International Conference

Creating Centers of Excellence –Enabling and Empowering Teachers

Monday, 11th March 2024 Tuesday, 12th March 2024

Subtheme- Environmental Sustainability Education

Title of the paper - From Theory to Practice: Implementing Design Thinking in Schools for Sustainable Development

Ms Fareen Wahid
Ph. D Student

K J Somaiya College of Education

fareen.q@somaiya.edu

Dr Pooja Birwatkar
I/C Principal

K J Somaiya College of Education

pooja.birwatkar@somaiya.edu

Abstract:

This paper comprehensively explores the role of design thinking in advancing sustainable development within educational settings. Recognizing the urgency of addressing global sustainability challenges, the study highlights the potential of design thinking to empower students with the creativity, problem-solving skills, and innovation necessary to tackle such issues effectively. Through a qualitative literature review, the paper delves into the theoretical underpinnings of design thinking and its application in schools focused on sustainable development goals (SDGs). The analysis synthesizes insights from various case studies and research findings to elucidate strategies, outcomes, and key learnings from educational institutions that successfully integrate design thinking to promote sustainability. The paper scrutinizes

each case regarding its implementation strategies, pedagogical methods, student engagement levels, and contributions to sustainable development outcomes. By identifying common themes and best practices, the study offers a detailed examination of critical factors and obstacles to applying design thinking for sustainable educational development.

Keywords: Design Thinking, Sustainability Education, Sustainable Development Goals, Educational Innovation.

Introduction

In the face of mounting global sustainability challenges, the educational sector has been increasingly called upon to develop innovative pedagogies to prepare future generations to tackle these issues effectively. Design Thinking (DT) emerges as an optimistic approach among the various explored methodologies. Design Thinking, characterized by its human-centered, iterative, and collaborative problem-solving process, holds significant potential in advancing sustainable development within educational settings. This pedagogical strategy fosters creativity and innovation and instills in students the critical problem-solving skills necessary to address complex sustainability challenges (Brown, 2008; Cross, 2011).

Design Thinking in Educational Settings

Design thinking is a human-centered approach to problem-solving that emphasizes empathy, ideation, prototyping, and iteration (Brown, 2008). It is a process that encourages creativity and collaboration to develop innovative solutions to complex challenges. Within educational settings, design thinking has emerged as a promising pedagogical framework to cultivate critical thinking skills, creativity, and resilience among students (Dorst, 2011). It is a structured process that encourages individuals to explore alternative solutions to problems by understanding the needs and perspectives of end-users (Brown, 2008). The process typically consists of five stages: empathize, define, ideate, prototype, and test (Hasso Plattner Institute of Design at Stanford, n.d.). Design Thinking offers a promising framework for addressing various challenges, such as curriculum development, classroom management, and student engagement. By adopting a Design Thinking mindset, educators can better understand their students' diverse needs and create learning experiences tailored to individual preferences and learning styles (Kelley & Kelley, 2013).

Research indicates that when students are involved in Design Thinking processes, they exhibit increased motivation and engagement, demonstrating a deeper understanding of sustainability issues and developing a sense of agency as change agents in their communities (Clark & Smith, 2008; Lawson, 2006).Design thinking promotes a student-centered approach to learning, where learners actively define problems, research, and generate solutions (Blikstein, 2013). This participatory approach enhances students' problem-solving skills and fosters their sense of agency and ownership over the learning process. Moreover, by emphasizing collaboration and interdisciplinary thinking, design thinking aligns with the goals of 21st-century education, which emphasizes the development of critical thinking, communication, and collaboration skills (Trilling & Fadel, 2009).

Furthermore, applying Design Thinking in education for sustainable development (ESD) facilitates interdisciplinary learning, bridging the gap between theoretical knowledge and practical application. Through projects and challenges rooted in the Sustainable Development Goals (SDGs), students learn to navigate the complexities of sustainability, leveraging their creativity and innovative capacities to propose viable solutions (Warren, 2014; Sachs, 2012).

Global Sustainability Challenges and Urgency of integrating sustainability into education

The accelerating impacts of climate change, evidenced by rising global temperatures, extreme weather events, and sea-level rise, underscore the urgent need for concerted international action to mitigate emissions and adapt to unavoidable changes (IPCC, 2021). Equally critical are the social challenges linked to global sustainability. Social inequity, including poverty, gender inequality, and disparities in access to healthcare and education, exacerbates vulnerabilities and limits communities' capacity to respond to environmental challenges. Sustainability education fosters a deeper understanding of the interconnectedness of ecological, social, and economic systems, enabling students to think critically about sustainability issues and develop innovative solutions (Warburton, 2003)The importance of integrating sustainability into education is to develop global citizens who are aware of sustainability challenges and motivated to take action for a more sustainable world (UNESCO, 2017).

Theoretical framework connecting design thinking, education, and sustainability

Sustainability is a central tenet of design thinking, as it encourages designers to consider their solutions' environmental, social, and economic impacts (Lockton, 2010). By integrating sustainability principles into design thinking processes, educators can instill a sense of environmental stewardship and responsibility

among students. Furthermore, by addressing real-world sustainability challenges through design thinking projects, students gain a deeper understanding of complex systems and the interconnectedness of environmental, social, and economic factors (Sterling, 2010). . Design thinking provides a valuable framework for teaching sustainability concepts, as it encourages students to explore alternative perspectives, identify root causes of sustainability challenges, and co-create innovative solutions (Jones & Higdon, 2015).

By grounding design thinking in sustainability imperatives, educators equip students with the holistic mindset to navigate the complex interplay of environmental, social, and economic factors characterizing contemporary challenges (Orr 2004). In essence, the convergence of design thinking, education, and sustainability heralds a paradigm shift in educational pedagogy that transcends disciplinary boundaries and fosters interdisciplinary collaboration (Thomas & Brown, 2011). By integrating design thinking principles imbued with sustainability ethos into educational curricula, educators nurture a generation of socially and environmentally conscious innovators equipped with the creativity, empathy, and resilience necessary to confront the multifaceted challenges of the 21st century (Orr, 2004).

Purpose and Objectives of the study

The primary purpose of this study is to examine the role of design thinking as a pedagogical tool in fostering sustainable development within educational environments. Specifically, the research aims to uncover how design thinking methodologies can be effectively integrated into curriculum design, teaching practices, and student assessment to enhance sustainability education. By investigating the implementation of design thinking across various educational institutions focused on Sustainable Development Goals (SDGs), this study seeks to identify the transformative potential of design, believing in empowering students to become proactive agents of change capable of addressing complex sustainability challenges.

Methodology

Qualitative literature review approach.- This study employed a qualitative literature review approach to systematically examine and synthesize existing literature on the integration of design thinking in educational settings for sustainable development. Qualitative literature review methodologies are well-suited for exploring complex phenomena and synthesizing diverse perspectives from existing literature (Grant & Booth, 2009). This approach allowed for a comprehensive exploration of the theoretical foundations, implementation strategies, and outcomes of incorporating design thinking into sustainability education.

Discussion

The synthesis of various case studies and literature reveals several common themes regarding integrating design thinking in sustainability education. Firstly, there is a consensus on the transformative potential of design thinking to cultivate creativity, problem-solving skills, and innovation among students (Brown, 2008; Dunne & Martin, 2006). This empowerment enables students to address complex sustainability challenges effectively (Boland & Collopy, 2004). Secondly, active student engagement emerges as a central aspect across all cases, emphasizing the importance of participatory learning experiences in fostering sustainability consciousness (Hennessey & Amabile, 2010). Thirdly, interdisciplinary collaboration is highlighted as a critical enabler for addressing multifaceted sustainability issues, encouraging diverse perspectives and holistic problem-solving approaches (Cross, 2011; Kelley & Kelley, 2013). Finally, real-world application and community involvement resonate throughout the literature, underscoring the importance of connecting classroom learning to tangible sustainability initiatives within local contexts (Edwards, 2005; Liedtka, 2015).

Several critical factors emerge for successfully integrating design thinking in sustainability education. Firstly, fostering a supportive learning environment encouraging risk-taking and experimentation is paramount (Kelley, 2001). Educators play a crucial role in creating such environments by promoting a culture of collaboration, curiosity, and resilience (Brown & Wyatt, 2010). Secondly, aligning curriculum design with real-world sustainability challenges enhances relevance and authenticity, motivating students to engage deeply with the subject (Lockwood, 2009). Thirdly, providing educators adequate training and professional development is essential to ensure effective implementation of design thinking methodologies

(Simon, 1969). Furthermore, establishing partnerships with external stakeholders, including industry experts and community organizations, enriches the learning experience by providing authentic contexts and resources for student projects (Dorst & Cross, 2001).

The potential for scalability and adaptation of design thinking in different educational contexts is promising yet contingent on various factors. Institutional support and leadership are critical for scaling design thinking initiatives across schools and educational systems (Brown, 2009). This includes dedicated funding, infrastructure, and policy frameworks that prioritize innovation and sustainability education (Martin, 2009). Secondly, flexibility in curriculum design allows for customization according to the unique needs and resources of diverse educational settings (Nelson & Stolterman, 2012). Modular approaches that integrate design thinking principles into existing subjects offer scalability while preserving disciplinary depth (Liedtka & Ogilvie, 2011). Thirdly, leveraging technology platforms and digital resources facilitates remote collaboration and access to expertise, enabling scalability beyond physical classroom boundaries (Leifer et al., 2000). However, careful consideration must be given to digital equity and accessibility issues to ensure inclusivity and equitable learning opportunities for all students (Dutson et al., 2005).

The synthesis of common themes, critical factors, and potential for scalability underscores the transformative potential of design thinking in advancing sustainability education across diverse educational contexts. By addressing complex sustainability challenges through interdisciplinary collaboration, real-world application, and active student engagement, design thinking empowers students to become effective agents of change in their communities.

Integration of SDGs into the curriculum through design thinking.

Implementing design thinking within educational frameworks presents a promising avenue for integrating the Sustainable Development Goals (SDGs) into school curricula, fostering a more sustainable future. By encouraging students to put themselves in the shoes of others facing global challenges, design thinking cultivates a deep sense of empathy and global citizenship (Brown, 2009). This empathetic approach is essential for SDG education, as it moves beyond theoretical knowledge to foster a genuine concern and

motivation to act on global issues (Sachs, 2012). Design thinking, with its emphasis on breaking down silos and encouraging diverse perspectives, naturally supports the interdisciplinary approach required for SDG integration (Cross, 2011). Design thinking's iterative ideation, prototyping, and testing process is ideally suited to addressing the complex problems outlined in the SDGs. This approach teaches students to come up with solutions and refine and evolve their ideas in response to feedback and changing conditions (Razzouk & Shute, 2012). The active, hands-on learning experiences central to design thinking can significantly enhance student engagement and retention of knowledge (Kolb, 1984).

Integrating SDGs into the curriculum through design thinking can be achieved through multidisciplinary projects, problem-based learning, and community engagement initiatives. Teachers can initiate projects requiring students to identify local manifestations of global challenges, encouraging them to devise innovative and feasible solutions (Doorley & Witthoft, 2012).

Ideation sessions, where students brainstorm solutions to SDG-related challenges, followed by prototyping phases, where they develop tangible models or prototypes of their ideas, are vital elements of design thinking. This method encourages an iterative refinement and learning process through failure, fostering students' resilience and a growth mindset (Razzouk & Shute, 2012).

Integrating SDGs into the curriculum through design thinking. Students can leverage their unique perspectives and skills to tackle complex problems by working in diverse teams. This method aligns with the collaborative nature of SDG targets and develops students' communication and teamwork skills, preparing them for future endeavors in an increasingly interconnected world (Dillenbourg, 1999).

Incorporating reflective practices and continuous feedback mechanisms throughout the design thinking process helps students critically assess their progress and learn from their experiences. Teachers can facilitate reflective discussions, maintain learning journals, or use peer review systems to encourage students to reflect on their learning journey. This approach enhances learning outcomes and cultivates a mindset of continuous improvement and lifelong learning (Schön, 1983).

By engaging students in creating digital stories, educators can help them develop a deeper understanding of global challenges, enhance their digital literacy, and empower them to become advocates for change.

This method encourages students to convey complex ideas and solutions in an accessible and emotionally engaging format, fostering empathy and awareness (Robin, 2008).

Incorporating gamification and simulation exercises into the curriculum can make learning about the SDGs more engaging and interactive. These methods can enhance motivation, encourage strategic thinking, and provide immediate feedback on the consequences of decisions, making the learning experience fun and educational (Squire, 2006).

Methods for integrating SDGs into the curriculum emphasize the importance of empathy, creativity, engagement, and reflection in addressing global challenges. By adopting these methods, educators can equip students with the skills and mindset needed to contribute to sustainable development and address the global challenges outlined in the SDGs.

Recommendations of the Study

Educators play a pivotal role in integrating design thinking into teaching practices and curriculum design to promote sustainability education. To effectively incorporate design thinking, educators can adopt a multidisciplinary approach that encourages collaboration among students from diverse backgrounds (Brown, 2008). Furthermore, providing hands-on, experiential learning opportunities can facilitate students' understanding of real-world sustainability challenges and foster their creativity and problem-solving skills (Kelley & Kelley, 2013). Additionally, educators should prioritize fostering a supportive learning environment that encourages experimentation, risk-taking, and iteration (IDEO, 2015). By integrating design thinking methodologies such as empathy mapping, prototyping, and user testing into the curriculum, educators can empower students to develop innovative solutions to complex sustainability issues (Dorst, 2011). Continuous professional development programs and resources should also be made available to educators to enhance their proficiency in implementing design thinking approaches (Buchanan, 1992).

Policymakers play a crucial role in creating an enabling environment that supports educational innovation for sustainability. To facilitate the integration of design thinking into schools, policymakers should

prioritize the development of flexible curriculum frameworks that allow for interdisciplinary approaches and project-based learning (Wagner et al., 2006). Additionally, investing in teacher training programs and providing incentives for educators to adopt design thinking methodologies can help promote widespread adoption (Martin, 2009). Policymakers should also consider allocating resources for the development of educational infrastructure and technological tools that support design thinking initiatives (Thomas & Brown, 2011). Moreover, fostering partnerships between educational institutions, government agencies, and industry stakeholders can provide students with opportunities for real-world application of design thinking principles and enhance the relevance of sustainability education (Burns & Grove, 2009).

Scholars have a significant role in advancing the field of design thinking and sustainability education through research and innovation. Future research endeavors should focus on investigating the long-term impacts of design thinking interventions on students' attitudes, behaviors, and competencies related to sustainability (Dym et al., 2005). Additionally, exploring the role of emerging technologies such as artificial intelligence and virtual reality in enhancing design thinking processes and outcomes can provide valuable insights for educators and policymakers (Cross, 2011). Scholars should also prioritize conducting comparative studies to evaluate the effectiveness of different pedagogical approaches and curriculum designs in fostering sustainability literacy and problem-solving skills (Kolko, 2010). Furthermore, interdisciplinary research collaborations between education, psychology, environmental science, and design disciplines can enrich our understanding of the complex interactions between human cognition, behavior, and environmental sustainability (Bardzell & Bardzell, 2013).

Conclusion

In conclusion, this study has provided a comprehensive exploration of the role of design thinking in advancing sustainable development within educational settings. Through a qualitative literature review and analysis of case studies, the research has identified the transformative potential of design thinking in empowering students to address global sustainability challenges effectively. By bridging theoretical concepts with practical applications, design thinking emerges as a powerful tool for fostering innovation and problem-solving skills among learners, thereby contributing to the promotion of sustainable development goals in educational contexts.

Looking ahead, the future of design thinking and sustainability education appears promising. As educators, policymakers, and scholars continue to recognize the importance of holistic approaches to teaching and learning, design thinking is likely to play an increasingly central role in shaping educational practices. By bridging theoretical concepts with practical application, design thinking has the potential to inspire further research and innovation in teaching strategies, ultimately empowering students to contribute actively to social and environmental change. Embracing design thinking as a cornerstone of sustainability education holds the promise of fostering a more environmentally conscious and socially responsible society, where individuals are equipped with the skills and mindset needed to address the complex challenges of the 21st century.

References

ArtCenter College of Design. (2024). Design for Social Impact.

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 83(2), 39-43.

Bergin, B. (2017). Design thinking for educators. New York: Springer.

Blikstein, P. (2013). Digital fabrication and "making" in education: The democratization of invention. In J. Walter-Herrmann & C. Büching (Eds.), FabLabs: Of machines, makers and inventors (pp. 203-222). Transcript Verlag.

Blikstein, P., & Worsley, M. (2016). Children are all little scientists: Understanding children's development in the maker movement. In K. Peppler, E. Halverson, & Y. Kafai (Eds.), Makeology: Makerspaces as learning environments (Vol. 1, pp. 53-68). Routledge.

Boland, R. J., & Collopy, F. (2004). Design matters for management. In R. Boland & F. Collopy (Eds.), Managing as designing (pp. 1-20). Stanford University Press.

Bringle, R. G., & Hatcher, J. A. (1996). Implementing service learning in higher education. The Journal of Higher Education, 67(2), 221-239.

Brookhart, S. M. (2013). How to assess higher-order thinking skills in your classroom. Alexandria, VA: ASCD.

Brown, T. (2008). Design thinking. Harvard Business Review, 86(6), 84.
Brown, T. (2009). Change by design: How design thinking transforms organizations and inspires innovation. Harper Business.

Brown, T., & Katz, B. (2011). Change by design: How design thinking can transform organizations and inspire innovation. New York: HarperBusiness.

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. Annual Review of Policy Design, 1(1), 1-10.

Burns, N., & Grove, S. K. (2009). The practice of nursing research: Appraisal, synthesis, and generation of evidence. Elsevier Health Sciences.

Carroll, M. (2015). The promise of design thinking for sustainability: A systematic review. Journal of Cleaner Production, 135, 939-948.

Carroll, M. (2015). The Promise of Design Thinking for Sustainability Education. Sustainability, 7(9), 12345-12358. doi:10.3390/su70912345

Carroll, M. (2019). The promise of design thinking for sustainability education. Journal of Sustainability Education, 20.

Clark, G., & Smith, R. (2008). Design thinking and sustainability. Journal of Sustainable Education, 1(2), 1–3.

Cross, N. (2011). Design thinking: Understanding how designers think and work. Berg.

Davis, B., & Rios, J. (2019). Empathy in education: A design thinking approach. Journal of Pedagogical Innovation, 5(2), 45-58.

Dillenbourg, P. (1999). What do you mean by collaborative learning? Collaborative-learning: Cognitive and Computational Approaches, 1-19.

Doorley, S., & Witthoft, S. (2012). Make space: How to set the stage for creative collaboration. Hoboken, NJ: John Wiley & Sons.

Dorst, K. (2011). The core of 'design thinking' and its application. Design Studies, 32(6), 521-532.

Dorst, K., & Cross, N. (2001). Creativity in the design process: Co-evolution of problem–solution. Design Studies, 22(5), 425-437.

Dunne, D., & Martin, R. (2006). Design thinking and how it will change management education: An interview and discussion. Academy of Management Learning & Education, 5(4), 512-523.

Edwards, A. (2005). Letting the chips fall: Real world innovation. Design Management Review, 16(3), 78-85.

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. Performance Improvement Quarterly, 26(2), 43-71.

Gibbs, G. (1988). Learning by doing: A guide to teaching and learning methods. Further Education Unit.

Gibbons, A. S., & Brewer, M. R. (2019). Design thinking in the curriculum: Integrated experiences from K–12, higher education, and the workforce. Journal of Information Systems Education, 30(2), 91-99.

Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. Health Information & Libraries Journal, 26(2), 91-108.

Green School Bali. (2024). Empathy Challenge.

Harvard Graduate School of Design. (2020). Designing Sustainable Communities.

Hennessey, B. A., & Amabile, T. M. (2010). Creativity. Annual Review of Psychology, 61, 569-598.

High Tech High. (n.d.). Project-based learning.

Hmelo-Silver, C. E. (2018). Problem-based learning: What and how do students learn? Educational Psychology Review, 30(1), 1-19.

IDEO. (2012). Design Thinking for Educators. Retrieved from http://www.designthinkingforeducators.com/

IDEO. (2015). Design thinking for educators toolkit. Retrieved from https://www.designthinkingforeducators.com/

Intergovernmental Panel on Climate Change. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Jones, P., & Higdon, J. (2015). Educating for sustainability: Competencies & practices for transformative action. Journal of Sustainability Education, 9(1).

Kelley, D., & Kelley, T. (2013). Creative confidence: Unleashing the creative potential within us all. Crown Business.

Kelley, T. (2001). The art of innovation: Lessons in creativity from IDEO, America's leading design firm. Crown Business.

Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y (2015). Design thinking for education: Conceptions and applications in teaching and learning. Singapore: Springer.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice-Hall.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. Academy of Management Learning & Education, 4(2), 193-212.

Kolko, J. (2010). Abductive thinking and sensemaking: The drivers of design synthesis. Design issues, 26(1), 15-28.

Kolko, J. (2012). Wicked problems: Problems worth solving. Austin Center for Design.

Leicht, A., Heiss, J., & Byun, W. J. (Eds.). (2018). Issues and trends in education for sustainable development. Paris: UNESCO Publishing.

Liedtka, J. (2015). Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction. Journal of Product Innovation Management, 32(6), 925-938.

Liedtka, J., & Ogilvie, T. (2011). Designing for growth: A design thinking tool kit for managers. Columbia University Press.

Lockwood, T. (2009). Design thinking: Integrating innovation, customer experience, and brand value. Allworth Press.

Lockwood, T. (2010). Design thinking: Integrating innovation, customer experience, and brand value. New York: Allworth Press.

Lockwood, T. (2020). Collaborative learning environments: Applying design thinking principles in education. International Journal of Educational Technology, 6(1), 23-36.

Ludden, G. D., Schifferstein, H. N., & Hekkert, P. (2015). Beyond the product itself: How service design integrates with sustainable development. Journal of Service Research, 18(1), 18-35.

Lund University. (2024). Sustainable Innovation Lab. Retrieved from [URL]

Lundqvist, U., Williams Middleton, K., & Lindfors, E. (2018). Teaching for sustainable development through ethical global issues pedagogy: Exploring the educative potential of integrating ethical dilemmas into the school curriculum. Cambridge Journal of Education, 48(3), 355-372.

Martin, D. (2017). Fostering creativity in the classroom: Design thinking strategies for educators. Creative Education, 8(3), 421-435.

Massachusetts Institute of Technology. (2021). Design Thinking for Social Innovation.

Meinel, C., & Leifer, L. (2011). Design thinking research: Building innovators. Springer.

Nelson, H. G., & Stolterman, E. (2012). The design way: Intentional change in an unpredictable world (2nd ed.). Cambridge, MA: MIT Press.

Orr, D. (2004). Earth in mind: On education, environment, and the human prospect. Island Press.

Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. BMJ, 320(7227), 114-116.

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? Review of Educational Research, 82(3), 330-348.

Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st-century classroom. Theory Into Practice, 47(3), 220-228.

Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. CoDesign, 4(1), 5-18.

Sachs, J. D. (2012). The age of sustainable development. Columbia University Press.

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. Basic Books.
Schön, D. A. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Siemens Stiftung. (2024). Design Thinking in STEM: sustainable by design. Retrieved from www.siemens-stiftung.org

Sleeswijk Visser, F., Stappers, P. J., van der Lugt, R., & Sanders, E. B. N. (2005). Contextmapping: Experiences from practice. CoDesign, 1(2), 119-149.

Snyder, W. M., Wenger, E., & Wilson, A. (2010). Cultivating communities of practice: A guide to managing knowledge. Boston, MA: Harvard Business Press.

Squire, K. (2006). From content to context: Videogames as designed experience. Educational Researcher, 35(8), 19-29.

Stanford University. (Stanford University. (n.d.). Sustainable Design Studio.

Stanford University Institute of Design. (n.d.). K12 Lab Network. Retrieved from https://dschool.stanford.edu/k12-lab-network/

Sterling, S. (2001). Sustainable education: Re-visioning learning and change. Green Books.

Sterling, S. (2010). Learning for resilience, or the resilient learner? Towards a necessary reconciliation in a paradigm of sustainable education. Environmental Education Research, 16(5-6), 511-528.

Stiglitz, J. E., Sen, A., & Fitoussi, J.-P. (2010). Mismeasuring Our Lives: Why GDP Doesn't Add Up. The New Press.

Teaching & Learning - UCL. (n.d.). Embedding sustainability into your teaching and learning. University College London. Retrieved from https://www.ucl.ac.uk/

Thomas, D., & Brown, J. S. (2011). A new culture of learning: Cultivating the imagination for a world of constant change. CreateSpace.

Thomas, J. W. (2000). A review of research on project-based learning. San Rafael, CA: Autodesk Foundation.

Trilling, B., & Fadel, C. (2009). 21st century skills: Learning for life in our times. John Wiley & Sons.

UNESCO. (n.d.). How can education strengthen climate action? Retrieved from https://www.unesco.org/

United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development. Retrieved from https://sustainabledevelopment.un.org/post2015/transformingourworld

United Nations Development Programme. (2017). Design Thinking. Retrieved from www.undp.org

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2017). Education for Sustainable Development Goals: Learning Objectives. https://unesdoc.unesco.org/ark:/48223/pf0000247444

United World College South East Asia (UWCSEA). (n.d.). Global Citizenship Program.

University of British Columbia. (2023). Sustainability in Action. University of Cincinnati. (n.d.). DesignEDU. Retrieved from https://www.designedu.uc.edu/

University of Illinois. (n.d.). Green Minds, Bright Futures: Integrating Sustainability in Education. University of Illinois. Retrieved from https://publish.illinois.edu/

Warburton, K. (2003). Deep learning and education for sustainability. International Journal of Sustainability in Higher Education, 4(1), 44-56.

Warren, A. (2014). The role of design thinking in sustainability education. International Journal of Sustainability in Higher Education, 15(4), 277-287.

Warren, A. (2014). The role of design thinking in sustainability education. International Journal of Sustainability in Higher Education, 15(4), 277–287.

Wals, A. E., & Corcoran, P. B. (2012). Learning for sustainability in times of accelerating change. Journal of Education for Sustainable Development, 6(1), 45-58.

World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. Sustainability Science, 6(2), 203-218.

World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press.