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Review Article

Pedagogy for Transformative Learning – Case of Sustainable Agriculture and Environment

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Abstract

Pedagogy for transformative learning is an educational approach that focuses on creating significant and lasting changes in learners' perspectives, behaviors, and values rather than simply transmitting the information. This article delves into the pedagogy for transformative learning with a specific focus on sustainable agriculture and the environment. Transformative learning involves a profound process of critical reflection that leads learners to re-evaluate their assumptions, values, and beliefs, resulting in a transformative shift in their perspectives and actions. In the context of sustainable agriculture and the environment, transformative learning holds great promise for empowering individuals to address complex environmental challenges and promote sustainable practices. This manuscript examines the fundamental principles and approaches of transformative learning, explores its practical application in sustainable agriculture and the environment, and discusses the potential benefits and challenges associated with its implementation. Furthermore, it also explores the pivotal role of educators and institutions in facilitating transformative learning experiences in the agricultural field. It offers practical recommendations for integrating transformative pedagogy into sustainable agriculture and environmental education. By emphasizing the importance of learner-centeredness, experiential learning, critical thinking, interdisciplinary collaboration, and utilization of technology, this paper seeks to equip educators and institutions with the tools to cultivate transformative learning experiences that inspire learners to become agents of positive change in creating a sustainable and resilient future for agriculture as well as the environment.

Keywords: Agriculture; Community engagement; Education; Food security; Pedagogy

Introduction

Courses and degree programs related to sustainable agriculture and food systems have been on the rise globally, with increasing recognition of the complex socio-ecological problems associated with industrial agrifood systems (David and Bell 2018; Horner *et al.* 2021). Within sustainable agriculture and food systems education (SFSE), agroecology programs have gained significant popularity (Kumar and Kumar 2014; David and Bell 2018). Agroecology encompasses scientific inquiry, on-farm practices, and social movements, with a growing emphasis on transformative approaches that address power dynamics, equity, and ecological renewal (Wezel *et al.* 2009; Anderson and Anderson 2020).

Transformative agroecology – a transdisciplinary, participatory, action-oriented, and political approach to building socially just and ecologically sound agrifood systems, has gained attention among scholars, practitioners, and activists (Horner *et al.* 2021). It draws from previous work on the systems and structures that shape relationships, knowledge, and power within agricultural food systems (Molina 2013; Kuri *et al.* 2023). Transformative agroecology recognizes the need for critical reflection and reflexive practice to navigate the complexities of this approach (Méndez *et al.* 2017).

In pursuing transformative agroecology, it is essential to consider the pedagogical approaches employed in agroecology education. Pedagogy is crucial in determining which types of knowledge are valued and how learning experiences can facilitate transformation and transition processes (Anderson *et al.* 2019). Initially, introduced by Mezirow (1991), transformative learning involves a shift in a student's frame of reference through experience and reflection, aligning with experiential approaches to education (Probst *et al.* 2019). It provides a framework for developing critical thinking skills and fostering a deep understanding of the complex social, economic, and ecological dimensions of agrifood systems.

While transformative learning has been acknowledged in agroecology and SFSE education, explicit consideration of specific pedagogies for transformative learning remains limited (Migliorini and Lieblein 2016). Questions persist regarding the pedagogies that facilitate transformative

learning and how agroecology education can support broader agroecological transformations (Anderson and Anderson 2020). There is a need for research to identify and assess transformative learning within agroecology and SFSE education, exploring the pedagogical approaches that enable students to reflect on their positionality within food systems critically and engage with the local contexts (van Oers *et al.* 2023).

This manuscript aims to contribute to the understanding of pedagogy for transformative learning in the context of sustainable agriculture and environmental education (Fig. 1). Drawing on case studies and scholarly insights, the key principles and approaches of transformative learning in sustainable agriculture and environment have been explored. The way pedagogy can support transformative learning experiences, foster critical thinking, and empower individuals to address complex environmental challenges has been discussed. The benefits, challenges, and potential outcomes of implementing transformative pedagogy in these fields have also been elaborated. Through this exploration, this manuscript is aimed to contribute to the ongoing efforts of educators, scholars, practitioners to promote transformative learning in sustainable agriculture and the environment, fostering a more sustainable and equitable future for the global food systems.

Concept of transformative learning

Transformative learning is a profound educational process that fosters a fundamental shift in an individual's beliefs, assumptions, and values, leading to a significant transformation in their perspectives and actions (Fig. 1; Mezirow 1991; Cranton 1994). This concept, first introduced by Jack Mezirow, has since become a central pillar in adult and higher education, with broad applicability to diverse disciplines, including sustainable agriculture and environmental studies. At the core of transformative learning, theory recognizes that learners construct their understanding of the world through experiences and reflection (Mezirow 1991; Anand *et al.* 2020). It aligns with social constructivist perspectives that emphasize the active role of learners in shaping their knowledge and meaning-making processes (Probst *et al.* 2019). Transformative learning goes beyond acquiring new information; it calls for a deep critical examination of one's assumptions and the socio-cultural contexts that shape them.

The transformative learning theory of Mezirow (1978) is grounded in the idea that learning is not just about obtaining knowledge but also involves unlearning and relearning. The theory highlights the importance of critical reflection, where learners question their previously unquestioned beliefs and cultural norms and engage in self-examination (Mezirow 1991). Critical reflection enables individuals to confront and challenge their existing mental models, facilitating the exploration of new perspectives and ideas and alternative ways of thinking (Horner *et al.* 2021). Moreover, transformative learning is not a solitary process; it thrives in dialogue and interaction with others (Mezirow 1991). Engaging in meaningful conversations with peers, educators, and community members can expose learners to diverse viewpoints and challenge their pre-conceived notions (Cranton 1994). These dialogues foster a sense of empathy, understanding, and openness to alternative perspectives, which are essential for transformative learning experiences.

Experiential learning is also vital in transformative learning theory (Cranton 1994). It is emphasized that transformative learning often emerges from real-life experiences that disrupt one's existing worldview and prompt critical reflection (Mezirow 1991; Fleming 2018). In sustainable agriculture and the environment, experiential learning can involve engaging with environmental challenges, participating in community-based initiatives, and observing the consequences of unsustainable practices. Such experiences provide powerful opportunities for learners to reassess their beliefs and develop a deeper connection to the subject matter (Taylor and Cranton 2013).

The concept of transformative learning, pioneered by Jack Mezirow, offers a valuable framework for understanding how individuals can undergo profound intellectual and emotional changes. In sustainable agriculture and environmental education, transformative learning is crucial in empowering learners to examine the complex challenges and interconnections within agrifood systems critically. Through the integration of critical reflection, dialogue, and experiential learning, transformative pedagogy enables students to become agents of positive change and work towards building socially just and ecologically sustainable agrifood systems. In the subsequent sections, we will explore how transformative learning can be applied in the context of sustainable agriculture and environmental education and how educators can facilitate transformative learning experiences to empower learners to address pressing environmental challenges and foster a sustainable future.

Pedagogy for transformative learning

To effectively cultivate transformative learning experiences in the context of sustainable agriculture and environmental education, pedagogical principles and approaches play a pivotal role (Horner *et al.* 2021). This section delves into key aspects of pedagogy that support transformative learning, emphasizing learner-centeredness, experiential learning, critical thinking, and interdisciplinary approaches, as well as recognizing the significance of emotions and affective aspects in the transformative learning process (Francis *et al.* 2020).

Learner-centeredness

Transformative learning recognizes learners as active agents

Fig. 1: Transformative learning in sustainable agriculture and environment

in their educational journey (Cranton 1994). Learner-centered pedagogy prioritizes learners' individual needs, experiences, and perspectives, empowering them to take ownership of their learning process (Filho *et al.* 2018). In the context of sustainable agriculture and the environment, learners' backgrounds, cultural contexts, and personal values are essential aspects to consider in designing transformative learning experiences (Anand *et al.* 2020). By tailoring educational approaches to meet the unique needs of learners, educators can create a supportive and inclusive learning environment that fosters self-discovery and critical reflection.

Experiential learning

Experiential learning is a cornerstone of transformative pedagogy, providing learners with opportunities to engage directly with real-world issues and challenges (Mezirow 1991). Field experiences, hands-on projects, and community engagement initiatives immerse learners in the complexities of sustainable agriculture and environmental problems, allowing for direct observation and reflection on their impact (Kong 2021). These experiences deepen learners' understanding of the subject matter and evoke emotional connections and a sense of responsibility toward environmental stewardship.

Critical thinking

Transformative learning necessitates the development of critical thinking skills, enabling learners to question, analyze, and challenge prevailing assumptions and paradigms (Cranton 1994; Raikou 2016). By encouraging learners to examine various perspectives and evidence critically, transformative pedagogy fosters a deeper understanding of complex agrifood systems and environmental issues. Critical thinking empowers learners to move beyond accepting received knowledge and instead engage in independent inquiry and problem-solving, facilitating transformative insights (Horner *et al.* 2021).

Interdisciplinary approaches

Sustainable agriculture and environmental challenges are multifaceted and require holistic solutions that transcend disciplinary boundaries (Anderson *et al.* 2019). Integrating interdisciplinary approaches in transformative pedagogy encourages learners to draw connections between various fields of knowledge, fostering a more comprehensive understanding of the interconnectedness of environmental, social, and economic aspects (Ahmad *et al.* 2022). By embracing diverse perspectives and expertise, learners are better equipped to address the systemic complexities of sustainable agrifood systems.

Emotions and affective aspects

Transformative learning is not solely a cognitive process but is also deeply influenced by emotions and affective aspects (Mezirow 1991). Emotions can be powerful catalysts for change, prompting learners to reevaluate their beliefs and values. In the context of sustainable agricultural and environmental education, cultivating emotional connections to the natural world and the communities affected by environmental issues can instigate transformative shifts in learners' perspectives and motivations for action (Maiese 2015).

In conclusion, pedagogy for transformative learning in sustainable agriculture and environmental education emphasizes learner-centeredness, experiential learning,

critical thinking, interdisciplinary approaches, and the recognition of emotions and affective aspects. By integrating these principles into educational practices, educators can create transformative learning experiences that empower learners to engage with the complexities of agrifood systems critically, foster a deep sense of environmental stewardship, and contribute to promoting sustainable and equitable agricultural practices and environmental conservation. The subsequent sections of this paper will explore the application of transformative pedagogy in sustainable agriculture and environment, highlighting examples of transformative learning activities and discussing the benefits and challenges associated with its implementation.

Sustainable agriculture and environment: context and challenges

The current state of sustainable agriculture and the environment presents pressing challenges that demand urgent attention and transformative solutions (Rehman and Farooq 2023). As global populations continue to grow, the demand for food and resources places unprecedented strain on the planet's ecosystems (Calicioglu *et al.* 2019). This section provides an overview of the key challenges faced in sustainable agriculture and environmental conservation, emphasizing the need for transformative approaches to address these critical concerns.

Climate change

Climate change is one of the most significant threats to sustainable agriculture and environmental stability. Rising temperatures, extreme weather events, and shifting precipitation patterns disrupt agricultural systems, affecting crop yields, water availability, farmer livelihood, and food security (Muluneh 2021). Additionally, climate change contributes to biodiversity loss and poses risks to ecosystem services supporting agriculture, such as pollination and pest control (Shankar and Shikha 2018). Transformative approaches to sustainable agriculture and environmental conservation must incorporate climate resilience strategies, such as climate-smart agricultural practices and ecosystem-based adaptation.

Biodiversity loss

The loss of biodiversity is a critical concern that undermines the long-term viability of agriculture and environmental health (Erisman *et al.* 2016). Intensive agricultural practices, deforestation, and habitat destruction led to the loss of plant and animal species essential for ecological balance and food production (FAO 2021). Preserving biodiversity and promoting agroecological approaches prioritizing ecosystem diversity are essential components of transformative strategies to safeguard sustainable agriculture and the environment.

Soil degradation

Soil degradation poses a significant threat to sustainable agriculture and food security. Unsustainable land management practices, such as extensive tillage practices, overuse of chemical inputs, deforestation, and erosion, deplete soil nutrients and compromise soil fertility (Gomiero 2016). Transformative approaches to sustainable agriculture emphasize regenerative practices, such as agroforestry, conservation agriculture, and soil restoration, to enhance soil health and ensure the long-term productivity of agricultural lands (Horner *et al.* 2021). However, climate change is a major factor contributing to land degradation, which eventually leads to the loss of biodiversity (Webb *et al*. 2017). There is therefore a need to find out options for reducing land degradation and climate-resilient agriculture in the era of climate change.

Unsustainable farming practices

Conventional farming practices are heavily reliant on chemical inputs, monoculture, and mechanization contributing to environmental degradation and social inequities (FAO 2021). These practices often perpetuate resource depletion, soil erosion, and water pollution, thereby compromising the resilience of the agricultural systems (Panhwar *et al.* 2019). Transformative approaches advocate and invoke agroecological and regenerative practices that promote biodiversity, enhance soil health, and minimize environmental impacts, supporting more sustainable and resilient agrifood systems (Horner *et al.* 2021).

Food waste and loss

Food waste and loss present significant challenges in sustainable agriculture and food systems. A substantial amount of food is lost or wasted throughout the supply chain, from production to consumption (Chauhan 2021). Transformative solutions may include addressing the food system inefficiencies, promoting sustainable production practices, improving post-harvest management, efficient management of the supply chain, starting innovative food recovery programs (e.g., food banks, gleaning projects, and surplus food redistribution), increasing public awareness and education to reduce food waste and ensure more equitable food distribution, by implementing the policies/regulation that incentivize reducing food waste and encouraging the partnership between different supply chain actors of food chain (Wang *et al.* 2021).

Inequitable access to resources

The inequitable distribution of resources, such as land, water, and knowledge, hinders the transition to sustainable agriculture and environmental conservation (FAO 2021). Smallholding farmers and marginalized communities often

face limited access to productive resources and are disproportionately affected by environmental degradation (Nhamo *et al.* 2022). Transformative approaches advocate for inclusive and participatory models that empower local communities and promote equitable access to resources and decision-making (Chiarelli *et al.* 2022).

In conclusion, sustainable agriculture and environmental conservation face critical challenges requiring transformative approaches to address their complexities effectively. Climate change, biodiversity loss, soil degradation, unsustainable farming practices, food waste, and inequitable access to resources are among the pressing concerns that necessitate innovative and inclusive strategies. Transformative learning and pedagogy are crucial in fostering understanding and critical thinking. Thus, collaborative efforts are needed to tackle these challenges and pave the way for a more sustainable and resilient agrifood system and environment. The subsequent sections of this paper will explore concrete examples of transformative learning activities and the potential benefits and challenges associated with implementing transformative pedagogy in the context of sustainable agriculture and environmental education.

Transformative learning in sustainable agriculture and environment

In sustainable agriculture and environmental education, transformative learning is a powerful tool to empower individuals to critically examine agrifood systems' social, economic, and ecological dimensions and environmental challenges (Kumar and Kumar 2014; Filho *et al.* 2018). This section delves into applying transformative learning in sustainable agriculture and the environment, showcasing examples of transformative learning activities that engage learners in experiential and participatory approaches.

Participatory research projects

Transformative pedagogy can be effectively applied through participatory research projects that involve learners in active collaboration with communities and stakeholders (Horner *et al.* 2021). Engaging in research on sustainable agriculture and environmental issues alongside local farmers, scientists, and policymakers allows learners to gain firsthand insights into the complexities of agrifood systems and environmental challenges (van Oers *et al.* 2023). This collaborative approach fosters a sense of shared responsibility and ownership over potential solutions, cultivating transformative shifts in learners' perspectives and promoting social engagement for sustainable change (Kuri *et al.* 2023).

Field experiences

Field experiences are central to transformative learning in sustainable agriculture and the environment (Bourn and Soysal 2021). Immersing learners in real-world environments, such as farms, forests, and natural ecosystems, provide tangible experiences that challenge pre-conceived notions and elicit emotional connections to the natural world (van Wynsberghe 2022). Through field experiences, learners witness the impact of human activities on the environment and engage with local communities, facilitating critical reflection and a deeper understanding of the interconnectedness of ecological systems.

Community engagement initiatives

Involving learners in community engagement initiatives allows them to contribute to local, sustainable development efforts actively. Participating in community-based projects, such as urban gardening, environmental restoration, and food distribution programs, empowers learners to apply their knowledge and skills to address pressing environmental and social issues (Schiavo 2021). Such transformative learning experiences enhance learners' sense of agency and foster a profound connection to the communities they serve, reinforcing the importance of sustainable and equitable agri-food systems (Könings *et al.* 2021).

Interactive workshops and dialogue sessions

Transformative learning thrives in dialogical settings that encourage meaningful exchanges of ideas and perspectives. Interactive workshops and dialogue sessions allow learners to engage in critical discussions, challenge assumptions, and explore diverse viewpoints (Horner *et al.* 2021). Facilitated by educators and experts, these transformative learning activities promote a deeper understanding of complex agrifood systems and environmental issues, encouraging learners to think critically and creatively about sustainable solutions (Filho *et al.* 2018).

Digital tools and technology integration

Leveraging technology and digital tools can enhance transformative learning experiences in sustainable agriculture and environmental education (Sarker *et al.* 2019). Online platforms, simulations, and virtual reality experiences can offer learners immersive opportunities to explore different scenarios and engage with complex environmental challenges (Kong 2021). For example, many agriculture scientists in Pakistan interact with students and farmers through digital platforms such as WhatsApp, YouTube, etc. which have proven very effective. Additionally, technology enables global collaboration and knowledge sharing, connecting learners with diverse perspectives and expertise worldwide, further enriching their transformative learning journey.

Transformative learning activities in sustainable agriculture and environmental education leverage participatory research projects, field experiences,

community engagement initiatives, interactive workshops and digital tools to empower learners to engage with real-world challenges and opportunities critically. By immersing learners in experiential and dialogical learning experiences, transformative pedagogy ignites a deep sense of environmental stewardship and social responsibility. The subsequent sections will explore the benefits and challenges associated with implementing transformative pedagogy in sustainable agriculture and environmental education, shedding light on the transformative potential of these approaches.

Benefits and challenges of implementing transformative pedagogy

Implementing transformative pedagogy in sustainable agriculture and environmental education offers numerous benefits for learners, educators, and communities (Fig. 2; Horner *et al.* 2021). However, it also presents inherent challenges that require careful consideration and proactive strategies. This section explores the advantages and obstacles of transformative learning approaches in these fields.

Benefits

Increased awareness and understanding: Transformative pedagogy fosters a deep understanding of the complexities of sustainable agriculture and environmental challenges (Filho *et al.* 2018). By encouraging critical reflection and experiential learning, learners gain a holistic view of agrifood systems and environmental issues, recognizing the inter-connectedness of social, economic, and ecological dimensions (Horner *et al.* 2021). This heightened awareness enables learners to make informed decisions and advocate for sustainable practices.

Empowerment and agency: Transformative learning empowers learners to become proactive agents of change (Howell 2021). By engaging with real-world problems and participating in community initiatives, learners develop a sense of agency and efficacy, feeling capable of positively impacting environmental issues. This empowerment fuels motivation and commitment to creating sustainable and equitable agrifood systems.

Development of critical thinking skills: Transformative pedagogy cultivates critical thinking skills essential for addressing complex challenges. Learners learn to question assumptions, analyze information critically, and consider diverse perspectives, enhancing their problem-solving abilities (Taimur and Onuki 2022). These critical thinking skills are transferable beyond the classroom, empowering learners to navigate complex environmental issues personally and professionally.

Building resilience and adaptability: Experiential learning and engagement with real-world challenges build resilience and adaptability in learners (Radović *et al.* 2021). Transformative pedagogy equips learners with the skills and mindset to respond effectively to changing circumstances, particularly in the face of environmental uncertainties and disruptions.

Fostering collaboration and community engagement: Participatory and community-based learning experiences foster collaboration and community engagement. Learners develop the ability to work collectively with diverse stakeholders, promoting inclusive decision-making and social cohesion within communities (Haron *et al.* 2017; Mebert *et al.* 2020). These collaborative skills are essential for effecting transformative change at multiple levels.

Challenges

Resistance to change: Implementing transformative pedagogy may encounter resistance from learner's comfort with traditional instructional approaches (Dorji *et al.* 2020). Transformative learning requires questioning long-held beliefs and values, which some learners may find challenging or uncomfortable.

Time constraints: Transformative learning experiences often require more time and resources than conventional didactic teaching methods (Pugh *et al.* 2002). Experiential learning, community engagement, and reflective activities demand careful planning and coordination, which may be constrained by limited class time or curricular requirements (Horner *et al.* 2021).

Need for institutional support: Transformative pedagogy requires institutional support and commitment. Educational institutions must provide adequate resources, training, and recognition for educators who adopt transformative approaches (Dorji *et al.* 2020). Without institutional backing, transformative pedagogy may face barriers to implementation.

Assessing transformational outcomes: Measuring the transformative impact of learning experiences can be challenging. Traditional assessment methods may need to capture the depth of changes occurring within learners' perspectives and actions. Developing robust evaluation tools to assess transformative outcomes is essential but can be complex.

Balancing local and global perspectives: Transformative learning in sustainable agriculture and environmental education must balance local contexts and global perspectives (Filho *et al.* 2018; Anand *et al.* 2020). While local engagement is crucial for addressing specific challenges, a global perspective is necessary to understand the broader interconnectedness of environmental issues.

In conclusion, transformative pedagogy in sustainable agriculture and environmental education offers a range of benefits, including increased awareness, empowerment, critical thinking skills, and collaboration. However, it also faces challenges, such as resistance to change, time constraints, the need for institutional support, and the complexity of assessing transformative outcomes. Acknowledging and addressing these challenges can enhance the successful implementation of transformative

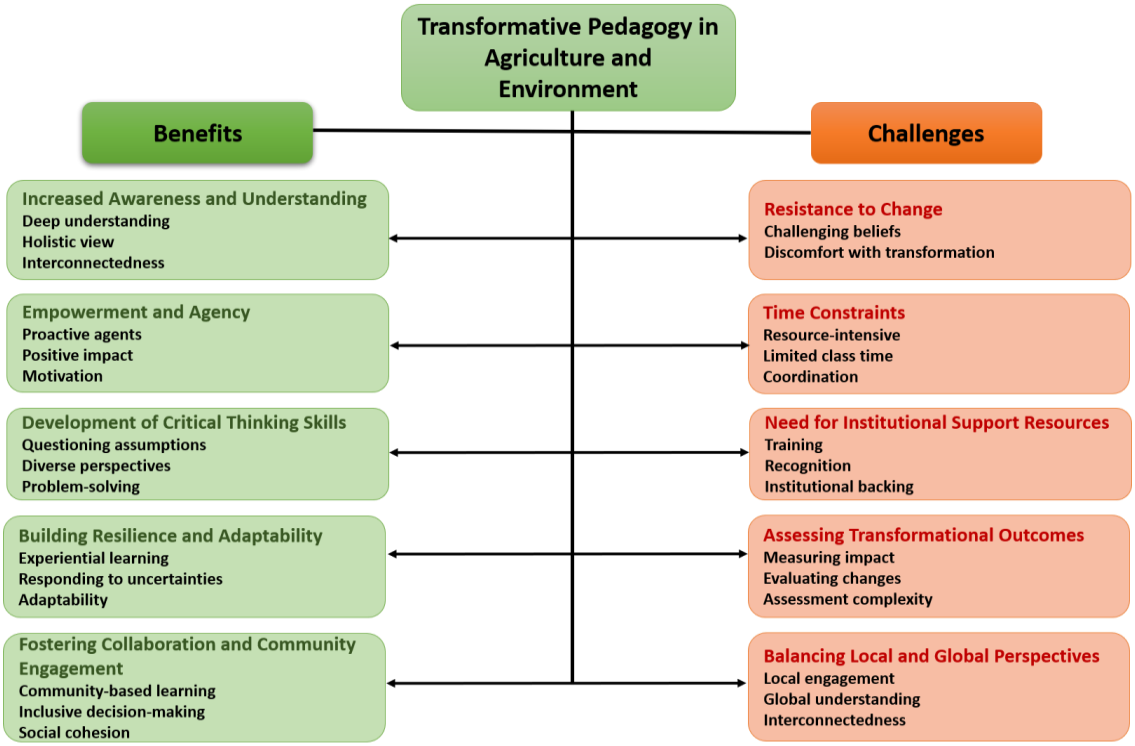

Fig. 2: Benefits and challenges of implementing transformative pedagogy

pedagogy, unlocking its full potential to empower learners as agents of positive change in sustainable agrifood systems and environmental conservation. The subsequent sections will highlight the crucial role of educators and institutions in facilitating transformative learning experiences and offer recommendations for integrating transformative pedagogy seamlessly into sustainable agriculture and environmental education.

Role of educators and institutions

The effective implementation of transformative learning in sustainable agriculture and environmental education hinges upon the active involvement of educators and institutions (Filho *et al.* 2018). This section emphasizes the crucial role of supportive learning environments, pedagogical innovation, collaboration, and professional development opportunities for educators to facilitate transformative learning experiences (Varela-Losada *et al.* 2022).

Supportive learning environments

Creating supportive learning environments is fundamental to transformative pedagogy. Educators must foster a culture of open inquiry, inclusivity, and trust where learners feel safe challenging their assumptions, and engaging in critical dialogue. Respectful and non-judgmental discussions allow learners to express diverse viewpoints, creating a rich and transformative learning experience.

Pedagogical innovation

Educators play a key role in driving pedagogical innovation to promote transformative learning. They can integrate various teaching methods, including experiential learning, participatory approaches, storytelling, and interactive technology, to cater to diverse learning styles and engage learners at deeper levels.

Collaboration among educators and stakeholders

Transformative learning experiences benefit from collaboration among educators, scholars, practitioners, and community stakeholders. Interdisciplinary collaborations foster a more comprehensive understanding of sustainable agriculture and environmental issues, while engagement with local communities ensures that learning experiences are contextually relevant and responsive to local needs.

Professional development for educators

Institutions should prioritize ongoing professional development opportunities for educators to implement transformative pedagogy effectively. Workshops, seminars, and training programs can equip educators with the skills, knowledge and resources necessary to facilitate transformative learning experiences and address potential challenges.

Cultivating reflective practice

Educators can model reflective practice to inspire learners' critical reflection. By sharing their own transformative learning experiences and lessons learned, educators create an authentic and relatable context for learners to embark on their transformative journeys.

In conclusion, educators and institutions play a central role in nurturing transformative learning experiences in sustainable agriculture and environmental education. Educators can inspire transformative shifts in learners' perspectives and actions by cultivating supportive learning environments, embracing pedagogical innovation, promoting collaboration, and offering professional development opportunities. Institutional commitment to transformative pedagogy provides a strong foundation for educators to create meaningful and impactful learning experiences, fostering a generation of environmentally conscious and socially responsible individuals.

Integrating transformative pedagogy into sustainable agriculture and environmental education: practical recommendations for empowering learners

Seamlessly integrating transformative pedagogy into sustainable agriculture and environmental education requires deliberate and strategic efforts. This final section offers practical recommendations to harness the full potential of transformative learning in empowering learners to become agents of positive change.

Transformative pedagogy into sustainable agriculture and environmental education

Curriculum redesign: Incorporate transformative learning principles into the curriculum by designing outcomes emphasizing critical reflection, experiential learning, and interdisciplinary understanding (Chen *et al.* 2020). Embrace real-world case studies and complex problem-solving exercises that actively challenge learners to apply their knowledge to address sustainable agriculture and environmental challenges.

Interdisciplinary collaboration: Encourage interdisciplinary collaboration among faculty members and departments to develop comprehensive courses that transcend traditional disciplinary boundaries (Kumar and Kumar 2014). Collaborative projects and cross-disciplinary learning experiences foster a holistic understanding of agrifood systems and environmental issues, inspiring transformative insights.

Partnerships with local communities and organizations: Forge partnerships with local communities, NGOs, relevant organizations to create authentic and community-engaged transformative learning experiences. Learners can actively participate in research, projects, and initiatives contributing to local, sustainable development, fostering a sense of responsibility and connection to their surroundings.

Technology and digital tools: Integrate technology and digital tools strategically to enhance transformative learning experiences. Online platforms, virtual field trips, and social media can facilitate global connections and knowledge sharing, while simulations and interactive tools offer immersive learning opportunities that complement experiential learning (Kumar and Kumar 2014; Žalėnienė and Pereira 2021).

Evaluation and assessment: Develop innovative evaluation and assessment methods to measure transformative learning outcomes effectively. Consider qualitative approaches, self-assessment, and reflective writing to capture the depth of learners' transformative experiences (Cooper 2014). Institutional support for alternative assessment methods will incentivize educators to prioritize transformative pedagogy.

Global perspectives: Promote a global perspective in sustainable agriculture and environmental education by incorporating examples and case studies from diverse regions and cultures (Žalėnienė and Pereira 2021). This international context enhances learners' understanding of the relationship among ecological challenges and fosters a sense of global citizenship.

In conclusion, integrating transformative pedagogy into sustainable agriculture and environmental education involves curriculum redesign, interdisciplinary collaboration, community partnerships, technology integration, and innovative assessment methods. By embracing these recommendations, educators and institutions can cultivate transformative learning experiences that empower learners to confront environmental challenges critically and contribute to building a sustainable future. Through transformative learning, learners become active agents of positive change, collectively shaping socially just and ecologically sound agrifood systems and environmental conservation. This global prospect holds immense promise for creating a more sustainable and equitable world for current and future generations.

Transformative learning in the case of sustainable agriculture and the environment

The pressing issue of climate change necessitates transformative agricultural practices to ensure better livelihoods and preserve assets (Swartling and Vulturius 2013). Transformative learning offers a powerful tool for building a more sustainable environment, extending beyond traditional education to include direct experiences and developing sustainability skills (Driskell and Chawla 2009). The rise of sustainable agriculture and food systems courses worldwide reflects the alignment of transformative learning with experiential approaches to education (Jordan *et al.* 2014; David and Bell 2018). Leveraging higher education to transform agricultural food systems involves framing

learning opportunities that encourage critical reflection on students' positionality within food systems and facilitating engagement with selected components of their food systems (Cranton 1994).

Agricultural and environmental sustainability

The pursuit of agricultural sustainability is vital for feeding the world and maintaining a sustainable society, necessitating the removal of hazardous food production practices to maintain biophysical balance. Four main domains—technocentric, ecocentric, holocentric, and egocentric—present worldwide views on sustainability, serving as a basis to explore key issues in the debate (Wals and Bawden 2000). Teaching sustainability requires educators to shift mental models and adopt positive ways of discussing humanity's destiny and other spiritual and normative convictions.

Sustainable agriculture and environment in experimental learning

Sustainability demands critical thinking and problem-solving skills, empowerment, responsibility, and self-commitment. Transformative pedagogy, with experimental learning as a key component, facilitates education on sustainable agriculture and the environment, enabling learners to engage in various agricultural and environmental activities and connect with nature through enhanced thinking skills and capabilities (Farren 2016). Critical aspects of agricultural evolution in climate change adaptation include developing accessible and adaptable platforms for cooperation, increasing involvement, and communicating clear leadership commitments (Togbé *et al.* 2015). Transformative social learning facilitates multi-stakeholder interactions, cooperative learning, innovation, and entrepreneurial abilities, which are essential for adaptability and decision-making in environmental contexts (Orderud and Winsvold 2012).

Conclusion

This article underscores the significance of transformative pedagogy in the context of sustainable agriculture and environmental education. By encouraging learners to reflect critically on their assumptions and beliefs, transformative learning empowers individuals to become proactive agents of change in addressing complex environmental challenges and promoting sustainable agriculture practices. The key principles of learner-centeredness, experiential learning, critical thinking, interdisciplinary collaboration, and technology integration provide a robust framework for integrating transformative pedagogy into educational practices. The paper highlights the transformative potential of experiential learning, participatory research projects, and community engagement initiatives, which foster a deeper understanding of local challenges and encourage learners to contribute to sustainable solutions actively. However, it also acknowledges the challenges of resistance to change and the need for institutional support to implement transformative pedagogy effectively. Further research and collaboration among educators, institutions, and stakeholders are essential to advance transformative learning in sustainable agriculture and environmental education. Emphasizing the importance of continuous professional development for educators and incorporating robust evaluation and assessment methods can strengthen the impact of transformative pedagogy. This paper seeks to inspire a collective commitment to fostering a more sustainable and resilient future for our planet by reaffirming the importance of transformative learning and advocating for its integration into sustainable agriculture and environmental education.

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Author Contributions

Muhammad Farooq conceived the idea and finalized the manuscript.

Conflicts of Interest

Author declares no conflict of interest.

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