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The disruptive potential of importance-performance eduruption and transforming consumerism in single-used plastic reduction initiatives☆

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ABSTRACT

In an era demanding sustainable consumption, the challenge of single-used plastic (SUP) remains significant. This study delves into the transformative capacity of the Importance-Performance Eduruption method to reshape consumerism and encourage SUP reduction. Drawing on binary choice models, we elucidated the determinants influencing students' willingness to participate in SUP reduction initiatives. Beyond the quantitative metrics, the study highlighted the deep-seated influence of educational methods. Applied learning strategies like Problem-Based and Project-Based Learning emerged as influential touchpoints, aligning students with sustainable habits. Simultaneously, the importance-performance analysis revealed areas needing immediate intervention, notably research-oriented methods. Our findings spotlight the influential role education plays in driving sustainable consumer behavior. By integrating importance-performance insights into curriculum planning and broader policy frameworks, stakeholders can more effectively harness the disruptive potential of education to further the goals of Sustainable Development Goal 12 and create a more sustainable future.

1. Introduction

Single-use plastic (SUPs) consumption education emerges as a specialized domain within the broader spectrum of environmental education, with a sharp focus on augmenting awareness and catalyzing behavioral shifts concerning single-use plastics. This targeted educational approach is delineated from more encompassing frameworks such as education for sustainable development or consumer behavior education geared towards sustainable consumption. Central to single-use plastic consumption education is its emphasis on the environmental ramifications of disposable plastics, advocating for a concerted effort towards reduction, reuse, and recycling practices aimed squarely at mitigating this pressing environmental concern.

The consumption of SUPs has exponentially risen over the past few decades, posing significant environmental challenges. As oceans brim with plastic waste and landfills stretch to their limits, the consequences of our plastic-dependent lifestyles become palpably evident (Dilkes-Hoffman et al., 2019; Napper and Thompson, 2020). This escalating concern jeopardizes our ecosystems' health and compromises future generations' well-being. Recognizing the issue's magnitude, global frameworks like the Sustainable Development Goals (SDG 12, in particular) emphasize the need for sustainable consumption and production patterns, specifically reducing unnecessary plastic consumption. The role of education in shaping societal values and behaviors has long

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been recognized. However, SUP consumption education's potential as a transformative agent remains underexplored (Ebner and Iacovidou, 2021). Traditional teaching methodologies have often been siloed, detached from real-world challenges, thereby missing out on making a tangible impact on students' consumer behaviors. Given that younger generations are pivotal players in determining the trajectory of environmental sustainability (Kamenidou et al., 2019; Jerónimo et al., 2020), there's a compelling need to assess and refine educational strategies tailored to the issue.

Educational evaluation methodologies that have traditionally been compartmentalized, often detached from pressing environmental realities, limit their effectiveness in influencing consumer behavior. In response, there is an increasing recognition of the need to adapt and apply successful pedagogical strategies from broader educational contexts to reduce SUP usage. These strategies are applicable not only to SUP reduction but also to other critical areas of environmental concern. Active, hands-on problem-solving is foundational to effective environmental education. Pedagogies like Problem-Based Learning (PBL) and Project-Based Learning (PjBL) have been particularly successful in engaging students with sustainable development problems (Birdman et al., 2022; Carrió Llach and Llerena Bastida, 2023). These methods encourage students to engage directly with environmental issues, fostering a deeper understanding and commitment to sustainable practices (Bramwell-Lalor et al., 2020). For example, studies have shown that PBL and PjBL can significantly enhance students' awareness and proactive behaviors towards recycling and waste management (Ariati et al., 2021; Wibowo et al., 2021; Rachman and Toru, 2023; Juniati et al., 2024).

Furthermore, service-learning and collaborative learning have been instrumental in promoting community engagement and teamwork (Salam et al., 2019; Ansari and Khan, 2020; Zainuri and Huda, 2023), which are essential for addressing local sustainability challenges (Zainuri and Huda, 2023), such as community conservation efforts or the development of community gardens. The success of these pedagogies in fostering a sense of community and collective responsibility highlights their potential in broader environmental education contexts. Case-Based learning and simulations allow students to analyze and learn from existing environmental challenges and successes (Emblen-Perry, 2022). These methods help students grasp the complexity of ecological issues and the effectiveness of various interventions. On the other hand, reflective learning encourages students to consider their personal impact on the environment (Díaz-Iso et al., 2019), potentially inspiring significant changes in lifestyle and consumption habits. Field trips and interdisciplinary learning have also proven (Tal, 2001; Buldur et al., 2020; Arcodia et al., 2021; France et al., 2021; Kilag et al., 2023), effective by providing immersive experiences that deepen students' connection to natural environments and enhance their understanding of the interconnectedness of societal and environmental systems. The adaptability of these educational methods to address different environmental challenges underscores their critical role. They contribute to tackling the specific issue of SUP reduction and serve as a blueprint for comprehensive environmental education strategies aimed at cultivating a wide array of sustainable behaviors.

lThe current literature lacks a nuanced understanding of the complex dynamics between individual factors and pedagogical strategies in influencing students' readiness to engage in SUP reduction endeavors. Previous studies have often treated demographic and socio-economic factors as isolated variables influencing environmental attitudes (Kattoua et al., 2019; Jagun et al., 2022; Suryawan and Lee, 2023), a deeper exploration of how these elements interact with specific teaching methods is notably lacking. Moreover, the role of personal circumstances, such as daily expenditure patterns and living arrangements, remains under-examined in how they might augment or diminish the impact of pedagogical interventions. Furthermore, while the abstract importance and performance values attached to various educational methods provide a foundational understanding, the real transformative potential can only be unearthed by dissecting the interplay between these methods and the student's personal, academic, and socio-economic profiles. A more sophisticated examination is needed to discern the relationships and interactions between individual factors and pedagogical techniques and their collective impact on fostering a genuine willingness to participate in SUP reduction initiatives. This depth of investigation would offer a more comprehensive blueprint for educational institutions aiming to foster genuine and lasting pro-environmental behaviors among their students. Addressing this gap, the research question for this study on SUP reduction through educational initiatives is prominently stated:

How effective are different educational methods in influencing students' behaviors towards reducing the consumption of SUP?While numerous studies have addressed the environmental implications of SUPs and proposed diverse interventions for its reduction (Amenábar Cristi et al., 2020; Heidbreder et al., 2020; Fan et al., 2022), there is a conspicuous absence of research that fuses the pedagogical methods with sustainable consumer behavior, especially concerning SUP reduction. Current literature has delved into the broad roles of education in promoting sustainable habits (Ulhasanah and Goto, 2018; Liu et al., 2021; Jabeen et al., 2023), yet a granular understanding of which educational strategies resonate most with students in the context of SUP reduction remains elusive. Furthermore, the transformative potential of specific educational evaluation methodologies, such as the Importance-Performance Analysis (IPA) method, has scarcely been explored in academic literature (Nguyen et al., 2021; Phan et al., 2022), especially in the nexus of consumerism and environmental sustainability. Traditional pedagogical evaluations often focus on academic outcomes rather than the real-world behavioral changes they might engender. IPA is introduced as a strategic management tool designed to assess the effectiveness of an organization, program, or set of practices in alignment with their significance to stakeholders. Within the realm of educational research, IPA serves as a method to evaluate the efficacy of educational methods or programs in realizing desired learning outcomes or behavioral changes. The methodology encompasses the measurement of importance, evaluating the significance of various attributes or aspects of an educational program to its stakeholders, and the measurement of performance, assessing the program's effectiveness in relation to those important attributes. Additionally, IPA involves a gap analysis to pinpoint areas requiring improvement or adjustment based on the disparity between importance and performance. Applying IPA to SUP consumption education enables researchers to identify which educational strategies or components are most valued by participants in promoting sustainable behaviors towards single-use plastics. It allows for an assessment of how effectively these strategies are being implemented to achieve desired outcomes and identifies areas where educational approaches may need to be enhanced or refocused to better align with the goals of reducing SUP consumption.

The precise impact of this method in shaping not only the perceptions but also the actionable behavioral shifts towards reduced SUP consumption, remains under-researched. Moreover, while studies have explored demographic and socio-economic factors influencing pro-environmental behaviors, a comprehensive investigation is missing into how these factors, when intertwined with specific pedagogical strategies, affect the willingness to participate in SUP reduction initiatives. Against this backdrop, this study seeks to unearth the disruptive potential of the IPA method. By evaluating its efficacy in shaping students' perceptions and behaviors towards SUPs, the research aims to provide actionable insights for educators, policymakers, and environmental advocates. The overarching goal is to harness the power of education to foster a paradigm shift in consumerism, aligning it more closely with the tenets of sustainability.

1.1. *Indicator for education learning for SUP reduction initiatives*

The indicators for education learning in the context of single-use

plastic (SUP) reduction initiatives, as identified through the literature review, are operationalized in the survey to ascertain their effectiveness in fostering transformative learning experiences. Problem-Based Learning (PBL) and Project-Based Learning (PjBL), while distinct, share a commonality in their hands-on approach, driving students to confront and devise solutions for real-world environmental challenges, thus serving to disrupt conventional pedagogical practices by fostering direct action (Bes-Piá et al., 2023; Eny et al., 2018; Wróblewska and Okraszewska, 2020). Service-Learning, by immersing students in community service, creates opportunities for them to witness the direct impact of SUPs, thus solidifying their commitment to change, a crucial step towards sustainable behavioral change (Valsan et al., 2020; Azme et al., 2023). Collaborative learning disrupts traditional classroom dynamics by engaging students in joint problem-solving, fostering peer-to-peer engagement and innovation (Almajed et al., 2016; Crosby et al., 2018).

Case-Based learning, by presenting real-life success stories, acts as a powerful tool for illustrating the practical application of theory, providing relatable and tangible examples for students to learn from and implement in their own contexts (Chazara et al., 2016; Ballard and Mooring, 2021). Simulation, as an educational tool, offers a unique avenue to visualize the long-term impacts of SUP consumption, thereby altering perceptions and encouraging a reevaluation of consumption habits (Liu et al., 2023). By engaging in Research, students develop a deeper understanding of SUP issues, contributing to the discovery of innovative solutions, which positions this method as a significant disruptor to passive learning approaches. Reflective learning, through introspection on personal consumption behaviors, has the potential to challenge and change established habits, leading to more sustainable choices (Howell, 2021; Lee and Hales, 2022). Field trips extend learning beyond the classroom (Jones and Washko, 2022), offering experiential insights that can deeply influence students' perceptions and understanding of the SUP issue. Finally, interdisciplinary learning, by integrating diverse academic disciplines (Nakakoji and Wilson, 2020; Turner et al., 2024), offers a holistic view of the SUP problem, promoting a multifaceted understanding and a collaborative approach to finding solutions.

2. Method

2.1. Study area and respondent

This study was conducted on Java Island, Indonesia's economic and political nucleus, which is also a hub for the country's higher education. The research focused on five major urban academic centers: Jakarta, Yogyakarta, Bandung, Surabaya, and Surakarta (Fig. 1). As the capital, Jakarta is a critical economic zone with a range of leading universities that draw students nationally. Yogyakarta, known as the "soul of Java," combines its rich cultural heritage with a strong emphasis on education, hosting numerous universities that blend tradition with modern academic inquiry. Bandung, recognized for its cooler climate and historical significance, has a lively student community attending its prestigious

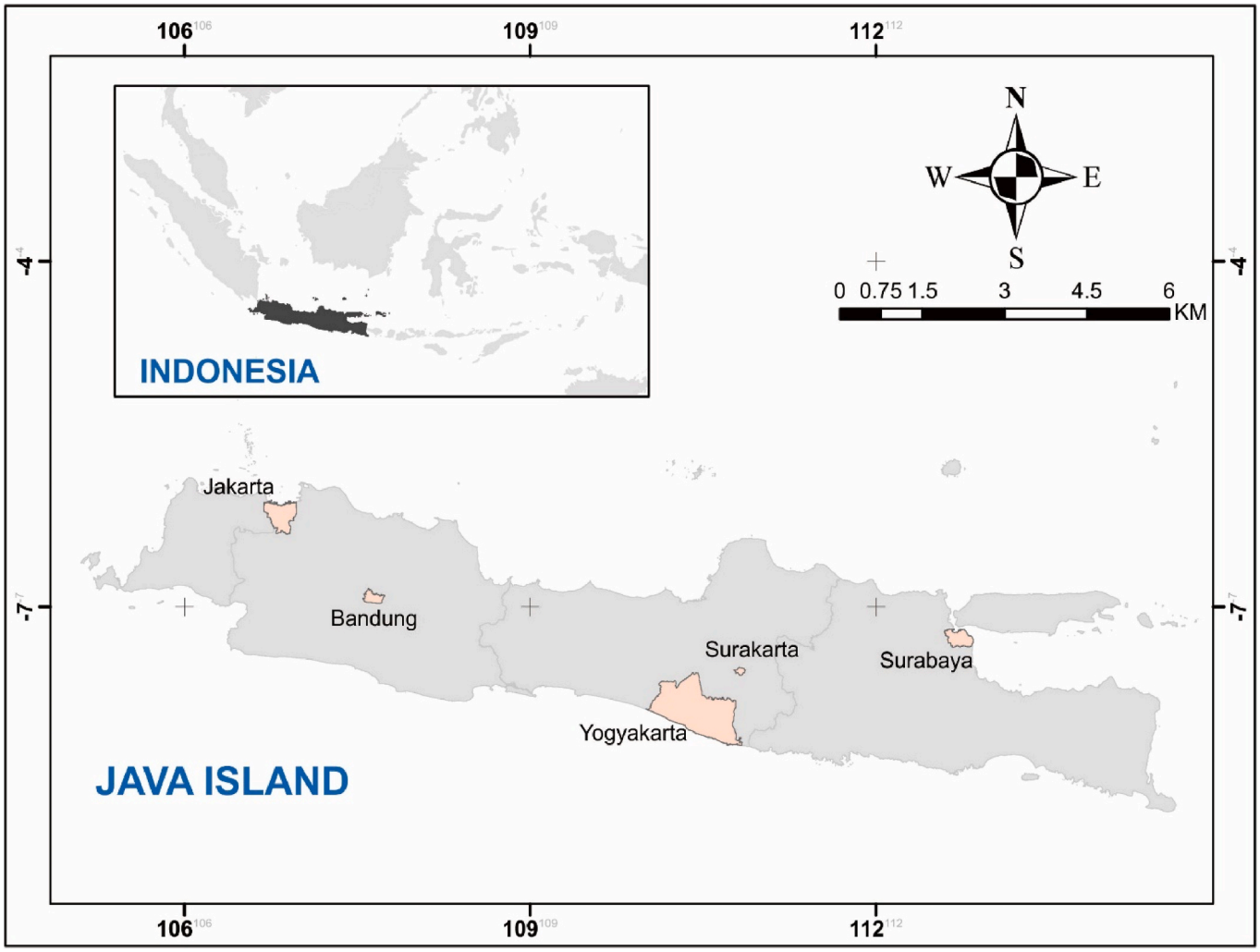

Fig. 1. Study location in Jakarta, Yogyakarta, Bandung, Surabaya, and Surakarta, Indonesia.

institutions. Surabaya, positioned to the east and notable for its status as a major port city, supports a dynamic educational environment with a diverse student body. Surakarta, or Solo, though smaller, is integral to Javanese culture and education.

This study specifically targeted students due to their vital role in promoting environmental sustainability. Recognizing that young individuals, especially those in higher education, are particularly receptive to innovative ideas and possess the capability to effect change in their communities, we tailored our recruitment process accordingly. We aimed to ensure a comprehensive collection of viewpoints across a diverse student body by employing a mix of purposive and snowball sampling techniques. This strategy enabled us to include students from various academic disciplines with differing levels of environmental awareness and influence within their peer groups, thereby enriching our dataset with a wide spectrum of insights for analysis.

To ensure a broad spectrum of student viewpoints, the study utilized a random sampling method across universities in these cities, targeting students from various academic backgrounds, years of study, and socio-economic statuses. This approach was selected to capture various perspectives and facilitate robust, generalizable insights into student attitudes towards SUP reduction across Java's varied university landscapes. The outcome of this sampling strategy was the successful surveying of 410 students from multiple universities, providing a rich dataset that underpins the study's findings. Through this diverse participant base, the research offers an in-depth look at student views on SUP reduction initiatives within Java's unique academic and cultural settings.

2.2. Questionnaire design and survey execution

This study is framed as an exploratory endeavor, predominantly centered on the perspectives of university bachelor's degree students towards SUP reduction initiatives to safeguard the environment. To this end, a meticulously designed questionnaire (Appendix) was forged, drawing inspiration from a comprehensive literature review, in-depth group interviews with relevant stakeholders (encompassed academicians, educators, and policymakers), and insights from a preliminary survey centered around SUP reduction initiatives. The finalized questionnaire integrated 10 indicators pertinent to SUP reduction initiatives (referenced in Table 1 for specifics).

IPA within this SUP reduction initiative, indicators refer to specific educational methods evaluated for their effectiveness in fostering sustainable behaviors (Phan et al., 2022; Suryawan and Lee, 2024b). These indicators assess both the importance and performance of each educational strategy. The importance of measurement considers how crucial each method is to stakeholders such as students, educators, and policymakers. This aspect evaluates the perceived significance of each pedagogical approach in contributing to SUP reduction efforts. Performance measurement, on the other hand, examines the effectiveness of these methods in implementation, precisely their success in raising awareness and encouraging behavior changes toward reducing SUP usage.

2.3. Survey execution

At the onset of the formal questionnaire, an elucidatory segment was dedicated to introducing the overarching objective of the survey and a detailed exposition of the research study. Paramount emphasis was laid on assuring respondents of anonymity, with a robust privacy statement being appended. When a respondent might have felt uncertain or sought clarifications regarding any question, the research team remained at their disposal to offer the necessary support. For clarity and comprehension, the survey was rendered in the region's official language and articulated in lucid, unambiguous terms. The first division of the questionnaire gravitates towards unraveling students' perceptions and inclinations concerning SUP reduction. This includes their propensity towards using sustainable alternatives, active participation in environmental conservation drives, advocacy for SUP-free campuses, preferences for eco-conscious products, and their willingness to participate in SUP reduction campaigns. The subsequent segment zeroes in on gauging students' perceptions of SUP reduction initiatives' Importance-

Table 1
Indicator for education learning for SUP reduction initiatives.

No	Indicator	Description	Supporting References
1	PBL (Problem-Based Learning)	Students are presented with real-world problems and are tasked with finding solutions. By presenting them with issues related to SUPs, they are made aware of the problem's magnitude and driven to find sustainable solutions.	Eny et al. (2018)
2	PjBL (Project-Based Learning)	This hands-on, dynamic approach to problem-solving is similar to PBL but typically involves more significant, more integrated projects. Students could design initiatives to reduce SUPs in their communities, promoting awareness and action.	(Bes-Piá et al., 2023)
3	Service-Learning	By working directly within communities, students can see the effects of SUPs firsthand. This direct exposure often results in a more substantial commitment to driving change.	(Valsan et al., 2020; Azme et al., 2023)
4	Collaborative Learning	In groups, students can brainstorm, challenge each other's ideas, and develop innovative solutions to combat SUP consumption.	(Almajed et al., 2016; Crosby et al., 2018)
5	Case-Based Learning	Examining real-life cases of communities or organizations that successfully reduced SUPs can offer students tangible examples to learn from and implement in their contexts.	(Chazara et al., 2016; Ballard and Mooring, 2021)
6	Simulation	Simulating the effects of SUPs on the environment (e.g., through software models) can help students understand the long-term implications of current consumption patterns.	Liu et al. (2023)
7	Research	Encouraging students to research the impacts of SUPs will deepen their understanding and commitment to finding alternatives.	Ghazali et al. (2021)
8	Reflective Learning	By reflecting on their consumption patterns and the broader implications of SUPs, students can develop a more personal connection to the issue.	Light and Seravalli (2019)
9	Field Trips	Visiting affected areas, recycling centers, or sustainable businesses can offer students practical insights into the SUP problem and its potential solutions.	Situmorang et al. (2020)
10	Interdisciplinary Learning	Addressing the issue of SUPs requires insights from various disciplines, from environmental science to economics to social studies. Promoting interdisciplinary learning gives students a holistic view of the problem and its potential solutions.	(Ali, 2019; Buregyeya et al., 2021)

Performance (I–P). Herein, respondents were solicited to express their perceptions regarding the I–P of the 10 above indicators, using a 5-point Likert scale ranging from 5 (signifying 'very important/strongly satisfied') to 1 (indicating 'very unimportant/strongly dissatisfied').

The concluding segment is an exercise in demographic data collection, capturing particulars like gender, the field of study, year of study, daily expenditure patterns, residential details, and any relevant course-related exposures they might have had. The survey's execution was orchestrated through face-to-face interactions in June 2023 across five major academic hubs on Java Island: Jakarta, Yogyakarta, Bandung, Surabaya, and Surakarta. A total of 410 students (Table 2) from diverse universities were pinpointed via systematic random sampling for these in-person interviews. Of these, a staggering 91.11% furnished complete responses, with a paltry 8.89% deemed ineligible for analysis due to incompleteness or inconsistencies in their answers. In each university, a student who met the criteria of being enrolled in a bachelor's degree program was selected for the interview. It's imperative to mention that the sample size in each city was meticulously determined in alignment with the student population metrics specific to those regions.

In our study, we employed a binary approach for surveying participants on their willingness to participate (WTP) in single-use plastic (SUP) reduction initiatives, explicitly categorizing their responses into two distinct options: "yes" or "no." This methodological choice was informed by the specific analytical needs of our research, which was structured around the use of logistic and probit models for data analysis. These statistical models are particularly well-suited for examining binary outcome variables, such as the willingness to participate in SUP reduction initiatives, as they allow for a detailed exploration of how different independent variables affect the probability of a participant's affirmative engagement in environmental actions. Several considerations drove the decision to utilize a binary response format. Firstly, it ensured the clarity and simplicity of the survey, facilitating ease of understanding and response from the participants. This was crucial for maintaining the integrity of the data collection process, as it minimized the risk of misinterpretation or confusion regarding the question being asked. Secondly, the binary format aligns seamlessly with the capabilities of logistic and probit models, which are designed to analyze inherently dichotomous outcomes. These models provide a robust framework for investigating the relationship between multiple predictors and a binary dependent variable, offering insights into the likelihood of an individual's willingness to act in favor of reducing SUP usage. By adopting this approach, our study efficiently captured and analyzed individuals' willingness to participate in SUP reduction initiatives, directly mapping this WTP to a binary outcome. This facilitated a focused analysis of the determinants of WTP, allowing us to identify and quantify the influence of various factors on participants' decisions to engage in environmentally beneficial behaviors. The binary nature of the data, combined with the analytical strength of logistic and probit models, enabled us to derive precise and actionable insights into the dynamics of environmental participation, contributing valuable knowledge to environmental behavior research.

Table 2
Socio-demography of respondent.

Attribute	Level	Frequency	Percent
Gender	Male	106	25.9%
	Female	304	74.1%
Daily Expenditure	Below IDR 10,000	24	5.9%
	IDR 10.000 - IDR 50.000	290	70.7%
	IDR 50.001 - IDR 100,000	76	18.5%
	Above IDR100,000	20	4.9%
Field of Study	Environmental Engineering, Environmental Science	28	6.8%
	Not related to the environment	382	93.2%
Have you ever taken a course related to the environment?	Yes	182	44.4%
	No	228	55.6%
Place of Residence	Apartment	4	1.0%
	Boarding	301	73.4%
	Live with parents	105	25.6%
Year of Study	1st Year	22	5.4%
	2nd Year	303	73.9%
	3rd Year	77	18.8%
	4th year and above	8	2.0%

2.4. Data analysis

The amassed data was meticulously processed through the SPSS software (version 26; SPSS Statistics Inc., Chicago, IL, USA). The primary step involved a comprehensive analysis of the university students' demographic details, delving into their perceptions and behaviors concerning SUP initiatives. Subsequently, we embarked on formulating the matrix framework, assessing the mean scores, and ranking the importance-performance (I–P) indicators of SUP initiatives. Further refining our data, we identified significant variances in students' perceptions of the I–P for SUP initiatives using paired sample t-tests, with a p-value less than 0.05 indicating statistical significance.

Leveraging the IPA approach, as described by Martilla and James (1977), allowed for spatially organizing our data into the IPA grid. Here, the I–P mean scores for SUP initiatives were plotted against the axes, with the X-axis representing students' perceptions of the performance and the Y-axis detailing their perception of an initiative's importance relative to the indicators of SUP initiatives. Based on previous research, four quadrants emerged from this analysis (Phan et al., 2022; Suhardono et al., 2024; Sutrisno et al., 2023a; Suryawan and Lee, 2024a). The "Keep Up the Good Work" quadrant consists of initiatives that students identified as very important, emphasizing the need for organizations to maintain their current performance levels in these areas. The "Concentrate Here" quadrant highlighted crucial areas students found essential but underperforming, signaling the need for significant improvement. The "Low Priority" quadrant contained initiatives the students viewed as less important and received modest performance evaluations. Lastly, the "Possible Overkill" quadrant captured fewer essential initiatives, yet their performance garnered favorable student reviews.

Delving deeper, we turned to the binary choice theory, using a Logistic Regression Model (LRM) to study students' participation in, perception of, and behavior towards SUP initiatives. Both logit and probit models were employed, probing how demographic variables like gender, field of study, year of study, daily expenditure, place of residence, and environmental course participation, along with their SUP perceptions and behaviors, influenced their willingness to participate (WTP) in SUP reduction programs. Four distinct models were developed. The model I, a logit model, had the dependent variable "WTP in SUP initiative", integrating demographic variables, SUP awareness, behaviors, and the overall importance mean of SUP solutions. Model II echoed the structure of Model I but incorporated the overall performance mean of the SUP initiatives. Model III and Model IV mirrored the structures of Model I and Model II but were framed using the probit model. Through these layers of analysis, the study aimed to comprehensively understand the intricate dynamics between student perceptions, SUP initiatives, and their underlying determinants.

3. Result

The Importance-Performance Analysis (IPA) is crucial to understanding how different pedagogical techniques are perceived in terms of their significance (importance) and how effectively they are executed (performance). From the data provided in Table 3, it's evident that different methodologies have varying levels of alignment between importance and performance. For instance, Problem-Based Learning (PBL) shows a moderate positive correlation, suggesting that as the perceived importance of PBL increases, its performance also tends to be

Table 3
Paired sample *t*-test alignment between importance and performance.

No	Indicator		Mean	Std. Deviation	Std. Error Mean	Correlation	p-value	t-value	p-value (2-tailed)
1	PBL (Problem-Based Learning)	Importance	4.271	0.758	0.037	0.553	< 0.001	1.182	0.238
		Performance	4.227	0.827	0.041				
2	PjBL (Project-Based Learning)	Importance	4.271	0.783	0.039	0.494	< 0.001	3.265	0.001
		Performance	4.139	0.838	0.041				
3	Service-Learning	Importance	4.078	0.838	0.041	0.542	< 0.001	−1.389	0.166
		Performance	4.134	0.870	0.043				
4	Collaborative	Importance	4.127	0.829	0.041	0.377	< 0.001	7.516	< 0.001
		Performance	3.734	1.040	0.051				
5	Case-Based	Importance	4.171	0.791	0.039	0.546	< 0.001	2.178	0.030
		Performance	4.088	0.826	0.041				
6	Simulation	Importance	4.134	0.791	0.039	0.410	< 0.001	2.322	0.021
		Performance	4.037	0.776	0.038				
7	Research	Importance	4.205	0.832	0.041	0.119	0.016	9.905	< 0.001
		Performance	3.588	1.053	0.052				
8	Reflective	Importance	4.000	0.821	0.041	0.378	< 0.001	2.646	0.008
		Performance	3.876	0.883	0.044				
9	Field Trips	Importance	4.032	0.928	0.046	0.431	< 0.001	5.300	< 0.001
		Performance	3.759	1.022	0.050				
10	Interdisciplinary	Importance	4.188	0.869	0.043	0.499	< 0.001	−2.775	0.006
		Performance	4.305	0.838	0.041				

rated higher. However, its p-value greater than 0.05 indicates this alignment is not statistically significant. On the other hand, Project-Based Learning (PjBL) also displays a moderate positive correlation. Still, with its p-value being significantly less than 0.05, it underscores a significant difference in perceptions, hinting at potential areas of improvement in its execution relative to its perceived importance. Service-Learning, like PBL, has a moderate correlation, indicating harmony between its importance and performance, but without statistical confirmation due to its p-value. Collaborative learning, with its weaker correlation, suggests a significant gap between how essential it is deemed and how well it is delivered, a sentiment echoed by its p-value of zero. Research, interestingly, has the weakest correlation, almost implying a disconnect between its perceived importance and performance. The zero p-value further confirms this significant difference, indicating a potential need to reevaluate how research is incorporated or delivered in the educational setup. This can be extended to other methodologies like case-based learning, simulation, reflective learning, field trips, and interdisciplinary learning. Each method, with its unique correlation and p-value, provides insights into areas of alignment or potential improvement. In essence, using a 5-point Likert scale captures these nuanced opinions, emphasizing the need for educators to focus mainly on methods with p-values less than 0.05, given the statistically significant misalignment between their perceived importance and execution (Phan et al., 2022; Sutrisno et al., 2023a).

The "Keep Up the Good Work" quadrant comprises (Fig. 2) educational evaluation methodologies proving their mettle, with both significant importance and satisfactory performance attached to them. Problem-based learning (PBL) pushes students to grapple with real-

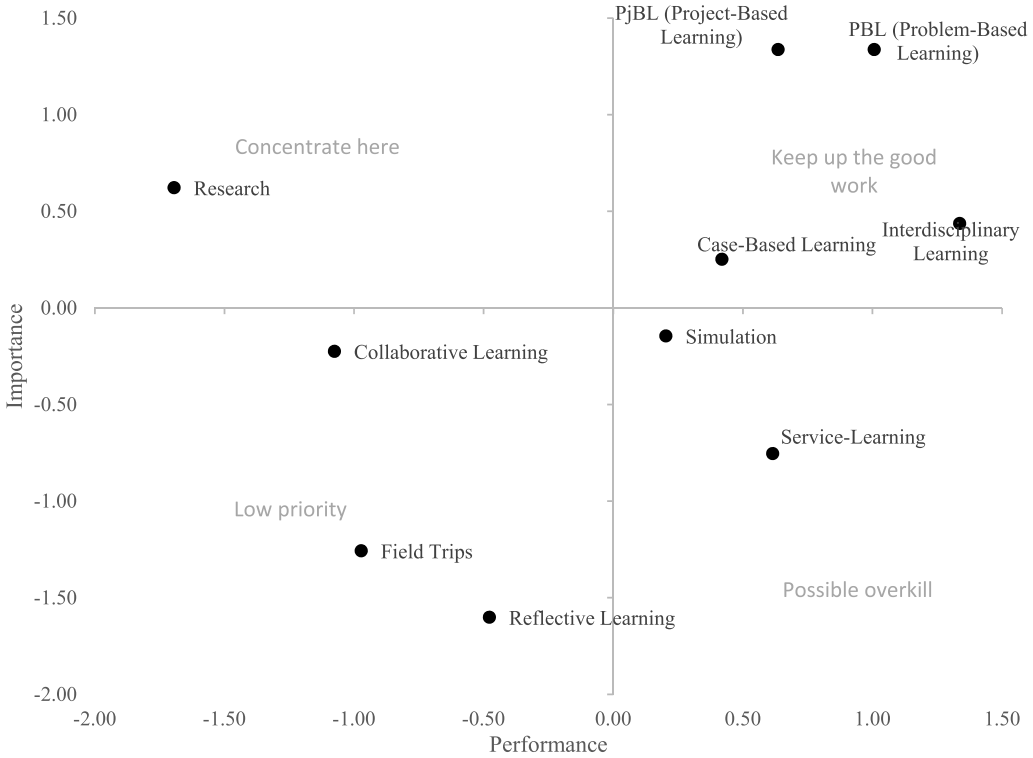

Fig. 2. IPA Grid for education learning for SUP reduction initiatives.

world challenges, precisely the tangible concerns of SUPs. This direct interaction with pressing issues heightens awareness and drives the pursuit of sustainable resolutions. Project-Based Learning (PjBL), while echoing the ethos of PBL, ventures further by encouraging students to craft expansive projects, potentially creating campaigns to curb SUP consumption in their locales. On the other hand, Case-Based Learning offers a retrospective lens, enabling students to dissect instances where SUP consumption was successfully diminished, thereby acting as a beacon for their endeavors. Lastly, interdisciplinary learning, with its all-encompassing perspective, becomes pivotal. Addressing SUP concerns mandates a multifaceted approach, drawing from various academic disciplines. This holistic mode of learning ensures students are not just tunnel-visioned but are equipped to appreciate the expansive implications and solutions related to SUPs. Contrastingly, the "Concentrate Here" quadrant homes the Research methodology. Diving deep into the intricacies of SUPs through rigorous research augments students' comprehension and solidifies their dedication to unearthing sustainable alternatives. Given its placement in this quadrant, it seems pivotal for educators to bolster how research is integrated and emphasized within the curriculum, making it resonate more deeply with its deemed significance.

The "Low Priority" quadrant comprises collaborative learning, reflective learning, and field trips. Collaborative learning is a crucible where ideas concerning SUPs can be molded, refined, and evolved through group brainstorming and discussions. On the other hand, reflective learning allows students to introspect, evaluate their consumption habits vis-à-vis the broader ramifications of SUPs, and foster a more profound, personal connection with the subject. By transporting students to sites like recycling hubs or eco-conscious businesses, Field Trips impart tangible insights into the world of SUPs. While these methodologies have distinct merits, their positioning in this quadrant hints that intensifying efforts here might not drastically uplift the overall educational landscape in the context of SUPs.

The "Possible Overkill" quadrant features simulation and service learning. Through simulation, students can extrapolate the future by visualizing the repercussions of unchecked SUP consumption, using virtual models to witness the environment's prospective plight. Service-learning places students amidst communities, making them firsthand witnesses to the dire straits induced by SUPs. Their direct involvement typically stirs a more profound conviction to instigate change. However, their placement in this quadrant prompts educational stakeholders to ponder whether the current emphasis on these methodologies might overshadow other pivotal areas.

The analysis described uses binary logistic (logit) and probit regression models to discern the factors influencing students' willingness to participate (WTP) in reducing SUPs consumption. Such models are adept at handling binary dependent variables like the WTP in this study, and they can unearth subtle relationships that other linear models might miss. Logit and probit models, both binary choice models, can sometimes yield similar results but are grounded in different mathematical foundations. The logit model draws from the logistic distribution, while the probit model is based on the standard normal distribution. These models consider the probability that an observation falls into one of two categories based on various independent variables. This research examined various predictors to comprehend their effect on student behavior regarding SUPs. Variables such as gender, daily expenditure, year of study, field of study, course relevance, place of residence, and the means of importance and performance from the IPA were considered. Each of these has its rationale, such as gender potentially determining differing environmental attitudes between sexes or the field of study gauging the influence of academic inclination on sustainable practices.

Table 4 showed Model I as a logit-based approach, rendered a Log-Likelihood Ratio (LLR) of 171.298, with an Akaike Information Criterion (AIC) per observation standing at 0.851 and a McFadden Pseudo R-squared value of 0.340. Its counterpart, Model II, another logit model, demonstrated a discernible improvement, recording an LLR of 219.495, an AIC per observation dropping to 0.734, and a McFadden Pseudo R-squared of 0.435. This suggests that the second Model fits the data better and does so with a potentially less complex model, as hinted by the lower AIC value. Venturing into the probit regression, Model III displayed an LLR of 179.029, an AIC per observation of 0.832, and a McFadden Pseudo R-squared of 0.355. Model IV, bearing close resemblance to Model II regarding enhanced performance, reflected an LLR value of 221.632, reduced AIC per observation at 0.728, and the highest McFadden Pseudo R-squared of the lot at 0.440.

The significance of these metrics lies in their capacity to gauge the models' efficacy. A higher LLR suggests a model that interprets the data more appropriately (Suryawan et al., 2024; Suryawan and Lee, 2023; Sutrisno et al., 2023b). In tandem, a lower AIC per observation indicates that a model does not just fit the data well but also does so without unnecessary complexity. While not directly analogous to the traditional R-squared in linear regression, the McFadden Pseudo R-squared provides insights into the proportion of variance the Model accounts for. Another critical metric is the Chi-squared test value (χ^2), provided as 14.067 at a significance of 1%. The fact that this value is lower than all the LLR values further authenticates the robustness of the models, substantiating that they are apt at explaining the variance in the dependent variable. Integrating these metrics, one can deduce that while all four models offer substantial insights into students' behaviors, Model IV

Table 4
Probit and logit model approach for willingness to participate.

Attribute	Probit				Logit			
	Model I		Model II		Model III		Model IV	
	Coef.	S.E	Coef.	S.E	Coef.	S.E	Coef.	S.E
Constant	−6.385[a]	0.712	−8.724[a]	0.893	−11.692[a]	1.386	−15.400[a]	1.718
Gender (Female = 1, otherwise = 0)	0.838[a]	0.177	1.010[a]	0.196	1.576[a]	0.320	1.864[a]	0.357
Daily expenditure (>IDR 50.000/day = 1, otherwise = 0)	0.741[a]	0.203	0.782[a]	0.224	1.494[a]	0.394	1.579[a]	0.447
Year of study (more than 2 years = 1, otherwise = 0)	0.759[a]	0.232	0.851[a]	0.242	1.608[a]	0.462	1.615[a]	0.457
Field of study (environmental related mayor = 1, otherwise = 0)	−0.166	0.338	−0.469	0.351	−0.469	0.643	−0.933	0.657
Course-related (Yes = 1, otherwise = 0)	0.825[a]	0.172	1.063[a]	0.192	1.549[a]	0.318	1.937[a]	0.358
Place of residence (Live with family, otherwise = 0)	0.682[a]	0.187	1.082[a]	0.216	1.357[a]	0.360	1.962[a]	0.403
Mean of IP	1.343[a]	0.156			2.434[a]	0.300		
Mean of PR			1.924[a]	0.200			3.365[a]	0.382
Goodness of Fit								
LLR	171.298		219.495		179.029		221.632	
AIC/N	0.851		0.734		0.832		0.728	
McFadden Pseudo R-squared	0.340		0.435		0.355		0.440	
χ^2 (df = 7, sig 1%)	14.067							

[a] significance at 1% levels.

(probit) emerges as the most fitting Model, albeit with a slender margin over Model II (logit). These findings can help educational institutions and policymakers tailor interventions that align with students' motivations and optimize their impact.

The statistical models presented in the table aim to predict the willingness of individuals to participate in SUP reduction initiatives. Four separate models are utilized: two probit models (I and II) and two logit models (III and IV). These models help to understand how various factors contribute to the likelihood of an individual's participation in SUP reduction efforts, summary of the key results from the models.

1 Gender (Female): Being female positively influences the likelihood to participate in SUP reduction across all models, indicating that women are more inclined to engage in such initiatives compared to men.
2 Daily Expenditure (>IDR 50,000/day): Individuals with a daily expenditure greater than IDR 50,000 show a higher probability of participating in SUP reduction activities. This could suggest that those with more disposable income are more willing or able to engage in these environmental efforts.
3 Year of Study (more than 2 years): Students who have been in their educational program for more than two years are more likely to participate in SUP reduction efforts, possibly reflecting increased exposure to environmental education or a greater sense of social responsibility as they advance in their studies.
4 Field of Study (environmental related major): Interestingly, the field of study does not have a significant impact on participation in SUP reduction according to the models. This might indicate that regardless of major, the propensity to engage in SUP reduction initiatives is not necessarily tied to one's academic focus.
5 Course-related (Yes): Individuals who have taken a course related to environmental issues or SUP reduction are more likely to participate in such initiatives, highlighting the importance of education in fostering environmental action.
6 Place of Residence (Live with family): Living with family appears to positively influence participation in SUP reduction, which may be due to the support or influence of family members in driving pro-environmental behaviors.
7 Mean of IP (Importance Performance): The higher the importance-performance score, the greater the likelihood of participation in SUP reduction initiatives. This suggests that when individuals perceive SUP reduction activities as important and are satisfied with their performance, they are more inclined to engage.
8 Mean of PR (Performance): In the models, higher performance ratings significantly increase the likelihood of participation, underscoring the role of effective SUP reduction activities in motivating individuals.

4. Discussion

Teaching-learning methods significantly influence the perceptions and behaviors of students, especially in the context of environmental consciousness and practices related to single-used plastics (SUPs). By deciphering which pedagogical methods effectively promote pro-environmental behaviors, educators can implement targeted curricula that lead to tangible positive outcomes (Liobikienė and Poškus, 2019; Kalla et al., 2022). In education aimed at promoting sustainability and combating issues such as SUPs, the "Keep Up the Good Work" quadrant is indispensable. This quadrant envelops teaching techniques that have garnered significant endorsement from students and demonstrated commendable performance in practice. The principal methods celebrated within this quadrant are Problem-Based Learning (PBL), Project-Based Learning (PjBL), Case-Based Learning, and Interdisciplinary Learning. These methods share a profound commitment to applied learning and an integrative approach at their core. They are not about passive absorption of information, they thrust students into real-world scenarios, demanding active engagement and application.

In SUP consumption, students might encounter a scenario involving the pollution of local waterways due to discarded plastics (Garcia--Vazquez et al., 2022). Instead of merely discussing the issue, they are tasked with diagnosing the root causes and brainstorming actionable solutions. The process is intrinsically collaborative, often requiring students to work in teams, harnessing diverse perspectives to arrive at innovative solutions. The real magic of PBL lies in its capacity to mirror genuine societal challenges. By grappling with the intricacies of such problems, students not only cultivate a more profound understanding but are often galvanized into tangible action. On a parallel but extended trajectory is PjBL. While PBL might terminate with a solution on paper, PjBL mandates the execution of the proposed solution (Ferreira and Canedo, 2020). For instance, after identifying the detrimental effects of SUPs in their community, students might design, plan, and initiate a community-wide campaign to replace SUPs with sustainable alternatives. It's a rigorous endeavor, demanding understanding, project management, communication, and advocacy skills. The end product is not just a theoretical resolution but a palpable change in the community.

While PBL and PjBL are future-oriented, aiming to equip students with tools to address impending challenges, Case-Based Learning is retrospective. It draws lessons from real-life instances where communities or organizations grappled with SUPs and emerged victorious. Such a method serves a dual purpose, including offering a blueprint for success and galvanizing students with tangible proof of change (Mansell et al., 2020; Raasok and Seland, 2021; Boyle, 2023). By dissecting these cases, students can glean insights into practical strategies, potential pitfalls, and the nuances of implementing sustainable practices in varying contexts. Lastly, Interdisciplinary Learning addresses the diverse nature of the SUP issue. Tackling the SUP menace is not solely an environmental endeavor; it encompasses economics, societal norms, behavioral, and more (Phan et al., 2022, 2023; Suryawan et al., 2023). An interdisciplinary approach ensures students are not myopic in their solutions, recognizing the economic implications of replacing SUPs, understanding societal resistance, and tailoring communication strategies accordingly. The "Keep Up the Good Work" quadrant doesn't just educate, and it transforms. They craft students who are aware of the SUP problem, equipped and passionate to combat it.

Unlike its counterpart, the "Concentrate Here" quadrant serves as an alarm bell, drawing attention to methods that might not be living up to their potential. Pre-eminently, the method of research casts a prominent silhouette within this quadrant. This positioning, counterintuitive at first, raises pertinent questions. Research stands as one of academia's strongest pillars (Shivakumar et al., 2022; Lisitskaya et al., 2023) Its placement here underscores a paradox: even as students acknowledge the importance of research in understanding the ecological, societal, and economic implications of SUPs, the method's actual delivery seems to fall short of expectations. Historically, research has been viewed as the touchstone of academic pursuit. It promises depth, rigor, and nuance, fundamental to any substantive study of environmental issues like SUP consumption. Its underperformance within the educational landscape of SUPs warrants a closer examination. One could postulate that the nature of research, often steeped in jargon and complex methodologies, might render it inaccessible to students. The dense statistical data, multifaceted models, and a barrage of terminologies could easily alienate learners, turning what should be a revelatory experience into a daunting one.

Then there's the challenge of relevance. SUPs, as an issue, is not locked within the confines of academia. It spills into politics, economics, culture, and everyday life. Purely theoretical research that doesn't tether itself to these real-world intersections might be perceived as detached, even irrelevant, by students. While students appreciate the profound insights research can offer, they might be grappling with its dense presentation, passive engagement, and perceived detachment from on-ground realities. To optimize the transformative impact of educational methods aimed at reducing single-use plastic consumption,

it is crucial that educators and program designers closely align the actual performance of each method with its perceived importance as indicated by the IPA Grid. This alignment is essential to harness the 'disruptive potential' of these methods, which refers to their ability to effectively challenge and change students' existing attitudes and behaviors towards SUPs.

For methods such as "Research," which the grid reveals as important yet underperforming, there is a clear imperative for enhancement. The underperformance might be due to a variety of factors, including but not limited to the method's integration into the curriculum, the resources available for students to conduct research, or the pedagogical approaches employed to teach research skills. To address this, targeted improvements could include the incorporation of more robust research projects that are directly tied to real-world SUP issues, improved access to research materials and platforms, and more intensive mentorship or workshop sessions to develop students' research abilities. Additionally, fostering partnerships with external organizations could provide practical insights and contexts for student research, potentially increasing engagement and the perceived relevance of their work.

The intersection and potential overlap between different educational indicators, such as interdisciplinary learning, PBL, and research, provide a rich area for discussion in understanding how these pedagogical strategies can collectively influence students' willingness to participate in single-use plastic (SUP) reduction initiatives. Interdisciplinary learning and PBL naturally intersect as both encourage the integration of knowledge from various disciplines to solve complex problems. This intersection is likely to enhance the effectiveness of each approach: interdisciplinary learning broadens the knowledge base from which students can draw upon to understand the multifaceted nature of SUP issues, while PBL provides a practical, problem-oriented framework through which this diverse knowledge can be applied. The synergy between these methods can deepen students' comprehension and foster a more holistic and actionable understanding of environmental challenges. However, the connection between interdisciplinary learning and research may not be as immediately apparent. Interdisciplinary learning tends to be broader, often involving collaborative efforts across different fields, whereas research can be more focused, delving deeply into specific aspects of a problem. Despite this, the research component is crucial for providing empirical data and rigorous analysis that can inform and validate the interdisciplinary approaches. Students engaged in research become better equipped to contribute substantively to interdisciplinary discussions, ensuring that proposed solutions are grounded in solid evidence.

Reflecting on the results from the IPA grid, it is evident that the effectiveness of these educational methods as perceived by students in terms of their importance and performance could be enhanced by leveraging their interconnections. For instance, if research is identified as an important but underperforming method, integrating it more closely with PBL or interdisciplinary learning could improve its effectiveness by providing a clearer context and application for the research activities. The inclusion of statistical models alongside the IPA grid analysis adds a quantitative dimension that complements the qualitative insights from the IPA grid. These models can help validate whether the perceived importance and performance of different educational strategies, as indicated by the IPA grid, translate into actual behavioral intentions, such as the WTP in SUP reduction initiatives. By examining how demographic and educational experiences influence these intentions, we can draw more nuanced conclusions about the effectiveness of each pedagogical approach. For example, if the models show that taking a course related to environmental issues significantly increases the likelihood of participating in SUP reduction, this could justify the high importance scores for course-related learning in the IPA grid. Conversely, if living with family is a strong predictor of participation, it may suggest that community-based or service-learning approaches, which often involve actions within one's immediate community or family, are particularly impactful.Understanding the factors influencing students' WTP in SUP reduction initiatives is crucial for shaping effective environmental interventions in academic settings. Each determinant, from gender to perceptions of importance and performance, provides a distinct lens into the complexities of student motivations. The gender dynamic, especially the female perspective, offers an intriguing insight. Sociological research has often pointed to women being more environmentally conscious and receptive to sustainability efforts than men (Jerónimo et al., 2020). The reasons could range from differing socialization processes to inherent nurturing instincts that extend beyond human relations to the environment. Within the realm of SUP reduction, this might translate to females being more predisposed to participate actively in such initiatives (Phan et al., 2022).

Daily expenditure, especially a benchmark like spending more than IDR 50,000/day, delves into the economic capacities of students. Those with a higher daily expenditure might have a broader financial leeway to make choices that favor sustainability (Geels et al., 2022; Sutrisno et al., 2023b), even if they come with a slightly higher cost. Their willingness to participate might be influenced by their capacity to afford alternatives to SUPs. A year of study is a surrogate for academic exposure and personal maturity. Students studying for more than two years will likely have had more encounters with discussions on global challenges, including the environmental implications of SUPs. Their prolonged academic tenure might have sensitized them to the urgency of the issue (MD and Aithal, 2022), prompting a higher WTP.

The influence of course-related factors cannot be overstated. Students who have taken environmental courses are not just academically informed but are likely more emotionally invested in environmental causes. Their structured exposure to the detrimental effects of SUPs and potential mitigation strategies might make them more enthusiastic participants in SUP reduction initiatives. Place of residence, mainly living with family, brings in the socio-cultural dimension. Familial values, discussions at home, and collective practices can significantly shape an individual's environmental consciousness. Living in a family setting that prioritizes sustainability might naturally incline students towards higher participation in SUP reduction. Lastly, when rated high, the Mean of Importance (IP) and Mean of Performance (PR) are barometers of students' perceptions and experiences. Students who perceive SUP reduction techniques as critically important might be more motivated to participate. Similarly, if they believe these techniques are being effectively executed in their milieu, it can reinforce their belief in the tangible benefits of participation, making them even more enthusiastic contributors.

4.1. Policy implication

The findings of this study provide a comprehensive understanding of the factors influencing students' willingness to participate in Single Used Plastic (SUP) reduction initiatives (Fig. 3). When juxtaposed with Sustainable Development Goal (SDG) 12, which underscores the need for sustainable consumption and production patterns, these insights illuminate policy frameworks for educational institutions, local governments, and broader stakeholders. An immediate implication of the study's results is the essential role of educational curricula in shaping sustainable behaviors. Given the pronounced impact of environmental course-related exposures on students' willingness to participate, educational institutions are poised to be significant catalysts in the march toward sustainability. By seamlessly integrating environmental and sustainability courses into their standard curriculum, these institutions can ensure that the principles of SDG 12 are familiar and relevant to all students, regardless of their field of study.

Furthermore, the study emphasizes the significance of applied learning in driving pro-environmental behavior. Strategies like Problem-Based Learning, Project-Based Learning, and Case-Based Learning resonate well with students due to their real-world applicability. Hence, an organic policy direction would be to encourage more institutions to adopt these learning paradigms, ensuring students understand the

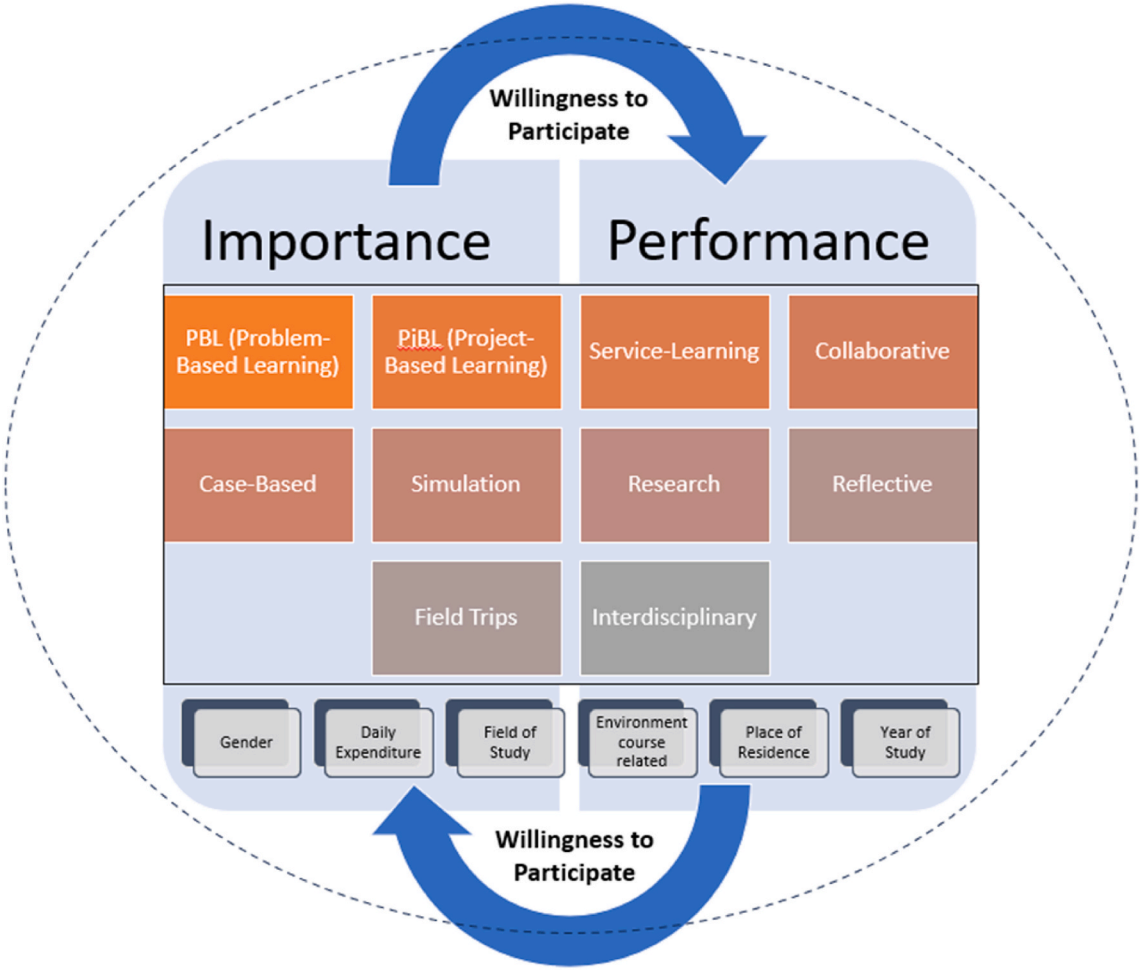

Fig. 3. Educational framewoek influencing students' willingness to participate in Single Used Plastic (SUP) reduction initiatives.

challenges of SUP consumption and feel equipped to address them.

Gender dynamics offer another intriguing policy dimension. The study suggests that female students might be more environmentally conscious or willing to participate in SUP reduction initiatives. This insight calls for creating gender-inclusive sustainability policies, perhaps even platforms where female students can lead and drive sustainability initiatives, thereby expediting the realization of SDG 12. Economic considerations, too, play a pivotal role (Suryawan and Lee, 2023). The association between daily expenditure and willingness underscores a need for policy maneuvers that provide financial incentives for students. This could manifest in various forms, from subsidies for eco-friendly products to grants for student-led sustainability projects.

Another noteworthy revelation from the study is the influential role of familial living conditions. This underlines the need for a multifaceted policy approach beyond educational institutions' confines. Engaging broader communities through workshops, seminars, and local sustainability projects could bridge the chasm between theoretical knowledge and its practical application, ensuring that the principles of SDG 12 permeate households and neighborhoods. Considering the students' appreciation of effective SUP reduction strategies, as evident from the high mean of importance and performance, it becomes apparent that institutional feedback mechanisms are paramount. A two-way communication channel, wherein students can voice their sustainability perspectives and offer feedback on institutional initiatives, could refine and enhance the effectiveness of SUP reduction endeavors.

In the Indonesian context, the effectiveness of educational methods aimed at reducing SUP consumption is significantly influenced by several key factors, including the availability of resources, teacher training, and the level of community involvement in environmental initiatives. The availability of resources plays a crucial role in the successful implementation of innovative educational methods such as PBL and PjBL. These approaches often require not just physical resources like materials and space but also access to digital technologies and platforms that can support interactive learning experiences. In Indonesia, the variability in resource availability across different regions and schools can impact the uniformity and effectiveness of these methods. Urban schools might have better access to resources, allowing for a more seamless integration of these methods, whereas rural and under-resourced schools may face challenges in their implementation.

Teacher training is another critical factor that determines the success of these educational strategies. The shift towards more active, student-centered learning approaches demands a departure from traditional teaching methods. This transition requires comprehensive training and professional development opportunities for teachers to acquire the necessary skills and confidence to facilitate these methods effectively. In Indonesia, where traditional rote learning has been prevalent, the need for teacher training becomes even more pronounced to ensure that educators are equipped to engage students in critical thinking, problem-solving, and collaborative work. Community involvement in environmental initiatives significantly enhances the impact of educational methods focused on SUP reduction. Service-Learning, for example, relies on strong partnerships between schools and local communities to provide students with real-world contexts for applying their learning. In Indonesia, community engagement in environmental issues varies widely, with some communities being highly active and others less so. The effectiveness of Service-Learning and similar methods, therefore,

depends on the extent to which communities are willing and able to collaborate with educational institutions. Successful initiatives often see schools working closely with local organizations, government bodies, and businesses to tackle environmental issues, creating a supportive ecosystem that reinforces the learning objectives.

4.2. Limitations and future research

Our survey design faced several challenges, particularly with the use of specialized terms like 'eduruption', 'importance', and 'performance'. We realized not all participants might fully grasp these concepts, despite our efforts to explain them. This was partly because everyone came from different backgrounds and had varying levels of prior knowledge about environmental issues. This situation showed us the difficulty of using complex terms in surveys and how they might affect people's responses. We also decided to use simple yes/no questions for parts of the survey to keep things straightforward. However, this approach might have oversimplified participants' true feelings or levels of commitment to reducing SUP. Real attitudes towards SUP reduction can be complex, and our yes/no questions may not have captured this complexity fully. Another concern with our survey was that it relied on participants reporting their own behaviors and attitudes, which could lead to biased responses. People might want to appear more environmentally conscious than they are, affecting the accuracy of our findings. Considering these limitations, future research could benefit from a more detailed approach, such as using a range of responses instead of just yes/no, and combining surveys with interviews or discussions. This would help us get a fuller picture of how people feel about SUP reduction and the effectiveness of different educational methods.For future research, it would be invaluable to delve into other influential factors not explored in this study, such as cultural attitudes towards waste, peer influence, or even the role of faculty in shaping students' environmental behaviors. Additionally, with the rapid evolution of educational technology, it would be worth investigating how digital tools and online platforms can be harnessed to enhance the effectiveness of SUP reduction education. Comparative studies across different countries or cultural groups can also shed light on universal best practices or region-specific strategies. Lastly, integrating qualitative methods, such as in-depth interviews or focus groups, can offer more prosperous, nuanced insights into student perspectives and the intricate dynamics influencing their willingness to participate in SUP reduction initiatives. Such mixed-method approaches can further strengthen the depth and breadth of our understanding in this crucial area.

5. Conclusion

The rising menace of SUP is indisputable, posing monumental environmental challenges and compelling individuals and institutions to seek sustainable alternatives. Universities, as the crucibles of learning and change, play an indispensable role in fostering an eco-conscious mindset. Our analysis underscores the effectiveness of integrative, problem-focused teaching methods in driving positive attitudes toward SUP reduction, as reported by the students. Techniques like Problem-Based Learning, Case-Based Learning, and Interdisciplinary Learning deeply resonate with students, enhancing their understanding of the multifaceted nature of the SUP crisis and empowering them to seek sustainable solutions. However, the disparity in the performance of research as a teaching method poses reflective questions. Even as research holds the key to a profound, nuanced understanding, its efficacy in influencing SUP reduction behavior, according to student feedback, remains constrained. This indicates a pressing need to recalibrate our approach, making research more accessible, applied, and engaging for students. Demographic dimensions including gender, daily expenditure, field of study, year of study, participation in environmental courses, and place of residence—significantly correlate with students' attitudes and behaviors toward SUP initiatives, emphasizing the importance of tailored educational strategies that resonate with diverse student profiles.Furthermore, leveraging the IPA provides a holistic view of areas of excellence and those requiring urgent attention. It acts as a roadmap, directing educational institutions on where to consolidate and where to innovate in their pedagogical techniques to foster a robust anti-SUP mindset. In the larger context, this study dovetails perfectly with Sustainable Development Goal 12, advocating for responsible consumption and production. By understanding the dynamics of students' willingness to participate in SUP reduction, as they perceive them, institutions can pioneer transformative change, channeling academic vigor toward a sustainable future. The journey towards reducing SUP consumption is multifaceted and complex. However, with focused educational strategies and a deep understanding of student perceptions, it promises significant strides in the right direction.

CRediT authorship contribution statement

I Wayan Koko Suryawan: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Laili Fitria:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Data curation, Conceptualization. **Nova Ulhasanah:** Supervision, Data curation, Conceptualization. **Iva Yenis Septiariva:** Writing – review & editing, Writing – original draft, Visualization, Validation, Formal analysis. **Wisnu Prayogo:** Writing – review & editing, Writing – original draft, Visualization, Validation, Data curation, Conceptualization. **Sapta Suhardono:** Writing – review & editing, Writing – original draft, Visualization, Validation, Investigation, Formal analysis, Data curation. **Mega Mutiara Sari:** Supervision. **Angga Dheta Shirajjudin Aji:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clrc.2024.100200.

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