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Empowering Middle School Students for a Sustainable Future: Integrating Circular Economy Principles with Youth Entrepreneurship Education

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ABSTRACT

Youth entrepreneurship education combined with the circular economy concepts provides a promising framework for tackling sustainability issues. To assess how well circular economy-driven strategies promote sustainability awareness and entrepreneurial abilities in middle school pupils, this study used a systematic literature review and bibliometric analysis (SLRBA). Using databases like ProQuest, PubMed, and Scopus, the main focus was research from 2013 to 2024. Important findings show that although instructors and students have good attitudes toward circular economy principles, their application is hampered by a lack of knowledge and resources. Although they encountered structural obstacles, interdisciplinary approaches such as project-based learning and flipped classrooms improved critical thinking and participation. To prepare kids for the demands of a sustainable workforce, youth entrepreneurship education greatly increased resilience, optimism, and entrepreneurial intention. However, more comprehensive implementation was constrained by policy gaps and a dependence on temporary fixes. To create inclusive, comprehensive, and future-ready learning environments that support global sustainability goals, this study highlights the significance of systemic frameworks, experiential learning, and focused policy reforms.

KEYWORDS

Circular economy; youth entrepreneurship education; sustainability awareness; experiential learning; interdisciplinary education; educational policy innovation.

Introduction

The circular economy provides a resource-efficient approach that combines financial gains with environmental sustainability. It is extensively adopted by public, corporate, and civic organizations and emphasizes technology-driven initiatives. It is also receiving more academic attention due to its potential to address global resource concerns (Velenturf & Purnell, 2021). The integration of circular economy principles with youth entrepreneurship education is emerging as a critical pathway to equipping students with the skills and knowledge required for a sustainable future (Liu et al., 2024). Circular economy emphasizes resource efficiency, waste reduction, and sustainable practices, aligning with the global Sustainable Development Goals (SDGs) (Krajnc et al., 2022). In education, these principles are particularly relevant for fostering a mindset that values innovation and sustainability (Binsuwadan et al., 2023; Renfors, 2024; Tiippana-Usvasalo et al., 2023). However, the challenge lies in effectively embedding circular economy principles into educational systems. Despite the positive attitude of educators and students toward circular economy, knowledge gaps and the lack of practical skills hinder their full implementation (Nguyen, 2023). Teachers face difficulties integrating circular economy concepts due to insufficient training, limited resources, and traditional teaching practices, which fail to promote behavioral change (Keramitsoglou et al., 2023). Youth entrepreneurship education provides a complementary framework for addressing these gaps by fostering critical skills such as resilience, creativity, and problem-solving, which are essential for addressing sustainability challenges (Bae & Kim, 2022; El-Gohary et al., 2023). Additionally, innovative teaching methods such as flipped learning and project-based approaches have demonstrated their ability to enhance engagement with circular economy principles. Still, their broader application is limited by structural barriers, including inadequate access to circular technologies and traditional curriculum constraints (Hall & Velez-Colby, 2018).

The core problem is the insufficient integration of circular economy principles into existing educational frameworks, coupled with inadequate support for teachers and limited adoption of innovative learning approaches (Kirchherr & Piscicelli, 2019; Renfors, 2024; Tiippana-Usvasalo et al., 2023). This hinders the ability of education to prepare students for the environmental and economic challenges of the future.

To promote sustainable practices and creative problem-solving abilities, the study sought to provide middle school students with the information, abilities, and attitudes needed to incorporate circular economy ideas into youth entrepreneurship education.

The study assesses students' and instructors' knowledge and comprehension of the circular economy principles while identifying integration opportunities and obstacles. It looks at how well transdisciplinary and experiential learning strategies—like project-based and flipped learning—can encourage circular economy involvement. To prepare students for problems in the sustainable workforce, it also examines how youth entrepreneurship education might promote resilience, optimism, and entrepreneurial intention. To uncover policy gaps and opportunities to promote sustainable development through focused educational practices, the study also examines systemic and multidisciplinary approaches that connect sustainability, social responsibility, and critical thinking.

Understanding and improving circular economy education among middle school students and teachers is the main goal of the research questions. They ask about the degree of awareness of circular

economy principles and the opportunities and challenges of implementing them in the way education is currently conducted. Additionally, the study aims to assess how well flipped and project-based learning and other multidisciplinary and experiential learning approaches promote student engagement with sustainability and circular economy. It also looks at how teaching young people to be entrepreneurs might help them develop resilience and optimism, which will better equip them to deal with environmental concerns. Finally, focusing on the potential of policy changes to support circular economy learning, it looks at how systemic methods might foster sustainability, social responsibility, and critical thinking in education.

Theoretical Framework

To offer a thorough framework for comprehending the relationship between sustainability education and young entrepreneurship, this study combines the theories of the circular economy (CE), experiential learning (ELT), and entrepreneurial intention (EIT).

Theory of the Circular Economy

The circular economy framework highlights the shift from a linear to a circular economic model by encouraging resource efficiency, waste reduction, and sustainability. The significance of giving students the information and abilities they need to comprehend and apply sustainable practices is supported by circular economy theory in the context of education. This is in line with the worldwide Sustainable Development Goals (SDGs), especially those that center on responsible production and consumption (SDG 12) and high-quality education (SDG 4). The theory provides the framework for investigating how to incorporate circular economy ideas into youth education to promote sustainable behavior and thought patterns (Chirumalla et al., 2024; Kirchherr et al., 2023; Rashid & Malik, 2023).

Theory of Experiential Learning (ELT)

With a focus on a cyclical process of concrete experience, reflective observation, abstract conceptualization, and active experimentation, Kolb's experiential learning theory emphasizes the value of learning by doing (Mekonnen, 2020; Schank et al., 2013; Tan & Kim, 2015). Since project-based and flipped learning strategies have improved engagement and comprehension of circular economy concepts, ELT is especially pertinent to this study (Keramitsoglou et al., 2023). These methods give students practical experience, which fosters more profound learning and the implementation of sustainability concepts in real-world settings.

Theory of Entrepreneurial Intention (EIT)

The entrepreneurial intention theory examines how attitudes, subjective norms, and perceived behavioral control impact entrepreneurial activity (Ferreira et al., 2012; Hueso et al., 2020; Moriano et al., 2011). EIT is used in this study to investigate how entrepreneurship education develops abilities, including critical thinking, optimism, and resilience—skills that are essential for tackling sustainability issues (Bae & Kim, 2022). By integrating circular economy principles with entrepreneurial ambition, this framework investigates ways to inspire students to develop sustainable solutions.

Combined, these theories offer a strong framework for examining how circular economy concepts are incorporated into youth entrepreneurship education, emphasizing the contribution of creative teaching strategies and skill development to developing sustainable and entrepreneurial mindsets.

Research hypotheses

The hypotheses for the study are:

- H1: Increased awareness of circular economy principles among students and educators positively correlates with successfully integrating circular economy concepts into educational practices.
- H2: Interdisciplinary and experiential learning approaches, such as flipped learning and project-based formats, significantly enhance student engagement and understanding of circular economy and sustainability concepts.
- H3: Youth entrepreneurship education integrating circular economy principles significantly improves students' entrepreneurial intention, resilience, and critical thinking skills.
- H4: Systemic and interdisciplinary approaches in education foster greater sustainability awareness, social responsibility, and critical thinking, helping to address gaps in circular economy education.

Methodology

Formulation of key concepts, relationship analysis, and supporting Ideas

The conceptual framework development focused on refining circular economy and youth entrepreneurship concepts through a systematic literature review and concept mapping. This approach organized key ideas, such as sustainability awareness, entrepreneurial skill development, and interdisciplinary education. Relationships between these concepts were analyzed to understand how circular economy principles and experiential learning impact student engagement and critical thinking. This process facilitated the creation of research questions and identified essential keywords for a systematic review, ensuring a comprehensive exploration of the integration of circular economy principles with youth entrepreneurship education. It provided a foundation for linking theoretical and practical insights effectively.

Data Extraction/Qualitative Synthesis

A systematic literature review with bibliometric analysis (SLRBA) was conducted to ensure reliable data extraction on the integration of circular economy principles in youth entrepreneurship education (Donthu et al., 2021; Rosário et al., 2021). By systematically reviewing and coding academic publications, the study examined circular economy-driven educational approaches' impact on sustainability awareness, entrepreneurial skill development, and interdisciplinary learning. The findings highlight how these approaches prepare students for future workforce challenges, emphasizing their role in fostering sustainability and critical skills for addressing global issues (Krajnc et al., 2022; Nguyen, 2023).

Evaluation of Circular Economy and Youth Entrepreneurship Education Integration

To evaluate the integration of circular economy principles and youth entrepreneurship education, a systematic review adhering to PRISMA criteria was conducted across databases such as Google Scholar, PubMed, Scopus, Web of Science, JSTOR, and ProQuest. Relevant articles from 2013 to 2024 were identified using Boolean search terms ("OR" and "AND") and targeted keywords. The review focused on original research and recent studies examining the role of circular economy-driven

approaches in fostering sustainability awareness and entrepreneurial skills. Findings highlight their potential in creating interdisciplinary, inclusive, and future-ready educational frameworks aligned with sustainable development goals.

Inclusion Criteria for Qualitative Synthesis

Inclusion criteria for the qualitative synthesis required original articles published in English and sourced from reputable journals or conference proceedings. Theses and dissertations were excluded. Selected documents focused on integrating circular economy principles into youth entrepreneurship education, emphasizing their impact on fostering sustainability awareness, critical thinking, and inclusive interdisciplinary learning environments that align with global sustainability goals.

Article Selection Process

The first step involved identifying 750 records from different databases and screening them for relevancy based on title and keyword. Using automation technologies, 450 duplicates and 200 ineligible records were eliminated, leaving 100 articles. These publications were further vetted by looking for pertinent information in the abstracts. Upon final screening, items not meeting the predetermined inclusion criteria were excluded. Figure 1 illustrates that 37 articles were selected and assessed for qualitative synthesis due to this sequential selection process.

Data Extraction/Qualitative Synthesis

A standardized data extraction procedure was followed to minimize subjectivity, capturing and coding relevant information from selected articles. The synthesized information was used to address the research questions. An excel sheet was prepared to record, code, and synthesize data, including author names, publication titles, journal names, publication years, research questions and aims, conceptual frameworks, research designs, methods and data analysis, key findings, and limitations and future research. This enabled comprehensive data extraction for analysis.

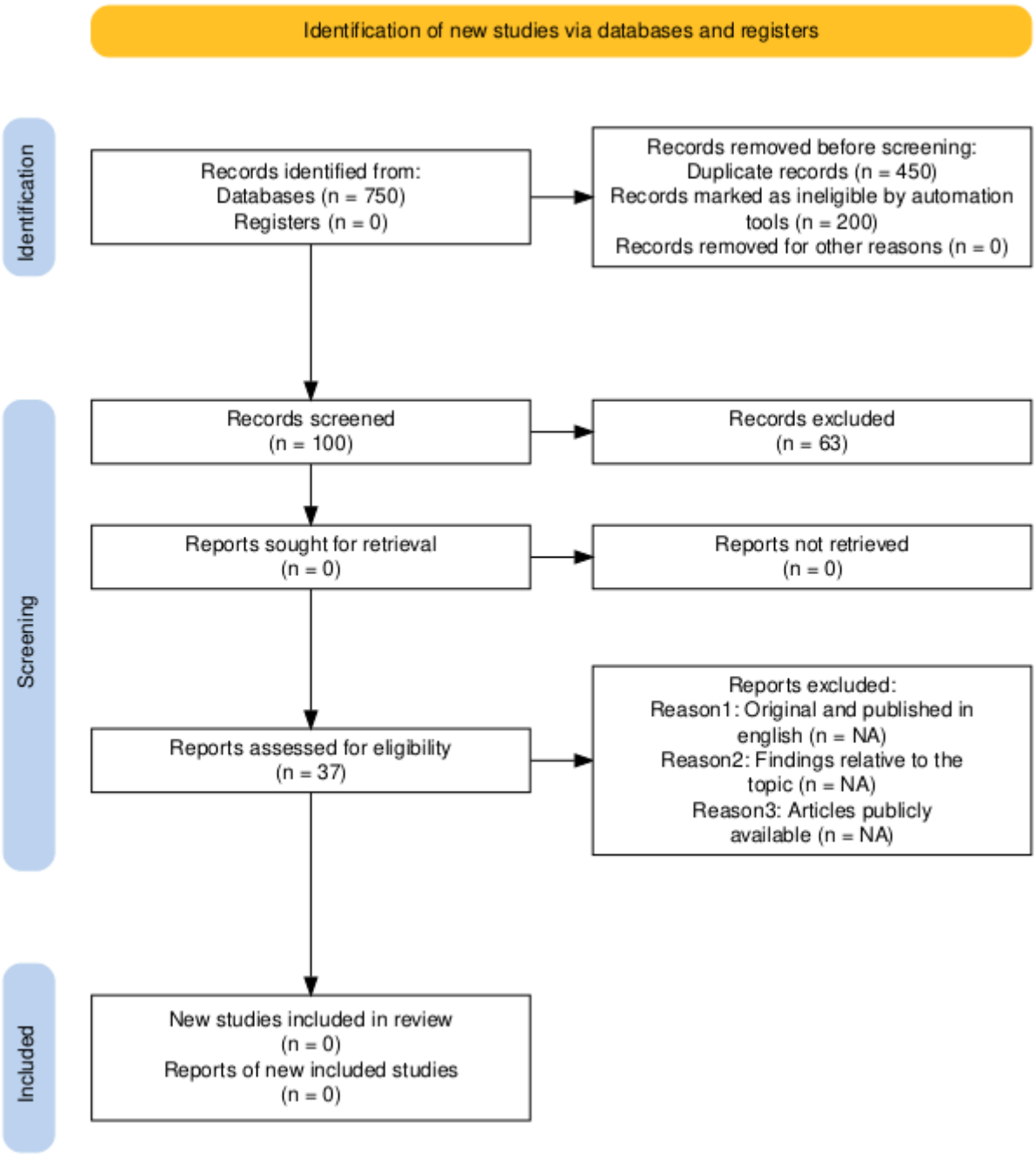
Data analysis

The methodology involved analyzing trends and citation frequencies to evaluate the integration of circular economy principles into youth entrepreneurship education. A review of publications from 2013 to 2024 examined growth patterns in academic contributions, with visual tools like graphs and tables highlighting key developments. Citation analysis identified influential studies and emerging research themes. Quantitative approaches evaluated relationships between variables such as educational methodologies and sustainability outcomes, while qualitative insights contextualized these findings. This mixed-method approach provided a comprehensive framework for assessing CE-focused educational strategies, revealing trends, gaps, and the impact of innovative pedagogical practices on skill development.

Ethical Considerations

Throughout the study, ethical considerations were meticulously observed. Data privacy was safeguarded by anonymizing personal information, and all sources were credited in compliance with copyright laws (Ducato, 2020; Hornuf et al., 2023). The research also adhered to ethical guidelines for using AI in education, ensuring that the potential biases and risks associated with AI tools were critically assessed. This practice reinforced the commitment to ethical research standards and respected the autonomy of all contributors.

Figure 1. *Identification of new studies via databases and registers (PRISMA diagram) (Haddaway et al., 2020)*

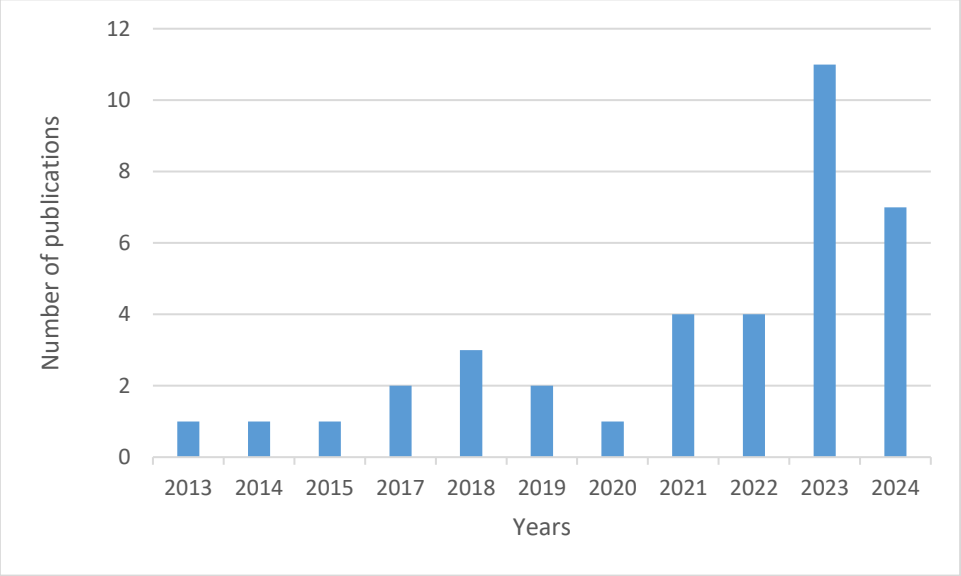


Results

Trends in the publication of articles from 2013 to 2024

Figure 2 illustrates the upward trend in publications focused on sustainable education and youth entrepreneurship from 2013 to 2024. Initial years (2013–2017) show limited publication activity, with fewer than three publications per year. A noticeable increase occurred in 2018, reflecting growing academic interest in integrating circular economy principles and entrepreneurship into educational frameworks. The peak in 2023, with over ten publications, indicates heightened scholarly engagement, possibly due to the urgency of sustainable development goals and the role of youth education in fostering sustainability. The slight dip in 2024 suggests a potential leveling or slight decrease in publication frequency as the field matures (Figure 2).

Figure 2. *Trends in Publications on Sustainable Education and Youth Entrepreneurship (2013–2024)*



Citation Frequency of Key Studies on the topic of Sustainable Education and Youth

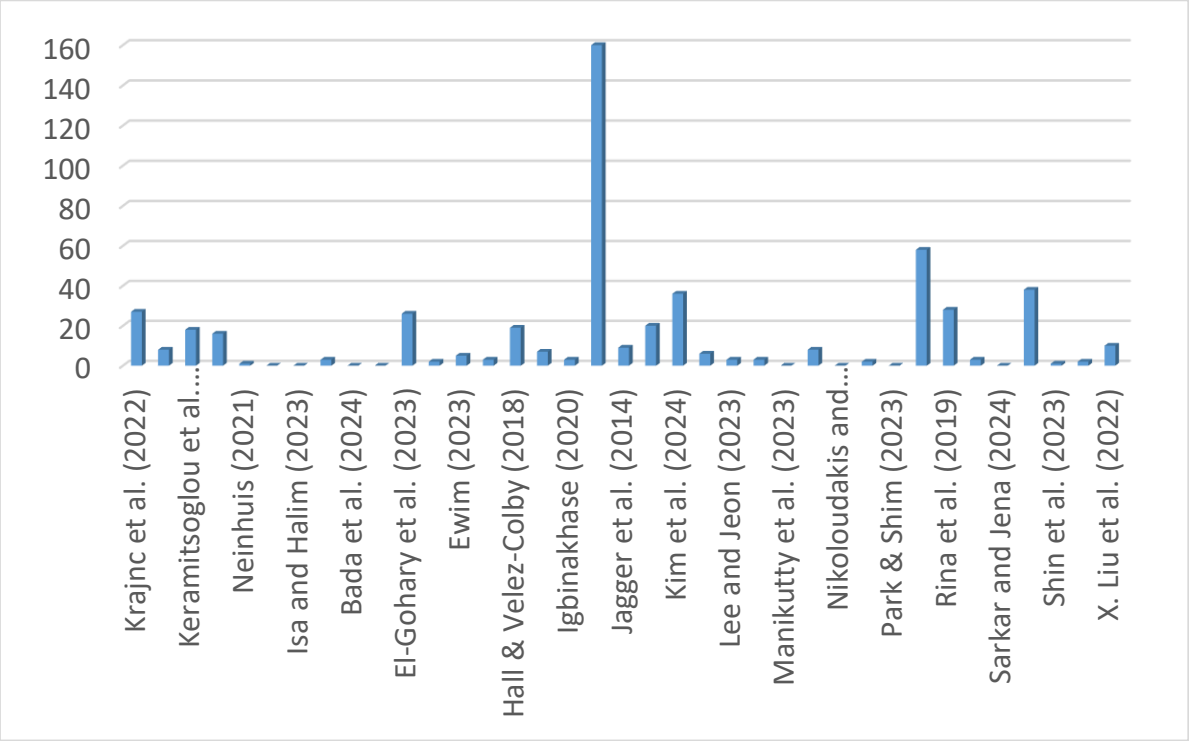
This section thoroughly examines how often pivotal research studies have been referenced in scholarly work within these domains. This analysis is crucial as it helps highlight the studies that have had the most significant impact on the academic community, guiding current research trajectories and educational practices related to sustainable education and youth entrepreneurship. By reviewing citation trends and frequencies from recent publications, this section sheds light on which topics garner the most attention and how the interdisciplinary nature of these fields fosters a diverse academic dialogue that spans multiple research areas. This inquiry reflects the current state of research and points to the future directions that scholars are likely to pursue.

Entrepreneurship

Figure 3 highlights the citation frequency of individual studies on sustainable education and youth entrepreneurship from various authors. The data reveals that Islam et al. (2021) received the highest citations, indicating a significant influence within the field. Other notable works, such as those by

Graf et al. (2022) and Nguyen (2023), also show high citation counts, suggesting that recent publications are gaining traction. The distribution of citations across studies illustrates the diversity of research contributions, with many authors from 2022 to 2024 receiving moderate attention. This trend may reflect the growing relevance and cross-disciplinary appeal of integrating circular economy principles and entrepreneurial skills in educational frameworks.

Figure 3: *Citation Frequency of Key Studies on Sustainable Education and Youth Entrepreneurship*



Methodologies in Circular Economy and Youth Entrepreneurship Research

Research on circular economy and youth entrepreneurship employs diverse methodologies to explore engagement and education. Quantitative studies, such as those by Krajnc et al. (2022) and Bae and Kim (2022), use surveys and statistical models like Exploratory Factor Analysis (EFA) and Structural Equation Modeling (SEM) to analyze factors influencing youth attitudes and intentions. Mixed-methods approaches, demonstrated by Nguyen (2023) and Keramitsoglou et al. (2023), combine quantitative surveys with qualitative interviews and case studies to comprehensively understand CE integration in education. As seen in Neinhuis (2021) and Ortiz et al. (2015), project-based learning models emphasize hands-on activities to enhance sustainability engagement, assessed through pre- and post-surveys. Systematic reviews, including Islam et al. (2021) and Sarkar and Jena (2024), synthesize existing data to identify trends and barriers but lack new empirical evidence. Experimental designs, such as those by Kim et al. (2024), validate interventions' effectiveness using pre-and post-tests and control groups, advancing practical applications in education.

Key Findings in Circular Economy and Youth Entrepreneurship Education: A Structured Overview

Circular Economy Awareness and Implementation

Studies such as those by Krajnc et al. (2022) and Nguyen (2023) reveal that while there is a positive attitude toward circular economy principles among youth and educators, knowledge and practical skills remain insufficient. Teachers recognize circular economy's relevance but face challenges in fully integrating concepts due to knowledge gaps. Experiential learning, as demonstrated by Keramitsoglou et al. (2023), enhances awareness but does not consistently lead to behavioral change, indicating a need for supportive resources and further training in circular economy integration.

Educational Approaches and Challenges

Research on diverse educational models, like Hall & Velez-Colby (2018) and Igbinakhase (2020), emphasizes the value of interdisciplinary and experiential learning to promote circular economy and sustainability. For instance, flipped learning and project-based formats facilitate deeper engagement, while barriers such as traditional practices and limited access to circular technologies hinder broader application. These findings highlight that incorporating practical experience and supporting autonomy is crucial for effective circular economy education.

Entrepreneurship Education and Youth Skills Development

Youth entrepreneurship studies, including those by Bae and Kim (2022) and El-Gohary et al. (2023), show that attributes like resilience, optimism, and entrepreneurial intention are reinforced through educational satisfaction and training programs. Additionally, programs that integrate business principles into STEM education, as explored by Ewim (2023), foster critical thinking and entrepreneurial skills, preparing students for the workforce and addressing sustainability challenges. These studies underscore the value of a holistic educational approach that equips young people with technical skills and cultivates soft skills crucial for entrepreneurship. Furthermore, such programs enhance the adaptability of youth in a rapidly changing economy, encouraging a proactive stance towards global economic shifts and environmental sustainability.

Sustainability and Systemic Thinking in Education

Reimers (2021) and Shapiro et al. (2021) emphasize the necessity of integrating sustainability into educational curriculums through a systemic approach that merges environmental stewardship with social responsibility and critical thinking. Their work suggests that students can develop a more comprehensive understanding of global challenges by intertwining elements such as STEM education with broader societal contexts like micromarketing or interdisciplinary studies. This educational framework fosters environmental awareness and cultivates a sense of social responsibility, enabling students to apply their scientific and technical knowledge to real-world problems. This approach encourages students to think systemically, recognizing the interconnectedness of environmental, social, and economic factors, and equips them with the skills to innovate and drive positive change in their communities and beyond.

Policy Implications and Future Directions

Several studies, such as Islam et al. (2021) and Jagger et al. (2014), highlight gaps in policy and consumer behavior integration within circular economy models, particularly in e-waste management.

The findings suggest that policy innovations and targeted entrepreneurship education can effectively bridge these gaps, providing practical pathways for youth to contribute to sustainable development goals. To capitalize on these insights, it is crucial for policymakers to create supportive environments that encourage young entrepreneurs to innovate within the realm of sustainable practices. Implementing robust educational frameworks that integrate sustainability into the core curricula can nurture a generation adept at transforming policy challenges into entrepreneurial opportunities. Moreover, fostering partnerships between educational institutions, industry, and government can facilitate the practical application of these innovations, thus accelerating progress toward global sustainability goals. This collaborative approach ensures that the theoretical knowledge imparted through education translates into actionable strategies that address pressing environmental issues, such as e-waste management, through sustainable business practices.

Limitations and Future Research Directions in Circular Economy and Youth Entrepreneurship Studies

Sampling and Generalizability Issues

Many studies, such as those by Krajnc et al. (2022) and Nguyen (2023), highlight limitations due to non-random sampling, small sample sizes, and single-context studies, affecting the generalizability of findings across diverse demographics and regions. Future research should expand sample diversity and incorporate longitudinal studies to assess the long-term impacts of circular economy and entrepreneurship education on youth perspectives and behaviors. Additionally, it is crucial to engage in cross-cultural studies to understand better how different cultural contexts influence the effectiveness of circular economy and entrepreneurship education. Researchers can identify universal principles and region-specific adaptations necessary for maximizing educational impact by comparing outcomes across varied settings. This approach can also foster international collaboration, sharing best practices and innovations that further enhance sustainability education's global reach and relevance. Furthermore, integrating advanced analytical methods and multi-dimensional data can help overcome the inherent biases of smaller, localized studies, providing a more comprehensive understanding of the complex interactions between educational initiatives and student outcomes in sustainability.

Context-Specific and Cultural Constraints

Several studies, including Ahmed (2023) and Elmonshid and Sayed (2024), note limitations related to the specific regional or institutional focus, which may not reflect global practices. Future research could explore these topics in varied cultural and educational contexts to develop more universally applicable findings and strategies. Building on this understanding, it's essential to recognize that educational strategies effective in one cultural setting may require significant adaptation to be just as effective in another. Researchers could, for example, investigate how different teaching methodologies in circular economy and entrepreneurship are received in various educational systems—from highly centralized to more decentralized frameworks—to tailor approaches that align with local cultural norms and values. An example of this would be studying the impact of project-based learning on entrepreneurial skills in students from collectivist societies such as Japan compared to individualistic cultures like the United States. This comparative approach could reveal crucial

insights into how collaborative versus competitive learning environments influence student engagement and success in sustainability initiatives.

Methodological Limitations and Data Reliance

Studies like Igbinakhase (2020) and Della Torre et al. (2019) rely heavily on secondary or self-reported data, which may introduce biases or lack depth. Researchers are encouraged to incorporate primary data collection methods, such as interviews or direct observations, to validate findings and provide richer insights into youth entrepreneurship and circular economy education. For example, utilizing big data to track real-time student interactions and engagements in online entrepreneurship platforms can offer a more dynamic and comprehensive view of learning progress and behavior patterns. Additionally, applying these advanced technologies to analyze longitudinal data could help researchers identify long-term trends and impacts of circular economy education, thus enhancing the reliability and applicability of research findings. This methodological rigor will not only strengthen the validity of the studies but also ensure that the conclusions drawn are robust and reflect actual conditions and outcomes in youth entrepreneurship and sustainability education.

Short Program Duration and Limited Follow-Up

Research by Keramitsoglou et al. (2023) and Shin et al. (2023) is constrained by the short duration of interventions, which limits the ability to observe long-term effects. Future studies should consider extended program timelines and longitudinal assessments to understand the sustained impact on students' environmental and entrepreneurial behaviors. Additionally, incorporating a series of follow-up evaluations at regular intervals post-intervention can help capture the evolution of students' attitudes and behaviors over time. These assessments could track changes in students' entrepreneurial ambitions and environmental consciousness, providing insights into the durability and decay of educational impacts. To further enrich these studies, researchers could also explore the role of external factors, such as economic shifts, policy changes, and social movements, in influencing long-term outcomes. This comprehensive approach would offer a more detailed picture of how educational interventions in circular economy and entrepreneurship can shape youth trajectories in a dynamically changing world.

Need for Broader Interdisciplinary Approaches

Some studies, like Shapiro et al. (2021) and Reimers (2021), emphasize the importance of interdisciplinary learning but often lack standardized frameworks to measure impact consistently. Future research could benefit from developing and testing integrated curricula that combine environmental, entrepreneurial, and systemic thinking skills across disciplines, aiming to foster holistic approaches to sustainability and entrepreneurship education. To effectively implement and evaluate such interdisciplinary curricula, partnerships between educational institutions, industry experts, and community organizations should be encouraged. These collaborations can facilitate the sharing of diverse expertise and resources, ensuring that the curriculum remains relevant and comprehensive. Additionally, the development of cross-disciplinary metrics and assessment tools will be crucial for quantifying the outcomes of these integrated educational approaches. For example, researchers could devise assessment frameworks that measure cognitive gains, behavioral changes, and real-world impact, such as students' ability to launch sustainable ventures or implement sustainable practices effectively. This would validate the educational strategies and demonstrate their

practical value in fostering a new generation of environmentally conscious and entrepreneurially minded leaders.

Discussion

Trends and Methodological Advances in Circular Economy and Youth Entrepreneurship Research

The increasing interest in integrating circular economy principles with youth entrepreneurship education is evident in the upward trend in publications from 2013 to 2024. A peak in 2023 highlights heightened scholarly engagement driven by the urgency of achieving sustainable development goals (SDGs) through youth education. The slight dip in 2024 suggests the field's maturation and underscores the need for diversified research methodologies to sustain progress.

Citation analyses identify influential works like Islam et al. (2021) and emerging contributions such as Graf et al. (2022), showcasing the field's cross-disciplinary appeal. Methodologically, research employs diverse approaches, including surveys (EFA, SEM), mixed-methods, and project-based learning, providing valuable insights into circular economy integration and youth engagement. However, limitations such as short-term interventions, reliance on secondary data, and single-context studies hinder long-term impact. Addressing these gaps through longitudinal, primary data-focused, and culturally diverse research is essential for advancing innovative educational practices.

Integrating circular economy principles with youth entrepreneurship education offers a promising framework for effectively empowering middle school students to address sustainability challenges. The findings from various studies shed light on critical areas requiring attention and improvement to ensure impactful educational outcomes.

Circular Economy Awareness and Implementation

While there is a positive attitude toward circular economy principles among students and educators, knowledge and practical skills gaps present significant barriers to integration. As Krajnc et al. (2022) and Nguyen (2023) highlight, educators face challenges due to insufficient training and resources. Experiential learning approaches, such as those demonstrated by Keramitsoglou et al. (2023), show the potential to enhance awareness but often need to translate into consistent behavioral change among students. This suggests the necessity for ongoing professional development for educators and the provision of structured resources to implement circular economy concepts in middle school curricula effectively.

Educational Approaches and Challenges

Interdisciplinary and experiential learning models, such as flipped classrooms and project-based formats, have proven effective in promoting engagement with circular economy and sustainability concepts, as noted by Hall & Velez-Colby (2018) and Igbinakhase (2020). However, traditional educational practices and limited access to advanced circular technologies hinder broader application. These findings underscore the importance of integrating practical, real-world experiences into educational frameworks while addressing systemic barriers. Promoting autonomy and creativity among students is critical to fostering meaningful engagement with circular economy principles.

Circular economy concepts are successfully incorporated into education through field trips and flipped classrooms. With flipped classrooms, students can watch videos and read books at home to grasp fundamental ideas like waste reduction and resource efficiency, while in-class activities

emphasize case studies and group problem-solving. Attending recycling facilities, farms, or neighborhood organizations during field trips exposes students to sustainability issues in the real world and enables them to suggest creative solutions (Cheng & Tsai, 2019; Hwang et al., 2015). Field trips, defined as educational excursions beyond the classroom, promote experiential learning, bridging theoretical knowledge with real-world applications (Jandrić et al., 2020; Mead, 2019). Supported by constructivist and experiential learning theories, they enhance critical thinking, problem-solving, and interdisciplinary connections (Brunhaver, 2018; Churchill, 2015). Aligned with curriculum standards, field trips deepen understanding across subjects like ecology and history (Ziegler, 2020). Despite logistical, equity, and funding challenges (Phillips, 2007), they remain vital for holistic education, offering innovative opportunities to engage students meaningfully. This review identifies best practices, highlights gaps, and suggests future research directions to enhance their educational value (Mead, 2019; Mujtaba, 2018).

Programs like the Invention Convention also encourage creativity and entrepreneurial abilities by enabling students to build sustainable products (Owens et al., 2002; Reis et al., 1998). These tactics can be strengthened by policies that provide funds, foster collaborations, and facilitate chances for experiential, hands-on learning.

Considering a few successful implementations, it can be cited the following case studies:

The Plasticpreneur Initiative in Kenya successfully integrates circular economy principles and entrepreneurship education, particularly in middle schools. This program aims to develop kids' entrepreneurial skills while teaching them about environmental sustainability and plastic recycling (Ong'are & Vyalu, 2023). This program blends hands-on training with small-scale recycling equipment with curriculum-based workshops on entrepreneurship, resource efficiency, and trash reduction. Students develop their creativity and commercial abilities by turning plastic garbage into marketable goods like keychains and tiles. The program fosters microbusinesses' growth, fostering communal impact and financial independence. It promotes recycling and increases sustainability awareness by highlighting environmental stewardship and responsible consumerism (Dijkstra et al., 2020). This creative strategy tackles the problem of plastic trash while giving young people the skills they need for future work, promoting long-term economic growth and environmental sustainability in the area (Oguge, 2019).

Another case study is the GreenBiz Youth Program in the Netherlands which is an innovative educational initiative designed to integrate circular economy principles into entrepreneurship projects for middle school students. This program encourages students to engage with local industries and repurpose waste materials into marketable products. The GreenBiz Youth Program equip students with sustainability and business skills. It emphasizes circular economy concepts, waste reduction, and resource efficiency through project-based learning, where students design innovative products from local waste, such as eco-friendly packaging. Collaboration with local businesses provides practical insights, while a flipped classroom methodology fosters active learning, critical thinking, and creativity. The program enhances entrepreneurial intentions and raises community awareness of sustainability. By blending theory and hands-on experience, the initiative prepares students to tackle future challenges and drive environmental and economic change in their communities.

Innovative Pedagogical Tools for Circular Economy (CE) Integration

In flipped classroom models, digital tools like Edpuzzle and Nearpod can create interactive video lessons where students actively engage with content through embedded quizzes and reflections before class. These tools allow teachers to assess prior understanding and tailor in-class activities accordingly (Sanmugam et al., 2019). For instance, an introductory module on the Circular Economy could include videos illustrating the lifecycle of materials, followed by in-class collaborative projects where students design circular solutions for local challenges (Petrova, 2023; Ramasany et al., 2022; Ware, 2021).

Project-based learning can be enriched using frameworks like the Gold Standard PBL model from the Buck Institute for Education (Sayuti et al., 2020; Swandi et al., 2023), which emphasizes key components such as real-world problem-solving, sustained inquiry, and student voice. Tools like Trello or Miro can facilitate project management and brainstorming (Ajiva et al., 2024; Horvat et al., 2021), while digital fabrication tools such as 3D printers and laser cutters enable students to prototype sustainable solutions (Lodhi et al., 2024; Soomro et al., 2021). For example, students could use these tools to design products that repurpose waste materials, reinforcing circular economy principles through hands-on experience.

Gamification and Simulation Tools: Incorporating gamification elements into these methods can enhance engagement. Tools like EcoChallenge or Planet Earth Game simulate decision-making in sustainability scenarios, encouraging students to explore the impact of their choices in a controlled environment. Such tools can deepen understanding of resource efficiency and waste reduction while developing entrepreneurial thinking (Thong et al., 2023; Weyl et al., 2022).

Entrepreneurship Education and Youth Skills Development

Youth entrepreneurship education significantly contributes to skill development in resilience, optimism, and critical thinking. Studies by Bae and Kim (2022) and El-Gohary et al. (2023) demonstrate the role of well-structured programs in reinforcing entrepreneurial intentions and preparing students to address sustainability challenges. Integrating business principles into STEM education, as explored by Ewim (2023), further enhances critical thinking and workforce readiness. These findings highlight the importance of linking entrepreneurship education with circular economy principles to equip students with the tools needed for future sustainability-focused careers.

Sustainability and Systemic Thinking in Education

Adopting a systemic approach that connects sustainability with social responsibility and critical thinking is essential for cultivating a holistic understanding of global challenges. Reimers (2021) and Shapiro et al. (2021) demonstrate how interdisciplinary learning that integrates STEM with micromarketing promotes environmental awareness and responsibility among students. These findings emphasize the need for educational programs that teach sustainability concepts and embed them into broader systemic frameworks to address the complexities of the circular economy.

Policy Implications and Future Directions

Policy gaps remain a critical barrier to effective circular economy education. Studies like those by Islam et al. (2021) and Jagger et al. (2014) highlight the lack of integration between policy, consumer behavior, and educational initiatives, particularly in areas like e-waste management. Innovative policies that support interdisciplinary education and targeted entrepreneurship training can bridge

these gaps. Such policies should aim to create pathways for middle school students to contribute to sustainable development goals through circular economy-focused educational practices actively.

Multi-level approaches are also part of the policy implications for education on the circular economy. At the local level, governments can encourage community cooperation by partnering with businesses to provide students with experiential learning opportunities and provide subsidies to schools for technological investments, teacher training, and curriculums that emphasize circular economy. Systemic change can be sparked nationally by incorporating circular economy ideas into STEM curricula, creating teacher training programs, and providing money for studies of creative teaching techniques. On a global scale, institutions such as UNESCO can define norms for circular economy education, foster cross-border cooperation, and encourage involvement in alliances with a circular economy focus. Together, these regulations seek to integrate sustainability into education, encouraging innovation and worldwide coherence in circular economy instruction.

In conclusion, the findings reinforce the need for a multifaceted approach to integrating circular economy principles with youth entrepreneurship education. Addressing knowledge gaps, enhancing experiential learning opportunities, fostering systemic thinking, and supporting policy innovations are crucial steps toward empowering middle school students for a sustainable future.

Implications of this study

Theoretical Implications

By connecting sustainability and entrepreneurial purpose theories, this study advances the theoretical understanding of incorporating circular economy concepts with young entrepreneurship education. Showing how experiential and multidisciplinary approaches improve critical thinking and systemic awareness in middle school education broadens Kolb's Experiential Learning Theory (Irwanto et al., 2024; Kaynar & Kurnaz, 2024). Connecting resilience, optimism, and critical thinking to sustainable enterprise supports the Entrepreneurial Intention Theory (Giancotti & Mauro, 2020; Scordato & Gulbrandsen, 2024). These results fill in gaps in the literature about systemic educational frameworks for sustainability and the development of entrepreneurial skills, while also highlighting the significance of incorporating circular economy principles into educational models to promote innovation and environmental stewardship.

Practical Implications

The results suggest practical ways educators and legislators might improve circular economy and entrepreneurship education. Project-based learning and flipped classrooms are two examples of experiential and multidisciplinary teaching strategies that can successfully engage students and enhance skill development (Aydın & Mutlu, 2023; Köpeczi-Bócz, 2024; Lavado-Anguera et al., 2024). To attain complete integration, teacher training programs that fill in knowledge gaps in circular economy principles are crucial. Using these observations, policymakers can create focused educational programs encouraging young people to be environmentally conscious and pursue entrepreneurship. Additionally, creating an integrated curriculum that combines circular economy with entrepreneurial skills provides scalable ways to give students the skills they need to successfully tackle global sustainability issues (Del Vecchio et al., 2021; Nguyen, 2023).

Conclusion

This study emphasizes the potential of incorporating circular economy ideas into adolescent entrepreneurship education to promote sustainability awareness, critical thinking, and entrepreneurial abilities. By utilizing multidisciplinary and experiential approaches, learning systems can better prepare students to tackle global issues. Notwithstanding encouraging results, obstacles to broad adoption still exist in teacher preparation, legislative support, and knowledge distribution. To align educational practices with sustainability goals, the study highlights the significance of systemic frameworks and focused interventions. It also provides educators and policymakers with practical insights to promote holistic, future-ready learning environments that prepare young people for an entrepreneurial and sustainable future.

Long-term Impact and Future Research Directions

This study's limitations include its reliance on secondary data, the brief length of interventions, and its limited generalizability across various educational and cultural contexts. Furthermore, it is difficult to evaluate the long-term effects of circular economy integration due to the absence of longitudinal data (Liu & Chang, 2010; Wang et al., 2016). To assess the long-term effects of circular economy-based interventions, future research should use longitudinal designs and broaden the sample's variety to encompass a range of cultural contexts (Colin-Chevalier et al., 2022). The breadth and accuracy of results will be improved by creating uniform multidisciplinary courses and utilizing primary data collection techniques like in-person interviews and observations. Investigating the function of digital technologies in circular economy education is also advised.

Conflict of Interest

No conflict of interest exists with me or my co-authors about this review article. This study was self-funded; I utilized my university's library resources and access to the AERA and other databases to support the research.

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