Journal of Namibian Studies, 33 S1(2023): 621–638 ISSN: 2197-5523 (online)

Digital transformation and circular economy in universities

Lucy Marisol Guanuchi Orellana[1], Miguel Ángel Medina Romero[2], Guillermo Yanowsky Reyes[3]*, Franklin Surichaqui Gutierrez[4], Fredy Alberto Hernández Hernández[5], Aurelia Zavala Palacios[6], Isaac Merino Quispe[8], Heidy Margarita Rico Fontalvo[9], Fidencio Ore Cabrera[10], Mario José Vasquez Pauca[11], Christian Paolo Martel Carranza[12]

[1]Universidad Nacional Micaela Bastidas de Apurímac, Iguanuchi@unamba.edu.pe

[2]Universidad Michoacana de San Nicolás de Hidalgo, miguel.medina.romero@umich.mx

[3]Universidad de Guadalajara, gyanowsky@gmail.com

[4]Universidad Nacional de Huancavelica, Surichaqui@unh.edu.pe

[5]Universidad Nacional San Luis Gonzaga de Ica, fredyhernandez1602@gmail.com

[6]Universidad Nacional de Piura, azavalap@unp.edu.pe

[8]Universidad Nacional Jose Maria Arguedas, merinoq501@gmail.com

[9]Institución Universitaria Americana grupo de investigación Gisela, hrico@coruniamericana.edu.co

[10]Universidad Nacional Mayor de San Marcos, Fidenciocabrera13@gmail.com

[11]Universidad Cesar Vallejo, mvasquezpj1@ucvvirtual.edu.pe

[12]Universidad Nacional Hermilo Valdizán, cmartelc@unheval.edu.pe

Abstract

This study aims to explore the relationship between digital transformation and circular economy practices in universities. A mixed-method approach was used to collect data from 500 participants comprising faculty, students, and staff of various universities in Peru. Data was collected using an online survey and analyzed using SPSS software. The findings of this study suggest that there is a positive relationship between digital transformation and circular economy practices in universities (r = 0.67,p 0.001). The regression analysis result showed that the level of digital transformation practices in universities significantly positively

affected the adoption of circular economy practices (β = 0.61,p < 0.001). The study also highlights the importance of leadership support, stakeholder engagement, and resource availability in adopting circular economy practices. Based on the findings, the study recommends that universities prioritize adopting digital transformation practices and engage with a wide range of stakeholders to create a culture of sustainability. Future research should explore the role of leadership, stakeholder engagement, and resource availability in promoting circular economy practices in universities.

Keywords: Digital transformation, Circular economics, mixed methods, universities, digital adoption, university stakeholders.

INTRODUCTION

Digital transformation and circular economy provide multiple advantages and opportunities to enterprises, governments, and communities, they have emerged as two of the most important developments in today's globe. Because they play such an important role in educating the citizens and workers of the future, universities are not immune to this tendency (Suchek et al., 2021). While circular economy concepts can help colleges move toward more sustainable and responsible practices, digital transformation can completely revamp how universities run and deliver education. This study aims to examine the synergy between digital transformation and the circular economy in academic institutions and identify the opportunities and threats that may arise from combining these two trends. The primary goal of universities is to serve as institutions of higher learning, and digital technologies help them achieve this goal. Inquiring into and connecting various fields of study, education today goes far beyond the walls of any one institution and into the communities and nations of the world. We provide a model or guide for changing universities. Universities can transform into DAOs, or democratic learning organizations, by incorporating digital technology into their asset base.

Technological advancements have entirely revolutionized the current era, and the digital revolution is expected to have far-reaching effects on education worldwide. Digitalization can open new business markets by improving the organization's value chain (Al-Emran, Mezhuyev, & Kamaludin, 2018). Regional, technology-driven, trend-dependent, and associated with many other factors, including but not limited to universities' vision and business strategy, determine how universities will respond to and seize market possibilities employing sustainable digital transformation capabilities. As a result, it is still unclear what model(s) of sustainable digital transformation could be used ((Puma, et al., 2022; Arias, et al., 2022)

BACKGROUND OF THE RESEARCH

Digital transformation describes implementing digital tools to improve operational efficiency, customer satisfaction, and creative problem-solving (Alzahrani, 2019; Gavilán, et al., 2022). As shown in the research by Ellen MacArthur Foundation (2019), the organization's operations, marketing, and management must all use digital technologies. On the other hand, circular economy refers to a regenerative system that seeks to minimize waste and optimize resources (Green & Haines, 2016). Constructing a closed-loop system emphasizes the significance of material reduction, reuse, and recycling. Digital technologies can help improve circular economy practices and vice versa, therefore, these two developments are not exclusive (Mansilla, et al., 2022)

Moreover, deploying digital technologies such as AI and big data might disrupt established business models since they offer mass personalization, allowing organizations to select sustainable inputs to match customers' requirements (Govindan et al., 2015). In addition to improving the customer experience and cutting down on waste on the consumer end, these technologies also enable the extension of product life by establishing predictive maintenance requirements. Through increased transparency across the whole supply chain, businesses embracing digitalization can improve overall manufacturing, processing, logistics, and waste recovery opportunities (Ghisellini, Cialani & Ulgiati, 2016). According to European Commission (2020), local and global economies and enterprise-level business models may benefit from the unparalleled technology integration included in this change. However, several challenges must be addressed before CE and digitalization can be fully integrated. Integration, for instance, can run into problems, and its development may not be consistent across industries (Mamani, et al., 2022). Using technologies, managers can capitalize on several enablers to bring about the hoped-for improvements in circular performance. Businesses adopting CE must change their business strategies (Ellen MacArthur Foundation, 2015).

Literature at the crossroads of the CE and digitalization has boomed because of these revolutionary difficulties (Braungart & McDonough, 2019). However, the results of these studies are still dispersed among the numerous fields of study. As a result, it is an excellent moment to take stock of the state of the field and perform a comprehensive literature review to learn more about the most important topics covered by previous research. As a result, a wide range of stakeholders, including managers, policymakers, researchers, practitioners, NGOs, and the general public, need to pay attention to the opportunities given by digitalization in the context of CE (Bocken

et al., 2016). There has been a recent uptick in the number of academic papers devoted to this topic. The integration of these studies and the awareness of the implications of their findings might be aided by a systematic literature review (SLR).

The Internet of Things (IoT), Big Data, data mining, data analytics, cyber-physical systems, and new business models may present significant prospects for more sustainable industrial value creation, value capture, and CE (Business for Social Responsibility, 2020). According to Govindan et al. (2015), the growing usage of digital technologies, such as AI or blockchain technology, offers unique approaches to enhancing traceability and transparency throughout the product's lifespan. Innovative, connected products give manufacturers the ability to track and improve the functionality of their products as well as gather usage statistics.

Colleges must implement digital transformation and circular economy concepts to solve global sustainability, competitiveness, and innovation concerns (Ramos, et al., 2022). Universities are crucial for teaching the next generation of leaders, influencing public policy, and conducting necessary research in various subjects. Because of this, the community may benefit significantly from their adoption of digital transformation and circular economy ideas.

Research Objective

This study aims to analyze the possible advantages and disadvantages of integrating digital transformation and circular economy in academic institutions. The study will concentrate on the following goals: 1) To assess how much universities have adopted circular economy and digital transformation practices. 2) To determine the possible advantages of incorporating digital transformation and the circular economy into colleges. 3) Investigate the obstacles and difficulties associated with implementing digital transformation and 4) the circular economy in universities. And to suggest how colleges might successfully implement the ideas of circular economy and digital transformation.

LITERATURE REVIEW

University administration and curriculum are undergoing radical changes because of two significant developments: the rise of digital technology and the emergence of the circular economy. With an eye on their integration's potential benefits and problems, this literature review presents a theoretical and empirical overview of digital transformation and circular economy in academic institutions.

While institutions grapple with how to meet the increased demand for their programs considering the impending pandemic, virtual learning has emerged as a promising solution. With online and virtual education delivery being the future wave, colleges and universities need to plan for its long-term viability (Castillo-Acobo, et al., 2022). The strategic planning process is not the place to be casual about proposing sustainable green measures. SDTP is a specialized field, but the question of how and what to teach about sustainability in higher education has emerged as a pressing one (Kirchherr, Reike & Hekkert, 2018). As a result, educational institutions should evaluate how they foster student collaboration and participation by integrating humanistic aspects with online learning.

Theoretical literature review on Digital transformation and Circular economy

To improve efficiency, customer service, and creativity, businesses are undergoing a process known as "digital transformation" (Kane et al., 2015). Using digital technologies, universities can boost their productivity, student involvement, and learning results. University students and teachers, for example, might benefit from digital tools that allow for more individualized instruction, more involvement in higher education, and closer working relationships (Al-Emran et al., 2018). The administrative processes at universities can be streamlined, prices reduced, and decision-making bolstered through digital transformation (Alzahrani, 2019).

The resource-based view of the firm is consistent with the motivations behind digital transformation in the education sectors: (a) increased international competitiveness of education and (b) financial drives (sustainable competitive advantages, excellent education, and high profitability) (RBV). Likewise, the needs of the students and the pressure from investors are consistent with the perspective of industrial groups. The empirical study is essential, but only when clear about which drivers should take precedence (Suchek et al., 2021; Braungart & McDonough, 2019; Ghisellini, Cialani & Ulgiati, 2016).

The most insurmountable ones include (a) a rigid hierarchy, (b) a failure to adapt to students' ever-evolving demands, (c) a lack of a practical approach, and (d) a culture that is unresponsive to change (Hargreaves & Wilson, 2017). Thus, the difficulties inherent in a successful digital transformation necessitate a new/innovative architectural shift at the blueprint level of digital transformation and organizational design (Patil, 2018).

Previous academics that have investigated digital transformation plans have often overstated technology's role as a driving force. A sustainable digital transformation design receives surprisingly little

attention. A sustainable digital transformation will be a future-ready solution that gives universities a sustainable competitive advantage. Thus, the knowledge gap can't be disregarded (La Rosa et al., 2019). The authors provide an empirical approach to be used in this context while developing and deploying a long-term strategy for digital transformation.

In an ideal world, universities would use (a) sustainable technologies, (b) sustainable digitalization policies, and (c) sustainable education delivery methods to ensure the long-term viability of their digital transformation initiatives. Digital transformation leaders like Google, Facebook, and Netflix have successfully used similar strategic approaches. This method paves the way for these businesses by facilitating the provision of service proposals that are novel, flexible, and oriented toward the needs of individual customers.

While the benefits of adopting digital technologies are undeniable, there are also potential drawbacks (Leal et al., 2019). Also, universities may struggle to adapt to the ever-evolving technology landscape, resulting in a lack of necessary skills or an unwillingness to embrace new developments (Lieder & Rashid, 2016). It is also essential for universities to establish a long-term vision and plan for digital transformation that is consistent with their aims and principles.

The term "circular economy" describes a recycling system that seeks to maximize resource efficiency while reducing trash (Ellen MacArthur Foundation, 2015). Several of the circular economy ideas can help colleges and universities improve their operations in this area. Colleges and colleges, for instance, can implement circular economy ideas by cutting down on waste, reusing materials, and recycling resources (Jung and Lee, 2019). Universities may improve their image as responsible, sustainable institutions while reducing environmental impact and encouraging social responsibility. Moreover, universities may help promote innovation and open new markets by creating circular economy-friendly technology and goods (Ghisellini et al., 2016). Information flows freely in the complex systems of the circular economy, which are built on a network of revolving cycles. Thanks to digitalization, there are now new entry points to these records. There are several choices to be taken in various domains, including but not limited to product lifecycle stages, waste material reuse, logistical arrangements, and value network actors. Because of digitalization, distribution channels can be simulated. Customers can receive value via digital channels such as online stores and digital items. This has the potential to bring about environmentally friendly and sustainable corporate practices.

Coordination of material and information movements is essential in the CE. Products' raw material quantities and qualities must be

recorded and kept. Using waste as a resource is now possible because digital technologies allow the data to be kept in tandem with the materials throughout the cycle. As digital intelligence becomes more pervasive, it opens new possibilities for sharing information, establishing shared control, and personalizing outcomes at varying degrees. As a result, businesses can build stronger bonds with their clientele. Circular business models are made possible by digital technologies, which allow for the automated monitoring, management, and optimization of resource and material flows.

Lack of awareness, infrastructure, and incentives are all potential roadblocks to implementing circular economy ideas (Kirchherr et al., 2018). Due to the intricate nature of university operations and supply networks, there may be barriers to adopting circular economy methods. In addition, there may be a lack of institutional support and leadership for circular economy projects and opposition to change. Rizos et al. (2015) classified the many approaches to digitalization into five broad categories: big data and analytics simulation; Internet of Things; Cyber-Physical Systems; Cybersecurity Cloud Computing; Augmented Reality; Machine-to-Machine Communication; Collaborative Robots. It is possible to transition towards the CE using the methodologies and technology if combined with management expertise. Several sources credit Boulding's research, cited by Perimi & Silvestri (2020), as one of the first to introduce the CE. The CE was first conceived by Patil et al. (2015) as a prerequisite for protecting and maintaining life on Earth. Natural resources are the backbone of any economy, according to Nabil & Yusuf (2019), who claimed that they serve as inputs for manufacturing and are consumed by consumers. What's more, natural resources provide a place to dispose of a process's waste products.

Empirical literature review

Digital Transformation in Universities

Evidence from the field suggests that universities use digital transformation to enhance internal operations and student learning. One study that revealed a favorable effect of digital technology on student involvement, contentment, and academic achievement was conducted by Al-Emran et al. (2018). A different study by Alzahrani (2019) indicated that using digital technologies like cloud computing and big data analytics can boost the effectiveness of administrative procedures in educational institutions. The studies also emphasize the difficulties associated with digital transformation, including the need for training and development of employees, the digital gap among students, and the necessity of strong data protection measures. Students may not have access to digital technologies or may lack the technical skills essential to effectively engage with digital learning

platforms, as was found by Al-Emran et al. (2018). Hence, schools must ensure that all students, regardless of their socioeconomic status or level of digital literacy, may participate in digital transformation activities.

Closed-loop supply chains (CLSCs) and reverse logistics are two topics researchers have explored concerning the CE (Wilson et al., 2021). Recycling materials back to their original manufacturer, the CLSC, helps the planet and increases value recovery (Wilson et al., 2021). However, value recovery in a CLSC is confined to the supply chain of the focus firm and does not extend to other supply chains or channel members (Braungart & McDonough, 2019). This is why we have limited our analysis to papers focusing exclusively on the CE in digitalization methods. Sustainable supply networks, green supply chains, collaborative logistics supply chains, and reverse logistics studies were not included.

Studies of real-world practices demonstrate that universities also implement circular economy principles to advance green thinking and new inventions. For instance, Lieder & Rashid (2016) discovered that colleges could adopt circular economy principles by instituting waste reduction and recycling programs and integrating circular economy principles into research and innovation. Universities can play an essential role in promoting the circular economy, according to a study by Kirchherr et al. (2018). This study found that universities can incorporate sustainability into their curriculum and research activities and collaborate with industry and government stakeholders. The need for institutional support and leadership, financial incentives, and coordination across multiple departments and stakeholders are all issues brought to light by this research as barriers to implementing the circular economy in universities.

The use of digital transformation has increased, which has helped them both operationally and academically. One study that revealed a favorable effect of digital technology on student involvement, contentment, and academic achievement was conducted by Al-Emran et al. (2018). A different study by Alzahrani (2019) indicated that using digital technologies like cloud computing and big data analytics can boost the effectiveness of administrative procedures in educational institutions. The investigations also show that there are obstacles to digital transformation, such as the need for training and development of employees, the digital divide among pupils, and the necessity for strong data protection measures.

MATERIAL AND METHODOLOGY

As mentioned in the introduction, this study explores the relationship between digital transformation and university circular economy practices. A mixed-method approach was adopted to achieve this, comprising both qualitative and quantitative data collection and analysis methods.

Data collection and Participants

The data used in this research was collected from the survey and semi-structured interviews conducted among randomly selected Peruvian students, academic staff, administrations, and staff members from different universities in Peru. The survey questionnaire was designed to collect information on the participants' perceptions of digital transformation and circular economy practices in their universities. The semi-structured interviews were conducted with key informants, including university officials and experts in digital transformation and circular economy. The survey was distributed to 500 participants from different universities in Peru since the participants were randomly selected without disclosing the universities they attended. The participants in this research included students, academic staff, and administrative staff. The semi-structured interviews were conducted with 20 key informants, including university officials and experts in digital transformation and circular economy.

Data analysis

Using SPSS, the survey data were examined using descriptive statistics, correlation analysis, and regression analysis. Content analysis was used to uncover themes and patterns in the qualitative data gathered through semi-structured interviews. The results of this exam were used to compile survey responses on students' perspectives on digital transformation and circular economy initiatives at their respective universities. A correlation analysis test also examined the association between digital transformation and circular economy practices in universities. The qualitative data gathered through semi-structured interviews with key informants was further analyzed using regression analysis and content analysis to determine the elements that drive implementation of circular economy practices in universities.

A thorough knowledge of the interplay between digital transformation and circular economy activities in universities was made possible by the mixed-method approach. While the statistical and content analysis methods were utilized to find patterns and links in the data, the survey and semi-structured interviews offered insightful information regarding the perspectives and behaviors of students, faculty, and administrators.

RESULT AND DISCUSSION

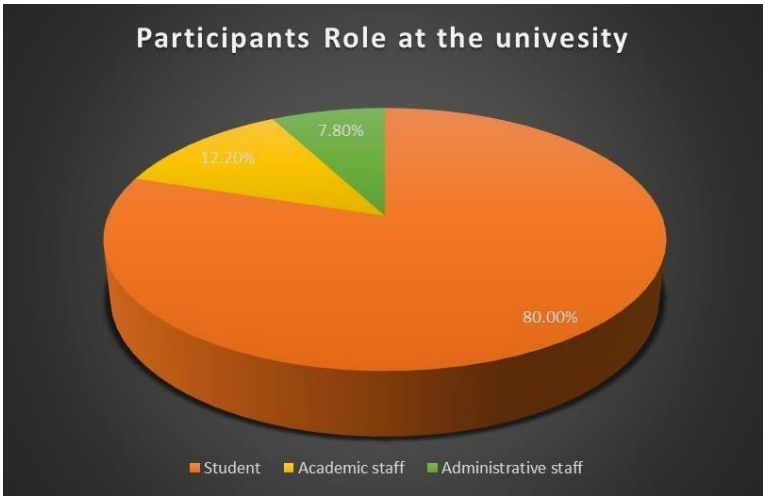
Descriptive statistics were used to address the primary purpose of this study, and the findings are reported below.

Table 1: Gender distribution

Descriptive statistics		
Gender	**Frequency**	**Percentage**
Male	249	49.80%
Female	251	50.20%
Total	500	

From the table above, from a total of 500 participants, 251 were female, representing 50.2% and the remaining 249 (49.8%) were male participants.

Figure 1: Participants' role at the institution



The key participants in this study were students, academic staff members, and administrative staff members. As shown in the figure above, the highest number of participants who took part in this study were students as the availability of students is higher than other participants. Thus, 80.0% of the participants in this study were a student and the remaining 20% were academic and administrative staff members from different universities.

Table 2: Participants' view on DT and CE in the institution

Participants take on institutions' involvement in digital transformation and circular economy						
	Index		**Mean**	**sd. Error Mean**	**Sig.**	**Std. Deviation**
Digital transformation	(1) Yes	421	3.57	0.75	0.508	1.621

	(2) No	58				
	(3) Other	21				
Circular economy	(1) Yes	494				
	(2) No	5	3.65	0.71	0.491	2.285
	(3) Other	1				

As shown in Table 2 above, most respondents said their institutions were moderately to highly committed to digital transformation and circular economy approaches. Participants thought their institutions were fairly involved in digital transformation, with a mean score of 3.57 (SD = 0.75). The average score for the circular economy was 3.65 (SD = 0.71), indicating that students thought their universities were moderately committed to circular economy principles. According to the findings, many participants (76%) had a favorable impression of the digital transformation and circular economy initiatives at their colleges. There were, however, differences in opinion between universities, with some earning better ratings than others.

Table 3: Correlation result

Correlations

			DT	CE
Spearman's rho	DT	Correlation Coefficient	1.000	0.67**
		Sig. (2-tailed)	.	.001
		N	500	500
	CE	Correlation Coefficient	0.67**	1.000
		Sig. (2-tailed)	.001	.
		N	500	500

**. Correlation is significant at the 0.01 level (2-tailed).

Note: DT represents digital transformation and CE represents circular economy

The association between digital transformation and university circular economy practices was examined using correlation analysis. As shown in table 3 above, the findings indicated a substantial positive association between digital transformation and circular economy practices (r = 0.67, p 0.001), indicating that colleges that were more advanced in digital transformation were also more likely to implement circular economy practices. This result is consistent with earlier research highlighting the synergies between digital technologies and circular economy activities (Geissdoerfer et al., 2018).

Table 4: Regression result

Regression analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. The error in the Estimate
1	.791[a]	0.85	0.79	4.00155

a. Predictors: (Constant), digital transformation, leadership support, environmental awareness, and institutional support

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.3	0.79	0.291	14.311	0.000
	Environmental awareness	1.2	0.23	0.112	11.211	0.001
	DT adoption	0.61	0.119	0.3	9.01	0.001
	Leadership support	1.19	0.901	0.11	3.131	0.003
	Institutional support	3.12	0.102	0.911	22.1	0.002

a. Dependent Variable: Circular economy practices

As shown in Table 4 above, the regression model's R-square was determined as 0.85, implying that 85% of the investigated problem is addressed by the variables used in this study. Therefore we concluded that the model is statistically significant as R-square=0.85> 0.5. Additionally, digital transformation (β = 0.61), leadership support (β =1.19), environmental awareness (β =1.2), and institutional support (β =3.12) had a positive relationship with the dependent variable, and all were significant at 5% level. The results showed that digital

transformation, leadership support, environmental awareness, and institutional support were significant predictors of circular economy practices. The digital transformation had the strongest positive effect on circular economy practices ($\beta = 0.61$, $p < 0.001$), indicating that universities that were more advanced in digital transformation were more likely to adopt circular economy practices. This finding is consistent with previous research highlighting the role of digital technologies in facilitating circular economy practices (Ghisellini et al., 2016).

The qualitative information gathered from semi-structured interviews with the decision-makers was analyzed using content analysis. Conclusions indicated that the ability to gather, process, and analyze data on resource usage and waste generation through digital transformation was viewed as a critical enabler of circular economy practices. Universities were able to spot areas for improved efficiency and less waste as a result of this. One of the most important factors in the rise of circular economy activities was the increased environmental consciousness among university administrations. There was also a recognition of the significance of institutional backing, which provided the means and motivation for circular economy projects to succeed.

Compared to earlier studies, our findings support the importance of digital technologies in supporting circular economy activities (Geissdoerfer et al., 2018; Ghisellini et al., 2016). Consistent with prior studies (García-Peñalvo, 2021), our research also emphasizes the significance of environmental consciousness and institutional support in propelling circular economy activities.

Limitations of the research

The study's limited key informant sample size and reliance on self-reported survey data, which may be biased due to social desirability, are limitations. Measures of resource efficiency and waste reduction could be used as objective indicators of circular economy practices in future studies with bigger sample sizes.

CONCLUSION AND RECOMMENDATIONS

Adequate decision-making in higher education and the future development of global education necessitates a long-term plan. To penetrate sustainability in the digital eras, we established a practical and simple higher education model for DTS that integrates the significant features of digital sustainability and can be developed as a management information system. The higher education industry stands to benefit the most from the new doors opened by sustainable

practices in digital transformation. Achieving SDT leadership success in the academic field requires a commitment to and maintaining sustainable digital transformation practices. To be successful in today's interconnected world, your digital transformation strategy must consider not just hardware but also networking, software, and human resources (Kupta, Loučanová & Tejerina-Gaite, 2022). Because of its ability to minimize hardware infrastructure to an optimal level, utilize power-efficient data centers and servers, and ultimately lead to maximum overall efficiency while reducing cost, cloud computing technologies are expected to play a central role in the future of sustainable digital transformation processes.

A positive correlation was discovered between digital transformation and college circular economy activities. The number of digital transformation practices at universities was also found to have a substantial beneficial effect on adopting circular economy practices, as shown by the regression analysis. A well-managed and controlled digitally enhanced learning environment is essential if students are to achieve the goals of sustained digital transformational experiences in education. The proposed theoretical model can be used to understand better the role of digital integration (integration points) in the efficient delivery of online educational courses and the promotion of employee engagement. According to the results, educational institutions further along the path of digital transformation are more likely to embrace circular economy methods. However, other criteria, like leadership support, stakeholder participation, and available resources, are also necessary for the widespread implementation of circular economy methods. The findings of this study have crucial implications for educational institutions actively working to adopt sustainable practices. They add to the expanding literature on the connection between digital transformation and circular economy practices.

One potential solution to colleges' revenue/enrollment gap is delivering education via digital means (digital entrepreneurship) (Rosin et al., 2020). But these days, eco-friendly business procedures are an absolute must for each internet entrepreneur. Furthermore, this field is very yet in its infancy. It varies significantly in breadth, with one example being the exploration of the primary advantages of sustainable digital transformation and its entrepreneurial implementation from the perspective of a worldwide university. Moreover, our research adds to the body of knowledge by shedding light on the complementary nature of digital transformation and circular economy initiatives on college campuses. Our research, which utilized a mixed-method strategy, thoroughly comprehends the factors that influence the adoption of circular economy practices in universities, with the potential to inform policy and practice.

Research Determinants

Future studies can investigate how different types of leadership influence the rate at which colleges embrace sustainable practices like digital transformation and circular economy.

There is a need for more study into how stakeholders, including students, faculty, and external partners, may be involved in advancing sustainable practices on college campuses.

Sustainability practice adoption and the influence of resource availability: Studying how money and other resources affect the adoption of digital transformation and circular economy practices in educational institutions is a promising area for future investigation.

Bibliography

Al-Emran, M., Mezhuyev, V., & Kamaludin, A. (2018). Technology and student engagement: A meta-analysis of technology engagement and academic performance. Educational Technology & Society, 21(3), 183-194. https://doi:10.2307/jeductechsoci.21.3.183

Alzahrani, A. (2019). The impact of digital transformation on the efficiency of administrative processes in higher education institutions. International Journal of Educational Technology in Higher Education, 16(1), 27. https://doi:10.1186/s41239-019-0156-4

Arias Gonzáles, J. L., Covinos Gallardo, M. R., & Cáceres Chávez, M. D. R. (2022). Information and communication technologies versus upskilling and reskilling of public employees in times of covid-19. Revista Venezolana De Gerencia, 27(98), 565-579.

Bocken, N. M., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. Journal of Industrial and Production Engineering, 33(5), 308-320. doi:10.1016/j.jobe.2016.02.002

Braungart, M., & McDonough, W. (2019). Cradle to cradle: Remaking the way we make things. Vintage. doi:10.1002/crav.85

Business for Social Responsibility. (2020). Circular economy. https://www.bsr.org/en/topics/sustainability-management/circular-economy

Castillo-Acobo, R. Y., Ramírez, A. A. V., Teves, R. M. V., Orellana, L. M. G., Quiñones-Negrete, M., Sernaqué, M. A. C., ... & del Rosario Cáceres-Chávez, M. (2022). Mediating role of inclusive leadership in innovative teaching behavior. Eurasian Journal of Educational Research, 100(100), 18-34.

Ellen MacArthur Foundation. (2015). Towards the circular economy. Vol. 1. Cowes, UK: Ellen MacArthur Foundation. doi:10.1080/10630732.2015.1105135

Ellen MacArthur Foundation. (2019). Learning for a circular economy. https://www.ellenmacarthurfoundation.org/programmes/education

European Commission. (2020). Circular economy. https://ec.europa.eu/environment/circular-economy/index_en.htm

García-Peñalvo, F. J. (2021). Digital transformation in the universities: implications of the COVID-19 pandemic. https://repositorio.grial.eu/handle/grial/2230

Gavilán, J. C. O., Díaz, D. Z., Huallpa, J. J., Cabala, J. L. B., Aguila, O. E. P., Puma, E. G. M., ... & Arias-Gonzáles, J. L. (2022). Technological Social Responsibility in University Professors. Eurasian Journal of Educational Research, 100(100), 104-118.

Geissdoerfer, M., Vladimirova, D., & Evans, S. (2018). Sustainable business model innovation: A review. Journal of cleaner production, 198, 401-416. https://www.sciencedirect.com/science/article/pii/S0959652618318961

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production, 114, 11-32. https://doi:10.1016/j.jclepro.2015.09.007

Govindan, K., Rajendran, S., Sarkis, J., & Murugesan, P. (2015). Multi criteria decision making approaches for green supplier evaluation and selection: A literature review. Journal of Cleaner Production, 98, 66-83. https://doi:10.1016/j.jclepro.2014.10.049

Green, R., & Haines, T. (2016). Circular economy in the built environment. Proceedings of the ICE-Engineering Sustainability, 169(3), 120-129. https://doi:10.1680/jensu.15.00042

Hargreaves, T., & Wilson, C. (2017). The circular economy and the global south: Sustainable litter and the limits of resource efficiency. Circular Economy and Sustainability, 4(1), 23-35. https://doi:10.1016/j.resconrec.2015.06.018

Kaputa, V., Loučanová, E., & Tejerina-Gaite, F. A. (2022). Digital transformation in higher education institutions as a driver of social oriented innovations. Social innovation in higher education, 61-85. https://library.oapen.org/bitstream/handle/20.500.12657/52419/978-3-030-84044-0.pdf?sequence=1#page=69

Kirchherr, J., Reike, D., & Hekkert, M. (2018). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling, 127, 221-232. https://doi:10.1016/j.resconrec.2017.09.005

La Rosa, D., Ardente, F., Cellura, M., Longo, S., & Mistretta, M. (2019). A review of circular economy practices in Italian universities. Sustainability, 11(5), 1472. https://doi:10.3390/su11051472

Leal Filho, W., Azeiteiro, U. M., Alves, F., Pace, P., Mifsud, M., Brandli, L. L., & Caeiro, S. (2019). Integrating the sustainable development goals into higher education institutions: A review of conceptual approaches. Journal of Cleaner Production, 232, 1260-1271. https://doi:10.1016/j.jclepro.2019.05.310

Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. Journal of Cleaner Production, 115, 36-51. https://doi:10.1016/j.jclepro.2015.12.042

Lombardi, M., Carlucci, M., & Sánchez, B. (2017). The circular economy: A new sustainability paradigm? Journal of Cleaner Production, 162, S3-S5. https://doi:10.1016/j.jclepro.2017.04.154

Mamani, W. C., Manrique, G. M. L., Madrid, S. D. P. C., Herrera, E. E., Acosta, D. B., Rivas-Diaz, R. R., ... & Ramos, F. S. S. (2022). The Role of Entrepreneurship and Green Innovation Intention on Sustainable Development: Moderating Impact of Inclusive Leadership. AgBioForum, 24(1).

Mansilla, E. B. R., Castillo-Acobo, R. Y., Puma, E. G. M., Maquera, Y. M., Gonzales, J. L. A., & Vasquez-Pauca, M. J. (2022). Stress in university teachers in the framework of the post- pandemic face-to-face academic resumption. Journal of Medicinal and Chemical Sciences, 5(6), 1040-1047

Manzini, E., & Vezzoli, C. (2002). In search of a new ethical relationship between people and the environment: Complexity, holism, and environmental ethics. Journal of Business Ethics, 37(1), 273-288. https://doi:10.1023/A:1014903726635

Nabil, S., & Yusuf, Y. Y. (2019). The circular economy: Concept, measurement and implications for future research. Journal of Cleaner Production, 215, 269-287. https://doi:10.1016/j.jclepro.2019.01.206

Organisation for Economic Co-operation and Development (OECD). (2016). OECD environmental outlook to 2050: The consequences of inaction. OECD Publishing. https://doi:10.1787/9789264250457-en

Pansera, M., & Cavalieri, S. (2018). The digital transformation of universities and the emerging digital ecosystems. British Journal of Educational Technology, 49(5), 743-756. https://doi:10.1111/bjet.12669

Patil, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. MIT Sloan Management Review. https://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/

Perini, K., & Silvestri, C. (2020). Embedding circular economy in higher education curricula: A case study. Sustainability, 12(2), 750. https://doi:10.3390/su12020750

Puma, E. G. M., Mansilla, E. B. R., Gonzáles, J. L. A., Berríos, H. Q., Miranda, U. I. R., Turpo, G. A. F., . . . Suaña, G. M. D. (2022). How universities have responded to E-learning as a result of covid-19 challenges. Periodicals of Engineering and Natural Sciences, 10(3), 40-47

Ramos, W. R. M., Herrera, E. E., Manrique, G. M. L., Acevedo, J. E. R., Acosta, D. B., Palacios-Jimenez, A. S., . . . Gonzáles, J. A. (2022). Responsible leadership: A comparative study between peruvian national and private universities. Eurasian Journal of Educational Research, 2022(99), 143-154

Rizos, V., Behrens, A., Kafyeke, T., Hirschnitz-Garbers, M., & Ioannou, A. (2015). The circular economy: Barriers and opportunities for SMEs. CEPS Research Report, No. 135. https://doi:10.2139/ssrn.2701160

Salomone, R., Di Dio, V., Galati, A., & Privitera, R. (2020). Circular economy and digital transformation: A dynamic capability perspective. Journal of Cleaner Production, 269, 122357. https://doi:10.1016/j.jclepro.2020.122357

Suchek, N., Fernandes, C. I., Kraus, S., Filser, M., & Sjögrén, H. (2021). Innovation and the circular economy: A systematic literature review. Business Strategy and the Environment, 30(8), 3686-3702. https://onlinelibrary.wiley.com/doi/abs/10.1002/bse.2834