Research Article

A Study Of Circular Economy Awareness In University Students: The Assessment Of Knowledge, Attitude And Behavior

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Abstract

This study explores the university students' awareness of the Circular Economy (CE) through the identification of knowledge, attitudes and behaviors (KAB). A quantitative method is applied by adopting the SDG survey questionnaire of Cifuentes-Faura that was developed using the 5Rs (Reduce, Reuse, Refurbish, Repair and Recycle) of the CE concept to measure the students' KAB towards CE. A total of 110 students studying economics-related courses from two Indonesian universities participated in the survey and the statistical program SPSS 20.0 was used for data analysis. The study found that the students' awareness of the circular economy is higher in terms of knowledge (85.5%) than attitude (55.5%) and behavior (68.2%). In a way, the results of attitude and behavior show that students tend to buy new things instead of reusing/renting or repairing them. The female students' knowledge of CE is higher than male students, whereas their attitude and behaviour show similar results. Additionally, there is a correlation between knowledge and attitude, attitude and behavior, and knowledge and behavior, which means that the variables influence each other.

Keywords: circular economy, knowledge, attitude, behavior, university students

Introduction

For the past decade, the circular economy has been recognized as a conceptual and practical solution for sustainable development. It provides two discourses that have previously been considered inconsistent or difficult to reconcile: economic interests and a central point where environmental protection can be addressed. The circular economy model breaks the linear economic model of the "take-make-consume-dispose'' pattern. It assumes that resources are inexhaustible, accessible, readily available and inexpensive to waste.

This model includes decision makers, advocates, consultants, academia/scientists, etc. at various levels as agents who are able to reduce material consumption, waste production, and emissions while maintaining economic growth. The first Asian countries to officially adopt CE at the national level were Japan and China. Denmark, Germany, the Netherlands, and the UK are the major European countries implementing CE initiatives, policies and pilot programmes. At the supranational level, the European Union (EU) adopted the CE Action Plan (CEAP) in 2020, which includes legislative proposals (European Commission, 2015). Although this is slower than

the aforementioned countries, it creates a determination to reduce pressure on natural resources, sustainable growth and employment.

In Indonesia, the government has launched a green economic policy that stimulates economic growth while giving consideration to the sustainability of natural resources. These are stipulated by various regulations: (1) The Industrial Law No. 3/2014 on industry aiming at realizing an independent, competitive and advanced industry, as well as a green industry, and (2) The Presidential Decree No.97 on Industries for the Realization of Independent, Competitive and Progressive Industries and Green Industries (Jakstranas). It contains a roadmap aimed at reducing household waste by 30% and ensuring the management of 70% of household waste by 2025. The Minister of National Development Planning was optimistic about the importance of the circular economy for economic recovery and social reform. Implementing a circular economy is one of the strategies and breakthroughs for rebuilding Indonesia to become more resilient after the COVID-19 pandemic through the creation of green jobs and increase of process efficiency by optimizing resource use.

A report published by the National Development Planning Agency (Bappenas) in collaboration with UNDP and the Government of the Kingdom of Denmark on 'the Economic, Social and Environmental Benefits of a Circular Economy in Indonesia' describes the results of a study on the potential of adopting circular economy in Indonesia. It is mentioned that the implementation of a circular economy in five industrial sectors has the potential to generate additional Gross Domestic Product (GDP) in the range of Rp 593 trillion to Rp 642 trillion. Focusing on five main sectors, namely the food and beverage industry, textiles, wholesale, and retail trade (focusing on plastic packaging), construction, and electronics, it is said that the implementation of the circular economy concept could also create around 4.4 million new jobs by 2030.

Such efforts require the contribution of various stakeholders to transform a linear economy into a CE society. Here, schools and universities play a significant role as an agent of change in education to accelerate the transition toward a CE society. They are strategic agents who could support CE through teaching, research, and social outreach activities. As an engine of skills and knowledge, universities become relevant institutions in enabling a circular economy approach, which has the potential to raise the bar for sustainable performance. These are achieved through all subjects in the field where students can advance complexity while at the same time acquiring the economic capacity to enable the necessary development of a sustainable human being. However, as of December 2021, there are few studies on CE in Indonesia and none of those has been specifically conducted in the higher education sector.

We conducted the study using the Knowledge, Attitude and Behavior (KAB) framework as it is found that the KAB instrument is an important input for environmental policy-making decisions (Sousa et al, 2020). It has presented a lot of insight for policymakers since it measures the gap between knowledge and action. Another reason emphasizing the importance of KAB towards CE in university students is that they carry sustainable consumption to their adult life, which is important for building a sustainable society (Joshi & Rahman, 2017) where they will be future corporate leaders, policymakers, and lawmakers (Mahat et al., 2017).

In light of this, the purpose of this study is to investigate university students' awareness of CE principles and practices by identifying KAB, assessing them in terms of gender differences, as well as looking into the correlation of the three constructs. This study is built around three research questions in order to achieve the goal. First, how is students' awareness (knowledge, attitude and behavior) on the concept of circular economy? Second, how is the students' circular economy awareness analyzed from gender differences? Here, we consider gender differences due to numerous studies that reveal gender difference as a basic attribute and an important aspect in pedagogy to understand the source of any inequalities, to improve average performance as well as to improve our understanding of how university students learn (OECD, 2009; Wigfall, 2010; Chapin & Warne, 2020; Jensen & Owen, 2001). Third, how do students' knowledge, attitude and behavior toward circular economy correlate with each other?

In this context, the results of this study are important for two reasons. First, it provides educators and policymakers with the information they need toward the curricula of courses in the field of economics. Second, it is a stepping stone for future research directions and practical impact on higher education in CE. It is an initial action to raise the awareness of university students as a part of promoting CE in higher education.

Literature Review

To contextualize our analysis, this study presents a concise literature review on CE, revealing its conceptual and practical gaps, an inquiry of the research using KAB towards CE, as well as an explanation about gender, sustainability and CE.

The emergence of Circular Economy in Education: conceptual and practical gaps

Alarcón, J et al., (2019) in Chile investigated on how to introduce the CE concept to primary school students and they found that practical experiences such as 'Do it Yourself (DIY)' activities by using waste can be a solution. In the level of higher education institutions (HEIs), Mendoza, J. M. F., Gallego-Schmid, A., & Azapagic, A. (2019) in the UK showed how HEIs applied an action-led approach in building the strategy for the implementation of CE. They found that the use of a novel proposed framework, namely the 'Backcasting and Eco-design for Circular Economy (BECE)' framework, as a novel combination is useful for facilitating CE solutions in the HEIs. Still, in the HEI context, Qu, D & Shevchenko, T (2019) analyzed recent research related to the roles of HEIs for CE implementation in China. From their review, they confirmed that university students play important roles in the CE education process. Educating CE to students is the key to promoting CE, since students will be the agents of change. However, barriers also exist such as the insufficient policies of CE practices in HEIs, the lack of professional development related to CE and the HEIs' curriculum. Different from the three aforementioned studies, a recent study conducted by Venugopal, P., & Kour, H. (2020) in India investigated the basic part related to CE, where they explored students' familiarity with CE concepts instead. In the study, they found that engineering students did not have awareness related to the CE concept although environmental education is a mandatory subject there.

The Circular Economy (CE) is considered as a recent concept (Murray et al., 2017). In 1996, Germany became the first country that integrated it in its national law under the "Closed Substance Cycle and Waste Management Act" (Su et al., 2013), followed by Japan in 2002 under the "Basic Law for Establishing a Recycling-Based Society" (METI, 2003), and China in 2009 under the "Circular Economy Promotion Law of the People's Republic of China" (Lieder & Rashid, 2016). However, the definition of CE varies by which different people may define the concept differently (ibid.). Geissdoerfer et al. (2017) pointed out that the definition formulated by EMF (2013) is seen as the most reputable definition. They defined a CE as,

> "..an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models (ibid. p.7)."

In addition, a more recent study conducted by Kirchherr & Piscicelli (2019) tried to reconceptualize the definition of CE. As the result, they revealed that CE is,

> "…an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro-level (products, companies, consumers), meso-level (eco-industrial parks) and macro-level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations (p.229)."

Through a simple explanation, the CE concept suggested that people add value towards products used for as long as they can to reduce waste to the very minimum level. This concept allows people to reuse, reduce, refurbish, repair, recycle products to generate added values which is opposite to the linear economy model of take-use-dispose.

Inquiry upon Knowledge, Attitude and Behavior (KAB) toward Circular Economy

Knowledge, Attitude, and Behavior (KAB) are research instruments that have been used in many disciplines since the 1950s. It was shaped by Bloom et al. (1956) and represented as a dimension of classification of educational objectives. Knowledge or understanding refers to the learner's cognitive domain. This area contains all the information that an individual has in relation to a particular area of research (Alexander, Jetton & Kulikowich, 1995). Attitudes are linked in Bloom's classification to emotions or emotional areas that represent emotions for behaviors that are closely related to behaviors. Furthermore, Thurstone (1931) confirmed that attitudes were subjective, which means that it is considered as the sum or sum of emotions about a particular action, achievement, idea, or concept. In such definition, there appears to be a potential for applying quantitative scientific thinking methods to the study of feeling and emotion, to esthetics, and to social phenomena (Thurstone, 1931) in many areas such as in the hospitality study (Kim, 2013), nursing (Knowles et al, 2015), etc. Finally, behavior is an individual's observable or concrete behavior or performance in response to a particular stimulus, which may be an application of an individual's knowledge or attitude (Thurstone, 1931; Alexander, Jetton & Kulikowich, 1995).

In the development of the conceptualization of KAB, the debate among scholars has been more intensified not only on the matter of measuring any subject using these single three-dimensions but also on the interconnection between them (Valente, Paredes & Polle, 1998; Ajzen, Timko & White, 1982; Fazio, 1990; Alexander & Dochy, 1995). Scholarly debates consider how knowledge affects behavior. While attitudes can also be aligned with behavior, it indicates that behaviors can inform attitudes (Fishbein, 1967) and attitudes are influential in attention. Consequently, attitudes can impact what an individual perceives and therefore impacts knowledge gains. On the other side, some scholars highlighted that knowledge—or attitude, for that matter—is not necessarily a strong predictor of behavior alone (Ajzen & Fishbein, 1977; Beavers, Kelley, & Flenner, 1982). Upon those arguments, as Schrader & Lawless (2004) concluded, the interaction between the three dimensions (KAB) is dynamic and sometimes mutual.

In response to the increasing public awareness regarding sustainability, research on environmental issues and specifically in CE using KAB has also been increasingly developing, such as research on the attitude towards sustainable consumption (Kuchinka et al, 2018). A positive correlation between high levels of environmental concern and brand loyalty was noticed, which signifies that people who tend to have higher concerns about environmental issues will be loyal to a brand after the company decides to go green. On the other hand, the study of Ma'ruf, Surya, & Apriliani (2016) encountered this argument by revealing that environmental knowledge and attitude affect only 32.3% of environmental behavior. Hence, in line with the emergence of the CE concept as reviewed in the previous section, studies on KAB towards CE studies have also begun to flourish. For instance, consumer behavior and attitudes toward CE (Siminelli, 2017) spread all over the world such as CE in Saudi Arabia (Almulhim & Abubakar, 2021), in China (Geng et al, 2012; Feng & Yan 2007) and in Japan (Bangert, 2020). However, there is still little research on CE using KAB and this has not been conducted in the Indonesian context and hence the need for further research.

Gender, sustainability and the circular economy

Gender differences is important to be reviewed in the context of CE awareness since several research throughout the years have revealed that concerns about contributing to the development of sustainable practices varies by gender (Meinzen-Dick, et al., 2014). It is confirmed that the ideas of sustainability and ideals

of sustainability and ideals associated with sustainable development are valued more highly by women (De Silva & Pownall, 2014). Other studies have proved that females hold more pro-environmental attitudes and behavior than males (Gifford & Nilsson, 2014; Milfont & Schultz, 2018; Zelezny, Chua, & Aldrich, 2000). In a more recent study by Cifuentas-Faura (2020) related to the concept of sustainability also found a somewhat similar finding, that women have a greater attitude towards sustainability than men.

A study conducted by Arnocky and Stroink (2011) found that females' emotional empathy is higher than males, in which the emotional empathy mediated the relationship between gender and environmental concern and cooperation. They pointed out that emotional empathy has to be taken as a key consideration to explain gender differences among priorities of environmental concern as well as in competitiveness and cooperation in sharing commonplace assets (Arnocky and Stroink, 2011). In regards to that importance, this study tries to investigate the students' CE awareness from based on their gender differences.

Methodology

Participants and Data Collection

The questionnaires have been distributed to 225 students studying economics-related courses in two universities in Indonesia. However, only 110 questionnaires were sent back and filled in by the respondents, 3 questionnaires were dropped as it is not valid. With such a small sample, this study does not intend to claim that the data displayed are representative of those two universities as a whole or proportionally, however the data can be considered as a preliminary data or a pilot study. A pilot study, often known as a "feasibility" study, is a small-scale preliminary study undertaken before any large-scale quantitative research to assess the feasibility or potential for a full-scale project (In, 2005). This questionnaire survey was carried out via google form due to the pandemic situation from July to August 2021.

Instruments

The quantitative method was utilized in this study by adapting and adopting the SDG survey questionnaire by Cifuentes-Faura (2020). His questionnaire is an adaptation of previous works that analyzed the perceptions of the subjects regarding the natural environment, focusing on primary and secondary school students (Cifuentes-Faura, 2020). Then we adapted it by using the 5Rs (Reuse, Reduce, Refurbish, Repair, Recycle) of the CE concept to measure the students' KAB towards CE. This SDG survey was chosen since there are close relations between CE and SDGs, in which some authors believe that CE is a new paradigm that aligns with sustainable development goals and encompasses environmental, economic, and social components (Solano-Pinto, et.al., 2020; Liu, et.al., 2018; Nikanorova & Stankevičiene, 2020).

In the questionnaire, the personal details merely include gender and age as those attributes indicate their preferences of the circular economy's KAB. The authors maintain the respondents' confidentiality, and their participation was voluntary. Each construct (knowledge, attitude and behavior) has 7 descriptors (see table 1). In each descriptor, students were asked to indicate their level of agreement or disagreement on a Likert-type scale: strongly disagree, disagree, neutral, agree, strongly agree.

Validity and Reliability

Initially, the questionnaire instrument for this study consisted only of attitude and behavior variables, with six items on the attitude variables and nine items on the behavior variables. As a result, the validity test was only performed for the attitude and behavior variables. Then we adapted the knowledge variable questions from the Cifuentes-Faura's (2020) SDG survey questionnaire for reliability. The validity test for the attitude and behavior variables is performed by comparing the r-count to the r-table. According to the calculations, all question items in each variable have an r-count value greater than or equal to the r-table (r-count > r-table), implying that all of the question items in each variable are valid.

Table 1. KAB Questionnaire on CE

Knowledge	K1	Saving water and electricity every day is a circular economic effort.
	K2	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.
	K3	5R (Reuse, Reduce, Refurbish, Repair, Recycle) behavior is a basic principle in the circular economy.
	K4	The circular economy view (5R) opposes the conventional economic view, namely production-use-waste in order to reduce acts of exploitation of nature.
	K5	Good waste management and reduction of various types of waste support a circular economy.
	K6	A circular economy emphasizes a business owner to be responsible for people's welfare.
	K7	Choosing drinks packaged in glass bottles rather than plastic is a circular economic effort.
Attitude	A1	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.
	A2	I think it is better to buy used stuff than a new one (thrifting).
	A3	Using the cheapest possible raw materials to reduce production costs is very important in running a business, even though these raw materials are a high risk for consumers.
	A4	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.
	A5	If I have a business, I will use an online-based system.
	A6	Programs in 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 natural systems).
	A7	I find it better to repair a broken item than to buy a new one.
Behavior	B1	I am used to carrying my shopping bag when shopping.
	B2	I only buy new things when needed.
	B3	I am used to renting things I need instead of buying.
	B4	I still own and use the clothes I bought more than 5 years ago.
	B5	I am used to giving used items to other people instead of throwing them away.
	B6	I am used to bringing a water bottle with me when I travel instead of buying bottled water.
	B7	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).

Source: authors

The Cronbach's Alpha internal consistency method was applied to check the reliability. However, from the results of the calculation, the coefficient value of Cronbach's alpha for attitude is 0.566 and for behavior is 0.639. Because the value of Cronbach's alpha coefficient on attitude is less than 0.600, it can be concluded that the attitude instrument is not reliable. While for the behavior variable, the Cronbach's alpha value is greater than 0.600, so it can be concluded that the behavior instrument is reliable and can be used as a data collection tool. Based on the result of the two calculations (validity and reliability), the instrument was revisited and revised. The revisions included creating seven question items for the knowledge variable, dropping one item from the attitude variable, and dropping two items from the behavior variable.

Data Analysis

The students' awareness (knowledge, attitude, and behavior) level was assessed using the SPSS 20.0 program and presented in the form of percentages. In regards to the level of knowledge, attitude and behavior (high, middle and low) we determined the range of each category based on the percentage as follows:

Table 2. Categorization based on Percentage of KAB Variables

Category	Percentage
High	$X \geq 25.67$
Middle	$16.33 \leq X < 25.67$
Low	$X < 16.33$

Source: Azwar (2012)

In addition, the T-test was used to determine the difference in the mean score between male and female students. If the total p-value is less than 0.05, it means that there is a difference in the mean score between male and female on that questionnaire item or variable. Moreover, Pearson's correlation tests were used for inferential analysis to determine the relationships between variables ('knowledge and behavior', 'knowledge and attitude', and 'attitude and behavior'). If the value of r-count is more than the t-table or the significant value is less than 0.05, it means that there is a correlation between two variables. The correlations mean that the variables influence each other.

Results and Discussion

In this section, the study presents the demographic characteristics of the respondents followed by the level of knowledge, attitude, and behavior toward CE. The study analyzed the results of the questionnaire descriptively (frequency distribution and percentages) to recognize the level of understanding of the CE concept as captured by their knowledge, attitude and behaviour in daily patterns. Then, the study presents the students' KAB toward CE analyzed by gender difference. Finally, the correlation between 'knowledge and behavior', 'knowledge and attitude', and 'attitude and behavior' are presented after Pearson's correlation tests were conducted.

Table 3. Sources of Information on the CE Concept

Source	Campus (university)	Social media	Electronics media (TV or radio)	Family or community	Others
Percentage	38.2	38.2	2.7	2.7	5.5

Source: authors

Level of knowledge, attitude, and behavior toward CE

In relations to research question 1 on 'how are students' awareness (knowledge, attitude and behavior) on the concept of circular economy?', this study found that the students' scores on the three variables - knowledge, attitude, and behavior - are dominantly categorized as high (see table 3). This finding is opposite to the study conducted by Venugopal, P., & Kour, H. (2020) in India, that investigated students' familiarity with CE concepts, and found that engineering students did not have awareness related to the CE concept although environmental education is mandatory for them. An almost similar finding was also found by Bhuwandeep & Das (2021), who studied sustainability awareness through KAB and found that the students tend to have good knowledge and positive attitude toward sustainable consumption, yet they showed low capability in practicing it in their daily lives.

Table 4. Students' KAB toward CE

Knowledge		Attitude		Behavior	
Category	Percentage	Category	Percentage	Category	Percentage
High	85.5%	High	55.5%	High	68.2%
Middle	14.5%	Middle	44.5%	Middle	31.8%
Low	0.0%	Low	0.0%	Low	0.0%
Total	100.0%	Total	100.0%	Total	100.0%

Source: authors

However, when looking at each item on the survey, there are several items namely A2, A7, and B3 (see Table 4) that must be discussed further, as at these items most students answered, 'I do not know'.

Table 5. Information related to Item A2, A7, B3, and K3

	Strongly disagree	Disagree	I do not know	Agree	Strongly agree
A2	0.0%	9.1%	48.2%	34.5%	8.2%
A7	0.0%	2.7%	44.5%	38.2%	14.5%
B3	2.7%	36.4%	50.0%	7.3%	3.6%
K3	0.0%	4.5%	6.4%	48.2%	40.9%

Source: authors

At item A2 with the statement "I think it is better to buy used stuff than a new one (thrifting)", most students (48.2%) were not able to take an attitude toward it, meaning that the attitude toward buying used stuff is still low. Buying used stuff actually belongs to one of CE's 5R (Reuse, Reduce, Refurbish, Repair, Recycle) concepts that is, 'Reuse'. This is the basic concept possessed by an individual who has a good attitude toward CE. This finding shows that students have not shown a positive attitude toward it although they understand that 'Reuse' is one of the basic principles of CE, reflected through the students' responses on the K3 item: "5R (Reuse, Reduce, Refurbish, Repair, Recycle) behavior is a basic principle in the circular economy" (see table 4). Therefore, it means that an individual's knowledge of a concept does not definitely influence their positive

attitude toward that concept.

The same phenomenon also happened at item A7: "I find it better to repair a broken item than to buy a new one". The students mostly (44.5%) answered "I do not know" toward this statement, although they may understand and agree that 'repair' belongs to one of the basic principles of CE (see K3 item on table 4). Finally, the students' response on item B3: 'I'm used to renting things I need instead of buying' is also the same as items A2 and A7 there they tend to answer, "I do not know". This statement also reflects the "Reuse" principle of CE. From the findings of the three items, it can be concluded that the students could not be able to take an attitude toward two basic principles of CE: Reuse and Repair. They may have an understanding towards them, yet their understanding does not lead them to have a positive attitude and behavior.

Students' knowledge, attitude, and behavior toward CE analyzed from gender

The analysis of the data according to the gender of the students answered research question 2 on 'how is the students' circular economy understanding analyzed from gender'. In the result of the T-test for each variable, it shows that differences in the mean score between male and female students (see table 5) are only apparent in the knowledge variable, since the total p-value is less than 0.05. There are no differences in the mean score on attitude and behavior.

Table 6. Mean and standard deviation (SD) of students' understanding of CE by gender

Variable	Total		Male		Female		p value	Finding
	Mean	SD	Mean	SD	Mean	SD		
Knowledge	28.84	3.08	28.03	3.12	29.26	2.99	0.044	There is a difference on the mean score between male and female
Attitude	26.07	2.71	25.55	2.08	26.35	2.96	0.144	There is no difference on the mean score between male and female
Behaviors	26.92	3.05	26.42	3.08	27.18	3.02	0.216	There is no difference on the mean score between male and female

Source: authors

However, when each item of each variable was investigated, there are some unique findings that could be explained further such as in the knowledge variable, there are two items (K5 and K7) that showed different means between males and females, since the p-value is less than 0.05. In the questionnaire, the statement K5 is "good waste management and reduction of various types of waste support a circular economy". The result shows that males and females have differences toward this statement. The data shows that the mean of females was slightly higher than males. Identical to item K5, differences toward K7 from the statement "choosing drinks packaged in glass bottles rather than plastic is a circular economy effort", also shows that the females possess a somewhat higher mean than males (see table 6). This finding is in line with the finding of the study conducted by Cifuentes-Faura (2020) in which his study found that in some items of knowledge toward sustainability, females are slightly higher than males.

Table 7. The results of the T-test on each item of the knowledge variable

Item	Total		Male		Female		p-value	Finding
	Mean	SD	Mean	SD	Mean	SD		
K1	3.92	0.85	3.82	0.80	3.97	0.87	0.360	There is no difference on the mean score between males and females
K2	4.54	0.57	4.45	0.60	4.58	0.55	0.236	There is no difference on the mean score between males and females
K3	4.25	0.77	4.39	0.64	4.18	0.83	0.167	There is no difference on the mean score between males and females
K4	4.10	0.83	3.95	0.87	4.18	0.81	0.164	There is no difference on the mean score between males and females
K5	4.35	0.58	4.16	0.55	4.44	0.58	0.013	There is a difference on the mean score between males and females
K6	3.95	0.81	3.79	0.78	4.03	0.82	0.144	There is no difference on the mean score between males and females
K7	3.74	0.89	3.47	0.95	3.88	0.82	0.023	There is a difference on the mean score between males and females

Source: authors

Although in general there are no differences between males and females in the attitude variable, the mean differences were still shown in items A4 and A6 since the p-values of those two items are less than 0.05 (see table 7). The statement of A4 is "if I have a business, I will consider whether the product or its packaging can be reused or recycled even though it is more expensive to produce", and A6 is "programs in 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 natural systems)". Towards both items, the female students show a relatively higher mean than males. Cifuentas-Faura (2020) in his study related to the concept of sustainability also found a somewhat similar finding in which women have a greater attitude towards sustainability than men. Actually, some previous studies have proved that females hold more pro-environmental attitudes and behavior than males (Gifford & Nilsson, 2014; Milfont & Schultz, 2018; Zelezny, Chua, & Aldrich, 2000). A study conducted by Arnocky and Stroink (2011) found that females' emotional empathy is higher than males, and that emotional empathy mediated the relationship between gender and environmental concern and cooperation. They pointed out that emotional empathy has to be taken as a key consideration to explain gender differences among priorities of environmental concern as well as in competitiveness and cooperation in sharing commonplace assets (Arnocky and Stroink, 2011).

Table 8. The results of the T-test on each item of the attitude variable

Item	Total		Male		Female		p value	Finding
	Mean	SD	Mean	SD	Mean	SD		
A1	2.60	1.19	2.79	1.12	2.50	1.22	0.227	There is no difference on the mean score between males and females
A2	3.42	0.77	3.26	0.76	3.50	0.77	0.126	There is no difference on the mean score between males and females
A3	4.00	0.99	3.92	0.88	4.04	1.04	0.544	There is no difference on the mean score between males and females
A4	4.03	0.66	3.82	0.65	4.14	0.64	0.013	There is a difference on the mean score between males and females
A5	3.91	0.76	3.92	0.75	3.90	0.77	0.905	There is no difference on the mean score between males and females
A6	4.47	0.62	4.18	0.61	4.63	0.57	0.000	There is a difference on the mean score between males and females
A7	3.65	0.76	3.66	0.75	3.64	0.78	0.902	There is no difference on the mean score between males and females

Source: authors

Finally, in the behavior variable, both in total or in each item, the finding shows that there is no difference between male and female students (see table 8). All p-values of each item were more than 0.05.

Table 9. The results of the T-test on each item of the behavior variable

Item	Total		Male		Female		p value	Finding
	Mean	SD	Mean	SD	Mean	SD		
B1	3.85	0.95	3.63	1.00	3.97	0.90	0.073	There is no difference on the mean score between males and females
B2	4.01	0.72	4.00	0.70	4.01	0.74	0.924	There is no difference on the mean score between males and females
B3	2.73	0.79	2.58	0.76	2.81	0.80	0.153	There is no difference on the mean score between males and females
B4	4.05	0.91	3.97	1.00	4.08	0.87	0.551	There is no difference on the mean score between males and females
B5	4.39	0.67	4.34	0.63	4.42	0.69	0.578	There is no difference on the mean score between males and females
B6	4.03	0.86	4.03	0.92	4.03	0.84	0.993	There is no difference on the mean score between males and females
B7	3.86	0.70	3.87	0.67	3.86	0.72	0.959	There is no difference on the mean score between males and females

Source: authors

Correlation between knowledge, attitude, and behavior toward CE

To answer the last research question of "how do students' knowledge, attitude, and behavior towards circular economy correlate with each other?" Pearson's correlation tests were conducted. The result showed that there is a correlation between knowledge and attitude, attitude and behavior, and knowledge and behavior (see table 9) since the value of r-count is more than the t-table or the significant value is less than 0.05. In general, these correlations mean that those variables influence each other. For example, if students have a good knowledge related to the CE concept, it may lead to a positive attitude toward CE and finally, it may result in conducting CE behavior or action. This is similar to the theory of planned behavior by Ajzen (1991) in which knowledge may construct attitude and attitude may construct an action/behavior. However, specific items as shown in the previous explanation confirmed a slightly different phenomenon by which students were indicated to possess good knowledge related to CE yet they did not have positive attitude and behavior reflected in some items in the questionnaire. This shows that knowledge for that matter does not necessarily construct attitude and behavior. The correlation between those three constructs have been debated long ago (Valente, Paredes & Polle, 1998; Ajzen, Timko & White, 1982; Fazio, 1986; Alexander & Dochy).

Table 10. Correlation test results between variables

Variable	r-count	sig	r-table
Knowledge and Behavior	0.413	0.000	0.187
Knowledge and Attitude	0.410	0.000	0.187
Attitude and Behavior	0.429	0.000	0.187

Source: authors

Conclusion

This study examines university students' awareness of CE concepts and practices by identifying knowledge, attitude, and behavior (KAB), analyzing those KAB based on gender differences and investigating the correlation between the three constructs. It was surveyed and analyzed through a questionnaire survey of students studying economics-related courses from two universities in Indonesia.

This study showed that the main sources of CE information for the students are from the university lectures and social media. One reason behind this finding is because most participants of this study attended a class in International Economy, which provides information on CE. Another main reason is that teaching CE at the university is important as a way to disseminate CE through n-helix shareholders.

Addressing the first research question of "how is students' understanding (knowledge, attitude and behavior) of the concept of circular economy?", this study concludes that the students' scores on three variables: knowledge, attitude, and behavior toward CE are categorized as high. However, in several aspects of the items in the attitude and behavior variables, students do not show a positive attitude and behavior even though knowledge is possessed. This could be a suggestion for universities to focus not only on knowledge creation but also on building a positive attitude towards CE. It will allow further development of positive behaviors and might be used as a model of lifelong learning.

In answering the second research question on "how is the students' circular economy understanding analyzed from gender differences?", this study concludes that only on the variable of knowledge there is a difference in the mean score between male and female students and there is no difference on attitude and behavior toward CE between males and females.

For the third research question, "how do students' knowledge, attitude and behavior toward circular economy correlate with each other?", it is concluded that there is a correlation between knowledge and attitude, attitude and behavior, and knowledge and behavior which means that those variables influence each other.

Research limitations/implications

The results of this study are important for policy, practice, theory, and subsequent research. It provides stakeholders, including policy makers and educators, with required information for designing curricula on CE-related subjects. This could also contribute to the body of knowledge (theory) in the CE field. This study is a stepping stone for subsequent research since this is the first study about students' KAB toward CE in Indonesia. However, this study has several limitations such as scope, where respondents were only took from 110 students studying economic-related subjects that will affect the generalizability of the findings. In addition, the variable that was explored was only limited to gender. Therefore, for future research in the same topic, the authors suggest to increase the number of respondents and include additional variables such as level of education, study program, or socioeconomic status of students.

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