

A Study on Level of Students Knowledge towards Circular Economy

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Abstract

Circular economy is believed to be the latest approach to replace the linear economy. However, in the context of higher education institutions, the awareness and sustainable practices regarding circular economy is still at par. Recent studies show that knowledge about the circular economy has not yet spread widely among university students. This study was done to identify the level of knowledge related to circular economy concept among undergraduate students. This study uses a quantitative methodology through a survey using a questionnaire towards 35 undergraduates' students in Universiti Teknologi Malaysia. Cronbach's alpha value of 0.93 shows high reliability of the questionnaire items. The data obtained was analyzed using SPSS software version 20 and reported descriptively. The results of the study show that there are seven items in the circular economy knowledge domain, and all of these items have a high mean value. This shows that UTM undergraduate students have extensive knowledge about the circular economy. The results of this study provide a meaningful contribution to stakeholders in planning appropriate curricula and programs for undergraduate students in higher education institutions. With a clearer understanding of students' level of knowledge about the circular economy, steps can be taken to strengthen knowledge about the circular economy in undergraduate education at UTM.

Keywords: Knowledge, Circular Economy, Higher Education Institution

Introduction

The world officially began implementing the 2030 Agenda for Sustainable Development, a revolutionary action plan centered around the 17 Sustainable Development Goals (SDGs), on January 1, 2016 (Cipriano et al., 2021; Ekhator et al., 2021). Over the next 15 years, the SDGs are expected to address pressing global concerns (Rosa et al., 2021). It aims to create a holistic global vision by integrating and balancing the three aspects of sustainable development (economic, social and environmental) (Otake & Hagenimana, 2021; Palomares et al., 2021). The Sustainable Development Goals, also referred to as the SDGs or Global Goals, are focused on protecting the planet from degradation, including through sustainable consumption and production, sustainable management of natural resources, and by taking immediate action on

climate change, so that the planet can support the needs of present and future generations (Robertson, 2021; Schenk et al., 2021).

The circular economy has gained popularity over the past ten years as both a theoretical and real-world approach to sustainable development (Elford & Eggers, 2021). It gives a focal point where environmental preservation can be addressed while also bringing together two discourses that were previously seen as incompatible or impossible to reconcile (Siddiqui et al., 2023). The "take-make-use-dispose" linear economic model is broken by the circular economic model. It makes the supposition that resources are unending, accessible, plentiful, and cheap to waste (Hewlett et al., 2023; Song, 2023).

In the Malaysia Madani Budget, the country's commitment to environmental sustainability and the circular economy is reflected in the transformation of Putrajaya into a Green City through waste management and recycling (Ministry of Finance Malaysia, 2023). A fund of RM30 million was allocated, signifying the government's commitment to sustainable practices (Ministry of Finance, 2022). Environmental Regulation also received attention, with a fund allocation of RM86.9 million, reflecting the need to protect nature for future generations. This step shows the cooperation of the authorities in monitoring environmental regulations. Through the allocation of significant funds for Putrajaya Green City and Environmental Regulation (Ho Chin Siong et al., 2012), the Civil Malaysia Budget not only shows Malaysia's seriousness in achieving environmental sustainability, but also shows responsibility for the well-being of the people and the growth of the country's economy. This is an important step in ensuring harmony between development and environmental sustainability (Malik et al., 2023; Ogiemwonyi & Jan, 2023).

Environmental education is an important matter in ensuring harmony between development and environmental sustainability (Onoprienko et al., 2021). University students need to have a good understanding of the circular economy concept (Deda et al., 2022; Nelson & Ionescu, 2021). Therefore, this concept is very relevant to be introduced in higher education institutions including University of Technology Malaysia (UTM) to ensure that students acquire sufficient knowledge and understanding. In this context, UTM students were chosen to study the concept of circular economy. By gaining a deep understanding of this concept, they can play an important role in practicing and promoting the circular economy in industry and society (Ferrer et al., 2023; Khoury et al., 2023). Through university education, UTM students can become agents of change that have a positive impact on environmental sustainability and sustainable economic development (Owojori et al., 2022).

Therefore, this study was made to identify the level of knowledge of UTM undergraduate students on the circular economy. Although university students are often good in their field of study, they do not necessarily know about the circular economy concept. Further research will identify various elements of the circular economy among university students.

Literature Review

Circular Economy Knowledge Among University Students

Research on the level of university students' knowledge of the circular economy has not yet been widespread. But there are some studies that have been done in universities abroad and locally. Knowledge of the circular economy is important for university students because it provides an understanding of a sustainable approach to resource and environmental management. This helps students understand the impact of their actions on the environment, drives sustainable innovation in various fields, prepares them to face global challenges such

as climate change, and gives them the skills to face a job market that emphasizes sustainability. This understanding also encourages active involvement in sustainable projects at the campus and community level, making them responsible and competitive peers in the era of sustainable development.

Xie, (2021) looked at the circular economy approach to the problem of environmental conservation of world cultural heritage sites. His study examines how well individuals comprehend the circular economy and environmental protection utilizing big data analytic approaches, including surveys, interviews, statistics, and other methodologies. The findings indicate that about 58% of college students think environmental protection is absolutely necessary, while 64.5% of people can completely appreciate the significance of environmental protection. About 55% of college students have little grasp of the circular economy. The majority of people also think that environmental protection may effectively safeguard the cultural heritage of the globe, foster economic growth, sustain social development, and advance social civilization.

In another study, Loste et al (2020) studied the knowledge about the role of Green Chemistry in sustainability strategies through the students' perspective and found that students knew the least about Green Chemistry, but after training, students positively appreciated the usefulness of Green Chemistry and considered it as effective for their work development. Education (training, awareness and dissemination) and regulations have been proposed for students as key actions to promote Green Chemistry as a tool to advance sustainability. According to Rahmatika Dewi et al., (2022) who conducted a survey of 110 students who attended economics-related courses from two universities in Indonesia, found that students had a high knowledge of the circular economy (85.5%) where the female students' knowledge of the circular economy was higher than the male students.

A survey conducted by Owojori et al. (2022) of 376 students from nine rural schools at the University of Venda on solid waste management for the concept of circular economy vision found that students' knowledge about solid waste management was low and insufficient. However, students are willing to participate in recycling projects to improve the current environmental conditions of the institution. Vintere, (2020) in a case study of 194 engineering students at a university to assess professional ecological intelligence on components that characterize a sustainable attitude towards the environment such as sustainable use, environmentally friendly transport, energy efficiency, zero waste, found that more than half of the respondents (52%) said that they have never heard of the SDGs, 43% are confident in their ecological intelligence and 42% say they may have ecological intelligence. Izzati Ramli et al., (2021) studied the challenge of PETRONAS University of Technology students in practicing the circular economy on printed study materials using a mobile application, called EcoCycle. The results of the survey showed that less than half of the respondents threw their printed study materials into the recycling bin and more than half of the respondents gave their study materials to their friends. This shows that university students know about the circular economy and the majority of respondents agree that technology plays an important role in the circular economy.

The importance of knowledge in solid waste management is emphasized in a study by Virsta et al., (2020) in a project entitled 'Waste Education Initiative', Bucharest University of Agronomic Sciences and Veterinary Medicine (USAMVB) has developed a questionnaire aimed at highlighting how education is organized in the field of waste management. In the survey evaluation, the questionnaire revealed that waste management education is not part of the curriculum and is carried out on the free initiative of local authorities, waste contractors, NGOs

and teachers. Local authorities and waste contractors provide educational materials and activities only in some schools and colleges, and not in universities. About 70% of pupils and students do not know about the circular economy. In fact, modern teaching and evaluation methods related to waste management require more educational practices and local initiatives with specific activities and active implications of all stakeholders.

In this context, the relationship between knowledge and the transition to a circular economy was studied by Atiku, (2020) and the findings show that the firm's eco-innovation process depends on strategic knowledge management. Therefore, increased knowledge is needed for the improvement of eco-efficiency and eco-innovation. According to Abad-Segura et al., (2020) who made a bibliometric analysis of 1366 articles about the challenges of transitioning from a linear economic model to a circular economy, found that the development and application of new knowledge leading to innovative, technological and sustainable processes, products and services is still needed.

All these studies show that the knowledge and understanding of the circular economy among university students plays an important role in shaping their views and actions towards environmental sustainability and sustainable development. Therefore, the objective of this study is to identify the level of knowledge among undergraduate students regarding the circular economy.

Methodology

A descriptive survey research design was used for this research. Undergraduate students at Universiti Teknologi Malaysia (UTM) are the study's target group. Kerlinger and Lee, (2000) suggested as many as 30 samples as the minimum number of samples in a quantitative study. Thus, 35 students took part in the study by responding to the questionnaire that was provided. The tool for gathering data was a structured questionnaire adopted from Rahmawati et al., (2021). There are two sections to the questionnaire (Part A and Part B). Background information about the participants, including gender, race, faculty, and course of study, is provided in Part A and the circular economy knowledge domain is covered in Part B.

Each item was rated on a five-point Likert scale, with 1 denoting "Strongly Disagree," 2 "Disagree," 3 "Not Sure," 4 "Agree," and 5 "Strongly Agree." Cronbach's alpha was found to validate the instrument's reliability in terms of instrument reliability. Cronbach's alpha value determination is based on Mohd Majid Konting, (2005); Pallant, (2010); Sekaran, (1992) as shown in Table 1 below.

Table 1

Reliability index classification

Indicator	Alpha Cronbach Value
Very high	>0.90
High	0.7 – 0.89
Moderate	0.3 – 0.69
Low	<0.30

Based on pilot study with 35 UTM undergraduate students, the Cronbach Alpha value obtained for knowledge domain's is 0.93, which is above 0.70. This can give the conclusion that the research questionnaire has a high internal consistency of the construct as suggested by Mohd Majid Konting, (2005); Pallant, (2010); Sekaran, (1992).

Respondents were given the questionnaire online via a Google form. UTM lecturers were given the URL to pass along to undergraduate students in all faculties. Data was gathered in July 2023 for two weeks. Data from the collected sources were retrieved, cleaned, and then imported into SPSS version 20 for analysis. The method's results have been displayed in the form of a table. The researcher makes use of Pallant, (2010) citation of the mean score interpretation in Table 2 to interpret the students' knowledge of the circular economy.

Table 2

Mean score interpretation

Mean score	Interpretation
1.00 – 2.33	Low
2.34 – 3.67	Intermediate
3.68 – 5.00	High

Results & Discussion Demography Characteristic

The analysis of the respondents' demographics obtained in this study are in terms of gender, race, faculty, and course of study as shown in Table 3. According to gender statistics, 31.4% of respondents are men and 68.6% of respondents are women. Malay students made up 91.4% of the respondents, followed by Chinese 5.7%, no Indians, and 2.9% of people of other races. 34.3% of respondents in this study came from the faculty of social sciences and humanities, followed by 20% from the faculty of built environment and surveying, 14.3% from the faculty of computing, 11.4% from the faculty of science, and less than 10% from each of the faculties of management, electrical engineering, and civil engineering. Lastly, 14.3% of respondents were diploma students and 85.7% of respondents were undergraduate students.

Table 3

Analysis of the respondents' demographics

Demography characteristic		
Gender	Frequency	Percentage (%)
Male	11	31.4
Female	24	68.6
Total	35	100
Race	Frequency	Percentage
Malay	32	91.4
Chinese	2	5.7
Indian	0	0
Others	1	2.9
Total	35	100
Faculty	Frequency	Percentage
Faculty of Civil Engineering	2	5.7
Faculty of Electrical Engineering	2	5.7
Faculty of Computing	5	14.3
Faculty of Science	4	11.4
Faculty of Built Environment and Surveying	7	20.0
Faculty of Social Sciences and Humanities	12	34.3
Faculty of Management	3	8.6
Total	35	100
Course of study	Frequency	Percentage
Diploma	5	14.3
Degree	30	85.7
Total	65	100

Students' Knowledge towards Circular Economy

Knowledge is an important foundation in shaping students' views and actions on global issues such as the circular economy. The most important transformational tool to address all social, economic and environmental issues is education, which is also seen as a means to achieve the goal of a circular economy. Education must be reoriented to integrate education for sustainable development (ESD) at all levels to realize the objectives of the circular economy. Education for sustainable development fosters the acquisition of knowledge (Vintere, 2020), values and abilities (Molderez & Fonseca, 2018), understanding (Gatti et al., 2019), as well as behaviors (Al-Naqbi & Alshannag, 2018) needed to build a society that ensures the protection and conservation of the environment, fosters social equality, and fosters economic sustainability.

Overall, the findings reveal that just 37.1% of respondents are familiar with the term "circular economy," and more than half (62.9%) are unaware of it (Figure 1). The question "Where did you learn about the circular economy?" was put to the students. Most people cannot answer. These are some examples of student responses that refer to the circular economy: course subjects, learning in class, internet, social media, billboard signs, YouTube and radio programs.

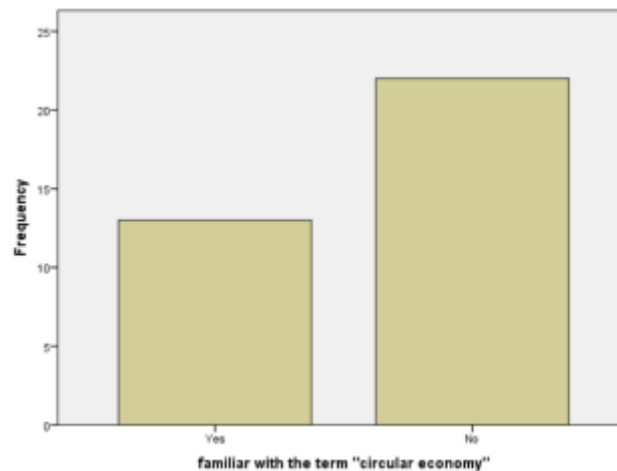


Figure 1. Are you familiar with the term “circular economy”?

The knowledge domain measures seven items in identifying students' knowledge of the circular economy as suggested by previous studies. The mean value for each item was calculated and discussed. Table 4 displays data for the domain of students' knowledge towards circular economy.

Table 4

Mean value for domain knowledge

Domain: Students' knowledge towards circular economy		
Statements	Mean (M)	Interpretation
Saving water and electricity every day is one of the circular economy efforts.	4.37	High
The purpose of reusing/recycling goods in the circular economy is to reduce waste on earth.	4.34	High
Circular economy is important to reduce misuse of natural resources.	4.31	High
5R behavior (Reuse, Reduce, Refurbish, Repair, Recycle) is a basic principle in the circular economy.	4.14	High
The circular economy involves good waste management work and the reduction of various types of waste	4.14	High
Circular economy emphasizes a responsible attitude towards human welfare.	4.20	High
Choosing to drink in glass bottles over plastic is a circular economy effort.	4.00	High
Total	4.21	High

All domain knowledge-related item mean scores are at a high level. This result suggests that respondents have a substantial amount of information about the question. Respondents agreed that saving water and electricity every day is one of the circular economy efforts with $M=4.37$, they know the purpose of reusing/recycling goods in the circular economy is to reduce waste on earth with $M=4.34$, they know that circular economy is important to reduce misuse of natural resources with $M=4.31$, they know 5R behavior (Reuse, Reduce, Refurbish, Repair, Recycle) is a basic principle in the circular economy with $M=4.14$, they know the circular economy involves good waste management work and the reduction of various types

of waste with $M=4.14$, they know circular economy emphasizes a responsible attitude towards human welfare with $M=4.20$ and they know choosing to drink in glass bottles over plastic is a circular economy effort with $M=4.00$.

Based from the result, having the right knowledge and basic information about the circular economy will help students make smarter decisions in practicing the circular economy concept. This is because by understanding the concept of the circular economy, students can identify opportunities to reduce resource wastage, increase the efficiency of resource use, and design products with a longer life cycle. Therefore, accurate knowledge of the circular economy can lead to innovation, reduction of environmental impact, and even long-term economic gains. This finding is in agreement with the study by Abad-Segura et al., (2020); Atiku, (2020) who mentioned that the innovation process depends on strategic knowledge management. This finding is also in line with Rahmatika Dewi et al., (2022) who found that students have a high knowledge of the circular economy. Therefore, understanding the system is an important level of professional knowledge for students in developing a circular economy for sustainability.

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Conclusion

This study has measured the level of university students' knowledge of the circular economy concept and the findings show that they have a high level of knowledge in this field. The high level of knowledge students has about the circular economy reflects their deep understanding of its concepts and principles. This means that they are more willing to apply and practice circular economy practices in their daily lives. This high level of knowledge gives hope for a more sustainable future, where this generation of students will have an important role in promoting circular economy practices in society and industry. This study provides a positive view of the level of preparation of UTM students in facing the challenges of economic sustainability in the future. However, although most students have good knowledge, efforts to further strengthen knowledge and encourage the practice of the circular economy should continue in their education.

It is suggested that future studies examine the extent to which the knowledge can be translated into practice in real life, as well as detect the factors that influence circular economy practices among students. In addition, it is suggested that future studies identify the long-term effects of such knowledge on sustainable development and changes in society. In a broader context, future studies can also focus on aspects of education and the preparation of a more comprehensive curriculum on the circular economy. This includes the integration of circular economy concepts in various disciplines such as technical and vocational education. In the context of the digital era, future studies can explore the use of technology and digital platforms in promoting awareness and understanding of the circular economy. This includes the use of applications, educational websites, or digital learning aids to help students understand and apply the circular economy concept. The study can also discuss ways in which circular economy education can be integrated with digital culture. With this comprehensive future study, we can produce more effective guidelines and strategies to strengthen the understanding of the circular economy among university students, as well as move the transformation towards a more sustainable and sustainable economy.

Knowledge about the circular economy can also encourage innovation in education. University students who understand the concept of circular economy may be able to create creative and interactive educational programs, which focus on the application of circular economy principles in every aspect of learning. They can design learning modules that integrate circular concepts into various disciplines, making learning more relevant to issues of environmental and economic sustainability. Educational programs like this will not only improve students' understanding of the circular economy, but will also shape their critical thinking in overcoming global challenges and encourage future generations to practice the principles of sustainability in their every step.

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