybe you have to burn it or put it on the ground."* [FN10] *"It's going to go to landfill and take hundreds of years to degrade—that's a big motivator. Plastic waste in the ocean killing the fish is not good, and it looks terrible thrown around."* [MN2]

		"Plastic is highly polluting. It really affects marine life, and also affects humans a lot more than we realize—blood cells and even male sperm." [MS3] *"Plastics thrown directly into the ocean affect marine life; the water quality reduces, and it affects people who are trying to enjoy the beach. It affects the overall ecosystem."* [FS6] *"Any plastic waste in the ocean killing fish is not good, and it looks terrible thrown around."* [FN8]
	Emotions	*"Seeing plastics floating in the ocean is very upsetting."* [FS5] *"When I see plastic bottles washing up and plastic waste floating in the oceans, I feel defeated, because an individual can only change so much. But I also feel a bit optimistic, because at least the plastic you can see can be dealt with, and there are companies dealing with microplastics."* [MS3] *"It's disappointing and sad to see plastics in the ocean—the wastefulness and disregard. People throw rubbish out of car windows; it's out of sight, out of mind, but it's still there."* [FS7] *"An advertisement from Korea about protecting sea animals was very vivid. After I saw that video, I really wanted to do better."* [FN10]
	Knowledge Gap	*"Have you heard of microplastics before? No, no, no—sorry, what's that?"* [FN10] *"I don't know what plastic is made from, but I know it lasts hundreds of years."* [FN10] *"No, I don't know what plastic is made from, but I know it lasts hundreds of years."* [FN8] *"Do you know what soft plastic is? No—is that like the foil on top?"* [FN8]
	Science vs non-science awareness	*"Have you heard of microplastics before? No, no, no—sorry, what's that?"* [FN10] *"Microplastics are a by-product of plastics that break down over time or from heat or friction; they end up in food, in the oceans, and within humans, and it's a growing issue."* [MS9] *"No, I don't know what plastic is made from, but I know it lasts hundreds of years."* [FN8] *"Do you know what soft plastic is? No—is that like the foil on top?"* [FN8]

		"From my understanding, maybe microplastic items are more serious than plastic items because plastic items are big and visible so we can collect and recycle them, but microplastic is invisible and may get into the land, soil, and air and we could not handle it." [FN10]
Attitudes and Behaviours toward Plastic Waste	Pro-environmental habits	*"Recycling is a massive part of my life. I keep a soft-plastic bin at home and once or twice a week I drop it at the supermarket. I don't buy crisps because the packets aren't recycled."* [MS3] *"Recycling is a priority. I'll often go out of my way to find the correct recycling bin."* [MS9] *"I try to reduce plastic: I use cloth bags, my own cup, and my own straw."* [FS6] *"I choose loose vegetables instead of ones packaged in plastic."* [FS6] *"I try to avoid buying things in plastic—choose fruit and veg without plastic, or glass rather than plastic."* [FS7] *"I started using shampoo and conditioner bars that come in cardboard; I buy them online because they're not always in shops."* [FS7] *"Back home, my family collected plastic bottles weekly and saved caps for a charity; here I use a refillable bottle."* [MN5] *"A positive point: if you use your own cup, you can get a small discount; in China we don't have this, so here I use my own cup to save money."* [FN10] *"In the UK I bring my own bag because you have to pay for plastic bags; back home I take the free plastic bags."* [FS5] *"I believe we should replace plastic with glass."* [FS1] *"I don't see convenience as a goal; I see it as something to overcome".* [MS3]
	Convenience, cost and skepticism	*"I would love to get discounts. For example, if I return my old clothes and they give me a discount because I'm kind of recycling."* [FS1] *"No to soft-plastic stores, because it makes the process more complicated and makes people lazy. Plastic is plastic—why can't we mix everything together?"* [FS1] *"I care about my budget first. I'm not going to pay more to save something I have no control over. It's supposed to be community action."* [FS1]

		"I would collect soft plastic from home if the drop-off is close; if it's far away, probably I won't." [FN10] *"If prices are similar, I choose Tetra Pak over plastic; if the difference is huge, I'll prefer plastic."* [MN2] *"Barriers are price, shared bins filling up, and time."* [MN2] *"Barriers include availability and placement of correct bins, and price. As much as I try, plastic is widely used and hard to avoid."* [MS9] *"If I'm being realistic, I won't give my time to take soft plastic to the supermarket."* [FS5] *"I wasn't aware that supermarkets collect soft plastic."* [FS7] *"Would I take soft plastic there? If I had a large quantity maybe, but probably not—it's extra effort and I'm not sure they really recycle it."* [FS7] *"I'm skeptical: sometimes councils send a proportion of recycling to landfill or incineration because they can't process it."* [FS7] *"Convenience and access to bins are big; supermarket schemes aren't always convenient or well signposted."* [FS7] *"Challenges for students are cost and time; cheaper things usually come in plastic; in Aldi, everything's in plastic."* [FS7] *"It's everywhere; if you buy a takeaway, you'll be stuck with a plastic tub."* [FN8]
	Recycling practices	*"Recycling is a massive part of my life. I keep a soft-plastic bin at home and once or twice a week I drop it at the supermarket. I don't buy crisps because the packets aren't recycled."* [MS3] *"At my previous campus, volunteers checked sorting very strictly. If you hadn't done it well, you had to take your garbage home and sort it again."* [FN10] *"My family has always been big on recycling and reducing waste. Recently it's been difficult because the council stopped collecting recycling bins."* [FS7] *"When you're out and there are only black bins, it's difficult to recycle."* [FS7]

	Context-dependent behaviour	*"It depends where you are. When I was in Saudi, because there were no recycling facilities, it wasn't my priority. Here it's a bit better, because there are facilities and the government cares, but I'll be honest: recycling is the least impactful thing. I don't think that will save our world."* [FS1] *"My awareness and knowledge have increased about the risk of plastic, but I can't say my behavior has changed, because in the city center there is no recycling area and even the rubbish place is mixed."* [FS1] *"In my home country I did better. Here in the UK, we don't divide kitchen garbage and general garbage, so I combine them."* [FN10] *"Recycling is my priority, but everyone is not perfect; sometimes when I am very busy or getting late, I throw it in the normal bin."* [MN2] *"I'll be honest: it's not a priority. On campus, if I see separate recycling bins, I'll use them. At home, I use one bin for everything."* [FS5] *"In Korea they take recycling seriously; where I'm from, everything is incinerated, so I'm not used to it."* [FS5] *"It's not a priority, but I try to recycle when I can. If there's no recycling bin around, I'll wait for the next one."* [MN4] *"I don't have a recycling bin at my dorm. I would drop soft plastics if I can collect them and it's on my way."* [MN4]
Barriers, Motivations and Responsibility	Barriers (support)	*"It's my responsibility, but city policy matters. Everyone is lazy; if no one checks, maybe we will not do it well. If staff or volunteers check and give a small punishment, maybe we will do it better."* [FN10] *"The challenge is informing people correctly; not all students are aware how recycling works in the UK."* [MS3] *"I'd pay up to about 15% or 20%, but students can't afford more."* [MS9] *"Governments will have to invest money, which they hate doing; that's a barrier to pushing biodegradable alternatives."* [MS9] *"If it's the same price, I would go for the sustainable option; if I have to pay more, I will not."* [FS5]

	Motivations and incentives	*"I would love to get discounts; for example, if I return my old clothes and they give me a discount because I'm recycling."* [FS1] *"If government would pay 70% or 80%, I would like to pay the rest. Government should fund scientists to develop more eco friendly materials."* [FN10] *"Community initiatives are important and motivate me. Education is very important so we know why we are doing this."* [MN2] *"Deposit schemes and small incentives motivate people; everyone would recycle more and even pick up plastics on the ground."* [MN2] *"Government agencies and nonprofits should spend on advertisement campaigns and incentives. If it gets to the point where people have to recycle, we might need to punish for not recycling."* [MS9] *"I like deposit schemes like getting 50p back; that would motivate me."* [FS6] *"Price equal bioplastic alternatives would help, and peer trends influence behavior."* [MN4] *"It's going to go to landfill and take hundreds of years to degrade—that motivates me to avoid it. Ocean waste killing fish is not good, and it looks terrible."* [FN8] *"Motivations are caring about the environment and protecting it for future generations, and the potential health implications of microplastics found in the body."* [FS7] *"Incentives like getting money back for bottles would encourage people, and local community schemes would also help."* [FS7] *"If it's the same price, I would go for the sustainable option; if I have to pay more, I will not."* (price parity as a motivator / deterrent) [FS5]
	Responsibility	*"I think the government and companies are responsible for everything—they affect the environment by producing these things. They should take action, not just individuals. If you encourage people, you will see good results."* [FS1] *"It's my responsibility, but city policy matters. Everyone is lazy; if no one checks, maybe we will not do it well. If staff or volunteers*

		check and give a small punishment, maybe we will do it better. [FN10] *"Travelers should take responsibility."* [FN10] *"As a citizen, I can use my own bag and cup, take food from home, and bring paper and boxes to recycling points."* [FN10] *"Government agencies and nonprofits should spend on advertisement campaigns and incentives. If it gets to the point where people have to recycle, we might need to punish for not recycling."* [MS9] *"Every person should be responsible, but generally the government is responsible for spreading awareness and strict laws and regulations."* [FS5] *"Maybe the government should make it more strict—penalties so people actually follow. Government policies should mandate bioplastics and make them available in markets."* [FS6] *"Responsibility is collective; other people's pollution affects me and mine affects others."* [MN4]
	Education as motivation	*"Community initiatives are important and motivate me. Education is very important so we know why we are doing this."* [MN2] *"Raise awareness for students and keep the university engaged with local sustainability groups."* [MS3] *"Education has to come first. Every behaviour change has to come with education—schools and households need to make people aware."* [MN4]

University Context and Targeted Recommendations	What is missing	*"We need to improve by putting facilities in different locations and making students aware of the places—make a map so students know where to bring things to recycle."* [FS1] *"International students should get information after coming to the UK about how to dispose of plastic and what materials we use. Many countries don't have different dustbins to segregate waste."* [FN10] *"Recycling bins are not as widespread in many areas. Awareness for students on campus and partnerships with local sustainable corporations would help."* [MS3] *"Put something meaningful on big posters about environmental awareness. Offer optional sustainability workshops or modules."* [MS9] *"On campus I see separate bins and events like the silent litter pick; more awareness and posters would be better."* [FS5] *"There aren't sufficient bins or many campaigns or workshops; stricter policies and making bioplastics available in supermarkets near campus would help. Deposit return on site would motivate people."* [FS6] *"In Germany I saw a scheme where you return plastic bottles and get your money back; if we had that, I would save bottles and deposit them."* [FS7] *"Ideal future: supermarkets offer biodegradable plastic where needed; loose items without packaging; more refill stations for cereal and detergent; more bin types including food waste."* [FS7]
	What helps	*"At the University of Birmingham I've seen many recycling facilities—even pottery, batteries, and wires—but students are not going to hold items all the time just to find a place to recycle them."* [FS1] *"Strict checking improved sorting at my previous campus; similar checks could help."* [FN10] *"I want my university to have reverse vending machines where people can give cans and bottles and earn money; it would automatically motivate a lot of students."* [MN2] *"Inform people correctly so they understand the environmental impact and the system."* [MS3]

		"On campus I see separate bins and events like the silent litter pick; more awareness and posters would be better." [FS5] *"When I came to the university, events gave cloth bags; that helped me reduce plastic."* [FS6] *"I've seen bins, but I'm not aware of workshops. Canvas is for assignments; I haven't seen anything about plastic there."* [MN4] *"Water fountains should be more widely available outdoors to encourage refilling bottles."* [MN4] *"Buildings provide a black bin and a recycling bin, so facilities are adequate, but shops and cafés on campus still sell everything in plastic. They could reduce plastic on campus and make plastic free options easier, so there's less reliance on disposal."* [FS7]