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A COMPARATIVE STUDY ON KNOWLEDGE, ATTITUDE, AND BEHAVIOUR OF POLISH AND NEPALI STUDENTS TOWARDS THE CIRCULAR ECONOMY

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ABSTRACT: The framework of circular economy (CE) has emerged as a sustainable alternative to a waste-generating linear economy. To achieve this goal long term, it is important to educate youth. The levels of knowledge, attitude, and behaviour (KAB) among developed countries and developing countries differ. However, there are limited comparative studies. Our study investigates the KAB of university students of two countries – Poland and Nepal – to assess possible differences between developed and developing countries. The survey data were analyzed by applying descriptive statistics, t-statistics, and multiple regression models, with total sample of 166 participants. According to the survey, students in both countries possess knowledge, positive attitudes, and positive CE behaviour, with the knowledge level of Nepali students significantly higher compared to Polish students. In addition, the behaviours of students are correlated with knowledge and attitude. The findings also suggest that knowledge and attitude predict CE behaviour among students and students' KAB differs across their place of origin (rural and urban). The findings of this study may be useful for policymakers, students, and academic institutions.

KEYWORDS: circular economy, KAB, student(s), higher education, rural origin, urban origin

Introduction

Circular economy (CE) stands at the crossroads of economic and environmental sciences, aiming to bridge the often-conflicting goals of economic growth and environmental sustainability. CE focuses on adding value by minimising waste through the principles of 5Rs: reuse, reduce, refurbish, repair, and recycle, contrasting with the linear economy of take, use, and dispose (Dewi et al., 2022). The CE is a key component of the UN's 2030 Agenda for Sustainable Development, supporting global sustainability by reducing waste and environmental impact. By promoting resource efficiency, CE directly contributes to Sustainable Development Goals 12 ("Responsible Consumption and Production") and 13 ("Climate Action") (Rahman et al., 2023).

The implementation of CE is significantly considered in developed countries, but little attention has been given to low and medium-income countries (Halog & Anieke, 2021). However, it is necessary to implement CE practices in both developed and low and medium-income countries to achieve SDGs. Halog and Anieke (2021) suggested the successful implementation of the CE model in developed countries, which can be transferred to low and medium-income countries also. Likewise, Skvarciancy et al. (2021) also suggested the need for a CE framework for the OECD countries. Similar to developed countries, the CE framework helps in the sustainable development of developing and transition economies (Korhonen et al., 2018). Achieving environmental and climate protection requires the cooperation of multiple stakeholders, such as universities or the industry (Rushayani et al., 2023; Eagle et al., 2015). Collaborative actions across sectors, such as the agri-food industry, can foster the transition towards sustainable economies at both global and EU levels, involving regions and individuals (Szczepaniak & Zielinski, 2021). According to Laroche et al. (2009), however, the pro-environmental "green revolution" is driven mainly by consumers (which is why consumer knowledge is so important), so appropriate information strategies are needed to change consumer behaviour. According to Smol et al. (2018), consumer awareness is crucial for CE to work.

This article aims to assess differences in knowledge, attitude and behaviour toward the CE across various groups in both developing and developed countries: male – female, and or urban, semi-urban, and rural origins. The paper consists of an introduction, a literature review on environmental education, and the use of the Knowledge-Attitude-Behaviour (KAB) model as a measurement tool. The study also conducts a bibliometric analysis to identify gaps in research on environmental education themes using the KAB method, followed by an application of the KAB model to students in Poland and Nepal. The results are viewed with the use of varying theories on the subject.

The current state of environmental education

Given the pressing need to address environmental degradation and climate instability, educating young people about the negative impacts and mitigation strategies is crucial, as attitudes formed early in life have lasting effects. The growing scarcity of natural resources and rapid population growth underscore the increasing importance of environmental education (Carrier, 2007; Lloyd-Strovas et al., 2018).

The goal of improving environmental literacy was formulated in the Belgrade Charter (United Nations, 1975). This document states that its central components are knowledge, attitudes, as well as skills, motivations, and commitment, especially regarding schools and higher education (ibid.). The Tbilisi Declaration further emphasised the need for environmental literacy to be interdisciplinary, multidisciplinary, or holistic (Lloyd-Strovas et al., 2018; Eagle et al., 2015). The case for CE education was raised in the UN's "Written statement for the global consultations on the circular economy" (United Nations, 2021), while the EU supports 56 projects supporting CE education for both youth and adults, including multiple guides, knowledge exchange hubs, and games, which are available on its European Circular Economy Stakeholder Platform (European Commission, 2021).

Research on CE awareness among EU youth is limited, with notable studies conducted in Poland's Małopolska region (Smol et al., 2018). Their research found that positive attitudes towards CE among Małopolska inhabitants correlated with higher education levels and, inversely, with age. Similar findings were cited in Lloyd-Strovas et al. (2018) regarding environmental literacy among educated and in Corbos et al. (2023) regarding age and environmental awareness regarding energy saving, as well

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as differences between different countries and lack of general tendencies between countries overall. Laroche et al. (2009) also point out that cross-country differences regarding pro-environmental attitudes and behaviour are not well documented in the scientific literature. These differences can depend on the background, age, etc.

The KAB model, originating from psychological research, is widely used to operationalise environmental education (Martin & Simintiras, 1995). It has also been applied in fields such as finance (Yudha & Pradana, 2022), tourism (Shen & Yang, 2022), and healthcare (Alves, 2023; Lotfi et al., 2019). This model emphasises how knowledge attainment, belief formulation and behavioural change interact (Liu et al., 2019; Liu et al., 2016). Unlike traditional approaches such as the Health Belief Model and the Theory of Planned Behaviour, which focus on direct predictors of behaviour, the KAB model (Ma et al., 2021) emphasises the role of knowledge as a predictor of attitudes and behaviour. A typical view of the structure of the KAB model includes an analysis of the impact of underlying factors on knowledge, the impact of that knowledge on attitudes and behaviour, and the role of attitudes in forming behaviour (Marklinder et al., 2022). This comprehensive approach provides a more subtle understanding of the factors that influence behaviour change and the pathways through which knowledge and attitudes are translated into action (Alves, 2023). The increase in knowledge, attitude, and behaviour (KAB) through learning was observed during experiments by Carrier (2007) and Aliman et al. (2019). Different methods may improve the state of KAB. Aliman et al. (2019), applying the EarthComm learning program, have shown increasing the environmental behaviour of students. According to Carrier (2007), the role of a teacher and the teaching infrastructure are especially impactful for the learning process.

Knowledge, attitude, and behaviour of researched students regarding environment and CE

The scholarship so far differs with outcomes regarding the measurement of KAB features on CE. Dewi et al. (2022) found high KAB levels among students, contrasting with other studies. Ma'ruf et al. (2016) reported high environmental knowledge among students but lower levels of attitude and behaviour. The study of Rahman et al. (2023) has shown students' high knowledge and behaviour towards CE, with an intermediate level of attitude. Fabrigar et al. (2006) report various studies that claim that a high amount of environmental knowledge is a better predictor than a low amount of environmental knowledge. There are several explanations for that, such as higher stability of the attitude being an outcome of higher knowledge or that attitude-relevant knowledge is highly correlated with other features, such as certainty.

Lloyd-Strovas et al. (2018) noted only 52% and 56% of familiar and factual environmental literacy among undergraduate students, with 40% of students not passing (grade F), and only 19% of students receiving a score of 60% or higher. The average score for attitude and behaviour were respectively 63% and 44%, thus being low. Only attitude received an average passing grade. Rushayani et al. (2023) showed that two groups of tested students (49 and 44) had low levels of environmental knowledge, while no tested students were classified as of poor attitude, with overwhelmingly almost 90% of high behavioural scores in one school, and other schools obtaining mainly good and moderate scores.

According to the findings of Eagle et al. (2015), overall tested students considered major environmental issues as beyond their control and were unwilling to implement significant behavioural changes to mitigate their impact on the environment. Laroche et al. (2009) claim that even knowledgeable students might not be aware of their negative environmental impacts. Moreover, some people may consider their engagement in environmental preservation as futile, and shift the responsibility solely toward the governments or corporations (Laroche et al., 2009). Similar results were obtained by Eagle et al. (2015), where tested students claimed that the government has the main responsibility for dealing with environmental problems, which was also a relevant theme in previous studies. Also, there is a link between consumers not willing to pay a premium for "green" products and those who do not believe that they can impact the environment with their deeds. Eagle et al. (2015) continue that there is a disconnect between personal liability and the perception of global consequences for the environment, linking it to the Systems Justification Theory (i.e. although people

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want to maintain a sense of security, they rarely take responsibility for maintaining it themselves – also regarding particular topics, such as the environment).

Group differences regarding KAB in environmental and circular economy education

Outcomes of different CE and environmental KAB research may contradict each other, as some research indicates that good knowledge and attitude are followed by pro-environmental behaviour (Aliman et al., 2019), while some earlier research (see: Laroche et al., 2009) shows that knowledge and attitude are good predictors of the behaviour. Aliman et al.'s (2019) research indicates that this does not have to be the case, claiming that motivation (which is not a part of the KAB model) has the highest impact on environmental behaviour. In the research of Rahman et al. (2023), the level of behaviour towards CE was higher than the attitude toward it. Also, Laroche et al. (2009) cite the conflict between different studies, some of which claim that attitudes and behaviours are weakly linked, while others claim that they are strongly linked, which can depend on the cultural background of the studied people. While environmental education is regarded as important, some studies show that the association between education and environmental knowledge is not statistically significant, the differences between different cultures regarding their knowledge might be a consequence of some of these "traditional conservation ethics" while other cultures might be lacking it (Ma'ruf et al., 2016). Eagle et al. (2015) continue that for instance, familiarity with a topic does not have to translate into certain behaviour regarding it. The differences can also be due to the background of the studied sample groups, such as gender, country of origin, or ethnicity.

Multiple studies have shown that female students respond with higher scores regarding their environmental awareness compared to male students, who, on the other hand, obtain higher knowledge scores, as in a series of studies mentioned by Dewi et al. (2022). The same results were obtained by Lloyd-Strovas et al. (2018), and similar results were obtained by Carrier (2007) when testing school children, but with no differences regarding behaviour. Some also show similar male and female attitudes regarding behaviour or attitude (Dewi et al., 2022).

It is not entirely clear whether different components of the KAB framework impact each other uniformly. According to Dewi et al. (2022), there is a correlation between knowledge and attitude, attitude and behaviour knowledge and behaviour, although based on their literature review, it is still unclear whether there is a correlation between environmental knowledge and attitude, and its application in the form of environmental behaviour. For instance, Ma'ruf et al. (2016) have shown that the impact of environmental knowledge and attitude on environmental behaviour might be limited.

The differences can occur even within certain countries, depending on different ethnic groups. Laroche et al. (2009), researching KAB differences between French- and English Canadians, discovered – contrary to their expectations – that French Canadians score higher on all of these features than their English counterparts (although English Canadians practice recycling more and pay a premium for ecological products). French Canadians were more knowledgeable on environmental issues than Anglophone Canadians, and the former had overall more pro-environmental attitudes than the latter. According to researchers, this could be due to the rising economic status of French Canadians since the previous research from the mid-90s or due to more communitarian-oriented attitudes of French Canadians. Yet, the second argument does not explain why there was a shift in the strength of their pro-environmental attitudes. Also, the research accepts the hypothesis stating that French Canadians are engaged less in pro-environmental activities, which can be a consequence of their more self-indulgent lifestyle. Finally, researchers state that there was no significant link between the knowledge and attitudes of the researched groups.

Laroche et al. (2009) claim that mainly the attitude explains the willingness to pay a premium for ecological products. Meanwhile, there are also other reasons for consumer choices, which have to be accounted for. Pro-environmental behaviour can be, to a certain extent, forced by financial necessities. For instance, according to Corbos et al. (2023), energy consumption can be curbed by the need for saving, thus impacting consumers' behaviour. As for Smol et al. (2018) research, 22-29% of respondents value the price of services from the sharing platforms (which are considered as a part of CE), indicating a potential financial attractiveness of the CE model, although 70% of respondents

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do not see value in the sharing economy. Eagle et al. (2015) agree that, overall, people do not implement in their daily life pro-environmental behaviours if it causes inconvenience in their lives, they might change their behaviour if there is a financial incentive to do it.

Research gap

The reviewed literature presents a lack of clear resolution on the KAB tendencies among different groups, although more often, females tend to prove themselves to score better on the attitude and behaviour scale, while males on the knowledge scale. Results of Smol et al. (2018) indicate that although knowledge regarding the environmental impact of resource overuse in the region of Malopolska is high, awareness and behaviour are low in this regard. Aliman et al. (2019) claim that environmental problems are especially relevant in developing countries due to pollution and resource exploitation. To investigate these differences, our study compares two countries – Poland and Nepal – which, according to the OECD ranking, are respectively developed and developing (OECD, 2020). To our knowledge, this kind of comparative research has not been performed so far.

Moreover, the goal of our research is to investigate what are the differences regarding these among students of different origins. Owojori et al. (2022) point out that environmental education of the rural youth is often neglected in the research. To our knowledge, previous research measuring the circular economy KAB did not take into account the differences stemming from the place of origin, being a significant research gap.

Bibliometric analysis

To understand the trends and focus areas in Knowledge, Attitude, and Behaviour (KAB) research, a bibliometric analysis was conducted using data from Scopus and Web of Science. We identified 593 articles in Scopus and 157 in Web of Science and subsequently merged and deduplicated the data using RStudio's Bibliometrix library (Aria & Cuccurullo, 2017). Due to missing data, 59 publications from Scopus were omitted, leaving 534 papers. No data points were excluded from the WoS database. The merger and deduplication process excluded 126 documents, resulting in a final merged database of 565 papers, indicating significant overlap between the two databases. From 1492 keywords, 51 met the threshold of appearing at least five times. Notably, sustainability and environmental education are not central themes in KAB research, as depicted in Figure 1.

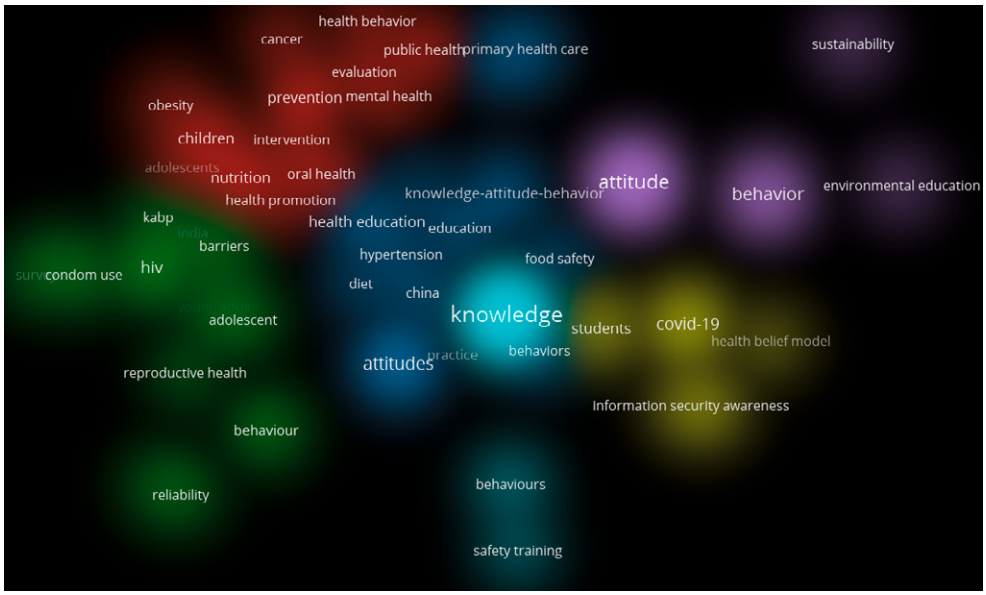

Figure 1. Clusters of keywords in the Knowledge, Attitude, and Behaviour literature

Source: authors' work generated in the software VOSviewer.

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Table 1 reveals that KAB research predominantly focuses on health education and promotion. A smaller portion addresses sustainability, highlighted in cluster 5. It is worth noting that often this research focuses on the youth (see keywords in clusters 1 and 2).

Table 1. Keywords regarding KAB research with the cluster division

Cluster	1	2	3	4	5	6	7
Keywords	adolescents, cancer, children, evaluation, health behaviour, health promotion, intervention, mental health, nutrition, obesity, oral health, prevention, public health	adolescent, barrier, behaviour, condom use, hiv, hiv prevention, India, KABP, reliability, reproductive health, survey, validity, young adults	attitudes, behaviours, China, diet, education, food safety, health education, hypertension, knowledge-attitude-behaviour, primary healthcare, qualitative research, questionnaire	COVID-19, health belief model, information security awareness, KAB model, students	attitude, behaviour, environmental education, sustainability	behaviours, knowledge, safety training	practice
Common theme	Youth health promotion	Disease prevention	Health Education	Health behaviour research	Sustainable behaviour attitudes	Safety awareness	n/a

Source: authors' work based on outcomes generated by the VOSviewer software.

The themes of sustainability and environmental education were occurring in the research before the third decade of the 21st century, yet they were foreshadowed by strictly health-oriented research, also due to the impact of the COVID-19 pandemic on the research (Figure 2).

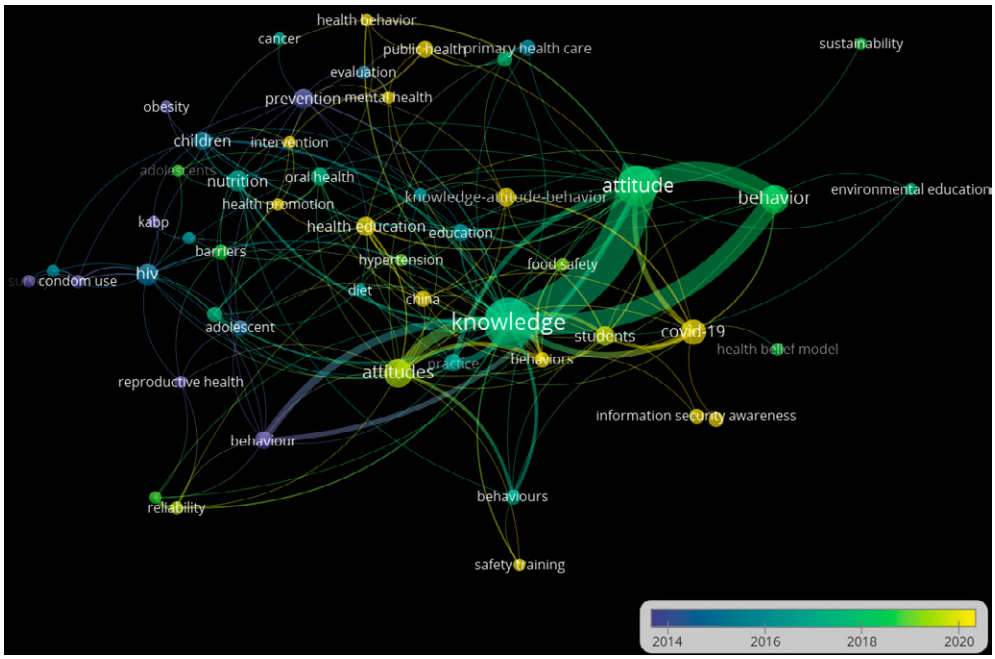

Figure 2. The evolution of scholarship using the KAB method, 2014-2020

Source: authors' work generated in the software VOSviewer.

Theoretical lens

As shown in the section with bibliometric analysis, the majority of studies using the KAB model are focused on health and healthcare. Regarding the application of the KAB model in environmental studies, it was used in several studies on fashion, specifically slow fashion (Seock et al., 2024) and green apparel (Dhir et al., 2020), besides themes of environmental literacy and CE. Our study applies the KAB framework, which structures questionnaires with separate categories for questions regarding

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all three mentioned components, the same as Dewi et al. (2022), and Rahman et al. (2023), and utilises the same questionnaire. Similarly to Dewi et al. (2022), our research attempts to answer the questions of the co-influence of KAB on the CE with relation to gender, but expands it by place of origin (rural and urban). Literature on the KAB model regarding environmental knowledge claims that in general higher levels of environmental knowledge lead to higher attitudes towards the environment, or differently – higher environmental attitudes translate to increased ecological behaviour, although there were examples of poor translation of knowledge towards behaviour (Ma'ruf et al., 2016).

As Corbos et al. (2023), the choice of youth for the research on environmental impacts is especially relevant as they will have the greatest long-term impact, or as Dewi (2022) mentions – they are agents of change. According to Smol et al. (2018), as the CE concept is quite new, CE awareness among youth has to be monitored to develop appropriate long-term strategies. Lloyd-Strovas et al. (2018) point out that if people have ingrained environmental awareness during their college years, they act accordingly throughout their lifetime. We have selected sample populations from one university in Poland and one in Nepal. According to Laroche et al. (2009), selecting one area makes the availability of different resources (such as green products) even. Although Smol et al. (2018) show that most research on CE awareness comes from China, the majority of the research reviewed in our article comes from Indonesia (see: Ma'ruf et al., 2016; Rahman et al., 2023; Rushayani et al., 2023; Rosviani et al., 2022; Aliman et al., 2019; Dewi et al., 2022).

Environmental KAB was previously constructed with Likert scales of different widths. Rushayani et al. (2023) used only a 3-level Likert scale (good, quite good, not good), with the use of the Mann-Whitney U Test to find out the difference between the two tested groups. Eagle et al. (2015), Lloyd-Strovas et al. (2018), and Rosviani et al. (2022) used a 5-point Likert scale, while the first one also expanded it by one more, sixth answer possibility. Lloyd-Strovas (2018) also suggested using an even number of answers (precisely six) in future research to decrease the number of problems arising from odd-number scales in the statistical analysis.

Method

This study employed a quantitative research design, utilising a survey approach to enhance statistical power and generalizability (Jones et al., 2013).

Study area and sample

The survey was done among higher education students from environmental engineering, management, and IT departments at Tribhuwan University in Kathmandu, Nepal, and economics and finance students from Warsaw University of Life Sciences, Poland. The data were collected using a Google Forms[1] online survey in the period of late February and March 2024. The Nepali students answered in English and Polish students answered in Polish. The total sample collected was 166. The sample distribution in Nepal and Poland is shown in Table 2.

Table 2. Country-wise sample distribution

Country	Sample	Percentage (%)
Nepal	96	57.8
Poland	70	42.2

[1] English version: https://docs.google.com/forms/d/1s6FhTmuOVn31xqZVQYl_NWla-BS6HbxHQc-2XOpYsk/edit Polish version: https://docs.google.com/forms/d/13bvhBlxSn8JK9dVZ2P4x2-dYjrfSr8ydzTvQEDJFAeg/edit

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Scale Construction

The scales for knowledge, attitude, and behaviour were adapted from Dewi et al. (2022). The knowledge scale included seven items, such as saving water and electricity and preferring glass to plastic packaging. The attitude scale also comprised seven items, including buying used items and using online systems for business. Similarly, the behaviour scale had seven items, like carrying a shopping bag and limiting new purchases. All items were rated on a six-point Likert scale. This study ensured reliability and validity, which are explained in the next section.

Reliability, validity, and limitations of the method

Pilot testing was done among 20 students in Nepal to ensure reliability. The Cronbach Alpha value was calculated to check the reliability. The Cronbach Alpha value of 0.545 was estimated to ensure moderate reliability of the scale constructed (Taber, 2018). Likewise, to ensure validity, as suggested by Cohen et al. (2007), content validity, construct validity, and criterion validity were checked. Since the scale for this study was adopted along with the literature review, this ensured content and construct validity. The result of this study was compared and contrasted with other studies. Similar results were achieved in other studies. Thus, this ensured criterion validity.

The model itself also cannot fully explain the linkages between knowledge, attitude, and behaviour, as some attitudes may be identified as strong and consequential, while others not, or even the difficulty of proving that knowledge itself influences attitude and behaviour (Fabrigar et al., 2006). Moreover, although survey data collection is widely used for KAB research, McKenzie et al. (2018) identify a difference between possibly self-reported and observed behaviour, as well as the difficulty of collecting the data for the identification of the observed behaviour.

Data Analysis and Ethical Considerations

For data presentation, this study used descriptive statistics (mean value and standard deviation). This study utilises an independent sample t-test, as well as correlation and multiple regression analysis. The collected survey data was processed in the SPSS software.

For ethical considerations, this study followed the suggestions of Gallardo (2012). Full disclosure was required to obtain prior consent for data collection. Moreover, neither harm nor gain of any kind was inflicted upon the respondents. Lastly, each respondent received the same treatment.

General results

As for the demographic distribution, most of the respondents (i.e. from both Nepal and Poland) were female (59.6%) as compared to male (40.4%). Likewise, most of the respondents come from urban (48.8%) and semi-urban areas (18.7%), while substantially less from rural areas (32.5%) (see Table 3).

Table 3. Demographic distribution

Gender	Frequency	%	Locale	Frequency	%
Male	67	40.36	Urban	81	48.8
Female	99	59.64	Semi-Urban	31	18.67
			Rural	54	32.53

For the evaluation of the KAB survey scores, a mean score interpretation, presented in Table 4, was used, similar to the research by Rahman et al. (2023). The assessment value was used in Tables 5 to 9.

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Table 4. Mean score interpretation

Score range	Interpretation
1.00 – 2.33	Low
2.34 – 3.67	Intermediate
3.68 – 5.00	High

Source: Rahman et al. (2023).

Table 5 provides the summary statistics for the overall knowledge scores. All the items for knowledge have a mean score higher than 3. This shows that, on average, surveyed students possess at least intermediate and, in general, a high knowledge of CE. This is confirmed by the overall average value of 3.83 for knowledge.

Table 5. Summary statistics of the knowledge

S. No.	Knowledge scale	Mean	SD	Interpretation
1	Saving water and electricity every day is a circular economic effort.	3.04	1.658	Intermediate
2	Reusing/recycling goods in a circular economy does not only aim to reduce waste on earth, but the most important thing is to reduce the exploitation of natural resources.	4.08	0.834	High
3	5R (Reuse, reduce, refurbish, repair, recycle) behaviour is a basic principle in the circular economy.	4.27	0.680	High
4	The circular economy view (5R) opposes the conventional economic view, namely production-use-waste in order to reduce acts of exploitation of nature.	3.86	0.876	High
5	Good waste management and reduction of various types of waste support a circular economy.	4.01	0.905	High
6	A circular economy emphasizes a business owner to be responsible for people's welfare.	3.90	0.840	High
7	Choosing drinks packaged in glass bottles rather than plastic is a circular economy effort.	3.69	1.025	High
Knowledge average		3.83		High

Similarly, Table 6 provides the summary statistics for the attitude. The average altitude is 3.31. This shows that surveyed students have a positive attitude towards the CE. Although the majority of scores regarding attitude can be classified as intermediate, there are also several mean scores which can be classified as high. The overall average can be assessed as a higher-end intermediate.

Table 6. Summary statistics of the attitude

S. No.	Attitude Scale	Mean	SD	Interpretation
1	I think that sorting household waste based on organic (wet waste) and non-organic (plastic, metal, glass) groups is wasting time because at the Final Disposal Site (TPA) all waste will be mixed again.	3.03	1.589	Intermediate
2	I think that it is better to buy used stuff than a new one (thrifting).	2.86	1.372	Intermediate
3	Using the cheapest possible raw materials to reduce production costs is very important in running a business, even though these materials are a high risk for the consumers.	2.58	1.667	Intermediate
4	If I have a business, I will consider whether the product or packaging can be reused or recycled even though it is more expensive to produce.	3.01	1.504	Intermediate

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S. No.	Attitude Scale	Mean	SD	Interpretation
5	If I have a business, I will use an online-based system.	3.81	1.001	High
6	Programs in the universities should teach how to be an entrepreneur who cares about the environment (reducing waste and pollution; prolonging the life of products and materials; and supporting the regeneration of the natural systems).	4.16	0.901	High
7	I find it better to repair a broken item than to buy a new one.	3.67	1.011	High
Attitude average		3.31		Intermediate

Likewise, Table 7 provides the summary statistics for the behaviour. All the items for behaviour have mean scores of more than 3, showing overall positive behaviour on the CE of the surveyed students. This is confirmed by the overall average value of 3.52 for behaviour. The breakdown of answer scoring was qualified the same as with the attitude (three answers qualified as high, four as intermediate). Still, the overall average was slightly higher than the attitude.

Table 7. Summary statistics of the behaviour

S. No.	Behaviour Scale	Mean	SD	Interpretation
1	I am used to carrying my shopping bag when shopping.	3.70	1.193	High
2	I only buy new things when needed.	3.98	1.015	High
3	I am used to renting the things I need instead of buying.	2.87	1.425	Intermediate
4	I still own and use the clothes I bought more than 5 years ago.	3.08	1.515	Intermediate
5	I am used to giving used items to other people instead of throwing them away.	3.80	1.115	High
6	I am used to bringing water bottle with me when I travel instead of buying bottled water.	3.66	1.234	Intermediate
7	I try not to throw away items that are consumable but I try to reuse them (for example by changing their function, giving them to someone else, or selling them).	3.55	1.173	Intermediate
Behaviour average		3.52		Intermediate

Comparison of results between Poland and Nepal

The t-test showed that there was a significant difference in the knowledge of Nepali students (M = 4.15, SD = 0.37) compared to Polish students (M = 3.39, SD = 0.44). The tested knowledge level of Nepali students was significantly higher compared to Polish students with $t(164) = 12.077$, $p<0.05$. However, there is an insignificant difference in attitude and behaviour between Polish students and Nepali students attitude in favor of Polish students, while in behaviours in favor of Nepali students.

In Nepal, there was a significant difference in the attitude of male students (M = 3.40, SD = 0.65) compared to female students (M = 3.10, SD = 0.69). The attitude of male Nepali students is significantly higher compared to female Nepali students with $t(94) = -2.07$, $p<0.05$. However, there is an insignificant difference in knowledge and behaviour among Nepali male and female students. As the gender breakdown for the same questionnaire was provided in the research by Dewi et al. (2022), the full comparison of Poland and Nepal – with the addition of Indonesian outcomes by Dewi et al. (2022) – is presented in Table 8.

In Poland, there is no significant difference in attitude, knowledge, and behaviour among Polish male and female students, although interestingly females were scoring higher on knowledge, and males were scoring higher on the attitude – contrary to most of the literature reviewed.

While analysing combined both countries, there was a significant difference in the knowledge of male students (M = 4.05, SD = 0.50) compared to female students (M = 3.68, SD = 0.53). The knowledge of male students is significantly higher compared to female students with $t(164) = -4.41$, $p<0.05$,

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although this data should be analysed separately, as Nepali male students obtained higher knowledge scores than female students, while in the Polish case, the results appeared conversely there is an insignificant difference in attitude and behaviour among Nepali male and female students. Moreover, with the addition of the Indonesian data, the different country samples show overall intermediate-to-high KAB, with smaller differences among them (Dewi et al., 2022). Overall, Indonesian students have scored the highest, with Nepali as the second and Polish students having the lowest averages overall.

Table 8. Breakdown of the KAB scores depending on gender

KAB	Gender	Nepal	Poland	Nepal + Poland	Indonesia
Knowledge	Male	4.19	3.22	4.05	4.00
	Female	4.09	3.41	3.68	4.18
Attitude	Male	3.40	3.45	3.40	3.65
	Female	3.10	3.30	3.22	3.76
Behaviour	Male	3.50	3.15	3.45	3.77
	Female	3.66	3.49	3.56	3.88

Source: authors' own work based on Dewi et al. (2022).

An interesting complement to this research is the analysis carried out by students' backgrounds on the rural and semi-urban/urban axis, yielding interesting results (see Table 9). Regarding the Polish sample, the students of rural origin have shown results of higher knowledge and attitude, with lower self-reported behaviour (on behaviour, it was the students of semi-urban place of origin who reported the lowest), while in Nepal students of rural origin scored the highest only in the category of the attitude, but also scoring almost as high on knowledge and behaviour as their urban counterparts. These differences are not big, but they might show some tendencies. It is interesting to contrast with some other studies, which claim lower knowledge, attitude and behaviour of the rural populations regarding the environment. It has been pointed out that urban residents show more interest in environmental issues compared to those living in rural areas (Jones et al., 1999; Yang, 2020), even with claims that rural dwellers may have an "anti-environmentalist orientation" (see: Jones et al., 1999). This trend was also evident in areas such as environmental awareness (Lin et al., 2010), especially in the beginning of the publics' growing concern over the environment, with only in the later years rural dwellers' "catching up" to attitudes of urban dwellers (Jones et al., 1999). These differences are explained by two different theories:

Differential exposure theory – awareness of urban dwellers is higher than rural dwellers, because they have higher exposure to environmental degradation. These differences diminish as the problem is framed locally rather than nationally, as local problems more strongly affect the research population (Jones et al., 1999; Sharp & Tucker, 2005). Moreover, the differences between urban and rural dwellers can be caused by the access to information, thus pointing towards the government as the institution which can effectively disseminate the information also to the rural areas (Wang et al., 2022). At the same time, it can be seen that in the case of Nepal, higher knowledge of the students originating from urban areas does not translate to higher behaviour and attitude. On the contrary, behaviour and attitude scores of the Nepali youth were higher among those originating from the rural areas. In Poland, the knowledge and attitude were higher among the students originating from the urban areas – whether in the developed countries the urban–rural information barrier is diminished, e.g. due to the widespread internet, would have to be further researched.

Environmental Deprivation theory – presents a similar perspective, which claims that urban dwellers display higher concern over the environment, as they suffer from higher levels of pollution (not only air or waste pollution, but also noise pollution) (Dudek & Landmesser-Rusek, 2023; Sharp & Adua, 2009; Zhang et al., 2024), but also due to the higher resource abundance, urban dwellers would have better education on the environmental issues (Dudek & Landmesser-Rusek, 2023).

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Similar observations can be traced in the research by Yang (2020). Although the CE questionnaire indirectly implies behaviour, the questionnaire used in our research does not investigate the intentions of the surveyed students.

Extractive theory – due to dependence on resource extraction from their immediate environment, rural dwellers' treat the environment in a more utilitarian way (Jones et al., 1999; Sharp & Adua, 2009). Sharp and Adua (2009) expand on this view, claiming that the extractive nature of the rural economy influences its culture, thus it is not only rural dwellers employed in the extractive industries who hold these views, but it is a general tendency due to the economic reality of these areas, as those employed in these industries influence their close surrounding (e.g. family, friends, neighbours).

Despite these offered explanations, they seem not to apply to our findings, which are more consistent with the view that these differences between rural and urban dwellers have diminished over time. Moreover, Sharp and Adua (2009) themselves admit that although there is a body of research researching these possible connections, the evidence of their validity can be described as "modest", although Sharp and Adua (2009, after Jones & Dunlap, 1992) consider two contradicting theories regarding changing (i.e. negatively or positively) attitudes of groups based on their place of origin:

Buttels' and Flinns' broadening-base hypothesis, claiming that growing understanding of environmental problems broadens the support for the environmental concerns to the wider society,

Economic-contingency hypothesis, claiming that the deterioration of the economic situation leads to the decline of the support of the environmental causes.

Considering the validity of both of these theories for our case study (although neither of them was confirmed in the research by Jones and Dunlap, 1992), the more even outcomes of our research may indicate "catching up" the well-being level in rural areas to urban areas. Whether the attitude differences in favor of the environment among the rural dwellers in Poland and Nepal are incidental, or may indicate higher levels of economic deterioration in the urban areas as compared to rural areas would have to be investigated further.

Table 9. Breakdown of the KAB scores depending on the place of origin

KAB	Place of origin	Nepal	Poland	Together
Knowledge	Urban	4.19	3.12	3.92
	Semi-Urban	4.08	3.24	3.89
	Rural	4.11	3.54	3.65
Attitude	Urban	3.24	3.25	3.24
	Semi-Urban	3.24	3.32	3.26
	Rural	3.59	3.36	3.41
Behaviour	Urban	3.50	3.54	3.51
	Semi-Urban	3.69	3.12	3.56
	Rural	3.66	3.45	3.50

As Jones et al. (1999) mention, other demographic factors might play a significant role in shaping KAB among different groups, and the differences in environmental awareness between urban and rural residents may vary depending on various factors. For example, research by Sapbamrer and Chittrakul (2022) shows that rural residents may be more aware of the risks associated with pesticide residues in agricultural products due to their knowledge of how significant pesticide current use is in agricultural production. This may also be a consequence of the continued proximity of these populations to industries applying impactful materials.

It is important to recognise the literature that links some circular economy themes to indigenous and traditional practices (Beamer et al., 2021; Beamer et al., 2023; Gladun et al., 2021; Yani & Noviantika, 2023). Some of these practices can help to form current circular economy practices. As it is the

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rural areas which are the knowledge banks of the indigenous and traditional knowledge, further research on the KAB differences between rural and urban areas may open up new learning possibilities for circular economy practices. Rural communities, which are closer to nature, may serve better the preservation of traditional knowledge (Cordero et al., 2020; Filippova et al. 2022), including the efficient use of resources (Gómez-Baggethun et al., 2010; Kusumastuti et al., 2022), upholding the argumentation by Jones et al. (1999) and Sharp and Tucker (2005) regarding the utilitarian approach to nature from the side of rural dwellers.

There might exist a break-even point between knowledge, attitude and behaviour due to place of origin, in which, on the one hand, rural experiences may form positive KAB scores, while connected with the urban settlements, education might enforce positive KAB scores as well. Further in-depth research would be needed to identify such a break-even point.

The relationship between knowledge, attitude, and behaviour

Table 10 shows the correlation between knowledge, attitude, and behaviour on CE among all interviewed students. It appears that the behaviour of students is weakly correlated to knowledge and attitude towards CE and the relationship is significant.

Table 10. Correlation between knowledge, attitude, and behaviour

Scale	Knowledge	Attitude	Behaviour
Knowledge	1		
Attitude	0.228 (p = 0.003)	1	
Behaviour	0.221 (p = 0.004)	0.191 (p = 0.014)	1

Thus, further analysis was performed to analyse the relationship between behaviour and knowledge and attitude. Multiple regression analysis was used to assess if knowledge and attitude predicted the behaviour of students on a CE. At first all four assumptions; i) normal distribution of dependent variables, ii) no multicollinearity, iii) no heteroscedasticity, and iv) no autocorrelation were checked. Figure 3 shows the normal distribution of dependent variables (with a perfect bell-shaped curve), which fulfils the first assumptions.

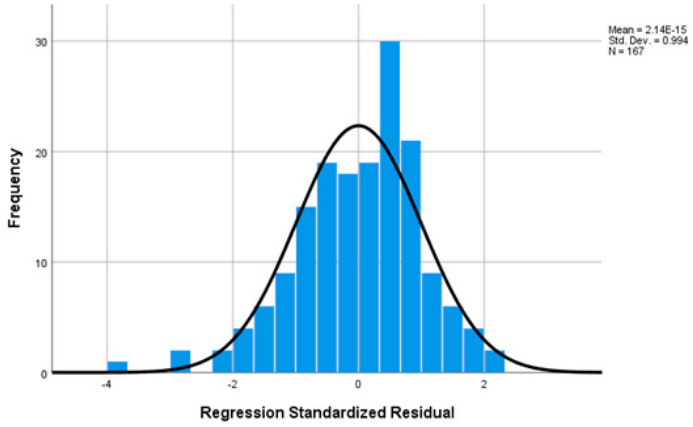

Figure 3. Histogram of dependent variable

Collinearity tests indicated that multicollinearity was not a concern (Knowledge, Tolerance = .948, VIF = 1.05; Attitude, Tolerance = .948, VIF = 1.05). The data met the assumption of independent errors (i.e. no autocorrelation) (Durbin-Watson value = 1.673).

Finally, Figure 4 shows there is no heteroscedasticity. The scatterplot of standardised predicted values showed that the data met the assumptions of homogeneity of variance and linearity.

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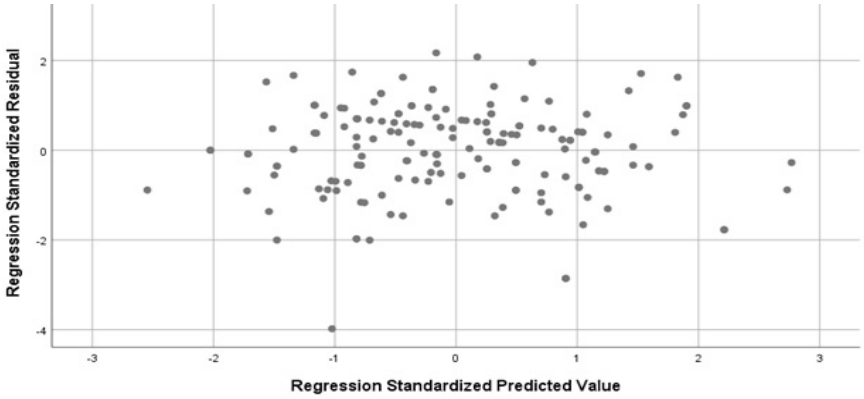

Figure 4. Scatter plot

Using the enter method it was found that knowledge and attitude explain a significant amount of the variance in the value of behaviour ($F(2, 163) = 6.095$, $p < .05$, $R^2 = .07$).

The analysis shows that attitude significantly predict value of behaviour (Beta = .167, t (166) = 2.088, $p < .05$), likewise knowledge also significantly predict value of behaviour (Beta = .241, t (166) = 2.29, $p < .05$). This shows that with one level increase in attitude positively changes behaviour by 0.167 level and with one level increase in knowledge positively changes behaviour by 0.241 level.

Conclusion and Implications

The CE concept promotes the reduction of consumption of waste, as well as the reduction of environmental damage. Higher education students are important stakeholders to contribute to it. Thus it is important to educate students on the environmental impacts and mitigation strategies of negative environmental impacts, as people's attitudes are formed in the early stages of their lives. The goal of such education is to improve the environmental literacy of the society. However, only knowledge and education are not enough to motivate the youth, and the development of environmental literacy – with the CE as a practical application of it – shall be monitored and become a part of long-term strategies. Moreover, their attitude may have an impact on their CE behaviour. Also, the knowledge, attitude, and behaviour of developed and developing countries vary. Thus, this study attempted to compare the KAP between university students in Poland and Nepal.

According to the survey, students in both countries possess knowledge, positive attitudes, and positive CE behaviour. The knowledge level of Nepali students is significantly higher compared to Polish students. The behaviours of students are correlated with knowledge and attitude. The findings also suggest knowledge and attitude predict CE behaviour among students. Interestingly, the disparity between rural and urban areas was not too large, and in some cases, the rural dwellers have answered more favourably than the urban dwellers. The reasons for it can be, for instance, the diminishing gap in the well-being of rural and urban populations, although the definitive confirmation of such claims would require further investigation.

The findings of this study can be useful for policymakers, businesses, students, and academic institutions. Policymakers and businesses can better understand the importance of the CE and implement more effective actions regarding it. Likewise, students can be motivated to gain knowledge and attitude to implement CE in their daily lives. Finally, academic institutions shall more broadly integrate the CE concept into the curriculum to motivate students. In order to expand on this research and to make the findings more robust, the future research shall consist of larger groups of the developed and developing countries. In the future such research is planned.

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Contribution of the authors

Conceptualisation, I.O., I.S. and R.S.; methodology, I.O. and R.S.; software, I.O. and R.S.; validation, I.O. and I.S.; formal analysis, I.O. and R.S.; investigation, I.O. and R.S.; resources, I.O. and R.S.; data curation, I.O. and I.S.; writing – original draft preparation, I.O.; writing – review and editing, I.O. and I.S.; visualisation, I.O. and R.S.; supervision, I.S. and P.B.; project administration, I.S.; funding acquisition, I.S.

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STRESZCZENIE: Koncepcja gospodarki o obiegu zamkniętym (GOZ) pojawiła się jako zrównoważona alternatywa dla gospodarki linearnej generującej odpady. Aby osiągnąć ten cel w dłuższej perspektywie, istotna jest edukacja młodzieży. Poziomy wiedzy, postawy i zachowania (knowledge, attitude, and behaviour – KAB) w krajach rozwiniętych i rozwijających się są różne. Istnieją jednak ograniczone badania porównawcze. W naszym badaniu analizujemy KAB studentów dwóch krajów – Polski i Nepalu – w celu oceny możliwych różnic między krajami rozwiniętymi i rozwijającymi się. Dane ankietowe zostały przeanalizowane przy użyciu statystyk opisowych, statystyk t i modeli regresji wielorakiej. Z badania wynika, że studenci w obu krajach posiadają wiedzę, pozytywne nastawienie i pozytywne zachowania związane z GOZ, przy czym poziom wiedzy nepalskich studentów jest istotnie wyższy w porównaniu z polskimi. Zachowania uczniów są skorelowane z wiedzą i postawą. Wyniki sugerują również, że wiedza i postawa przewidują zachowanie GOZ wśród uczniów. Co więcej, istniały interesujące różnice między KAB uczniów w zależności od ich miejsca pochodzenia (wiejskie i miejskie). Wyniki tego badania mogą być przydatne dla decydentów, studentów i instytucji akademickich.

SŁOWA KLUCZOWE: gospodarka o obiegu zamkniętym, KAB, studenci, szkolnictwo wyższe, pochodzenie wiejskie, pochodzenie miejskie

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