Engaging Pre-Service Teachers With SDG 4 Through the FIDS Design Thinking Model: An Exploratory Classroom Study

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ABSTRACT

This study explored the use of the FIDS (Feel-Imagine-Do-Share) Design Thinking model as an approach to engage pre-service teachers with authentic challenges related to Sustainable Development Goal 4 (SDG 4): Quality Education. There is a growing need to prepare future teachers to address complex educational issues through innovative and human-centered thinking. To accomplish this, the study examined how engagement in the FIDS model provided opportunities for empathy, collaborative problem-solving, creativity and action-oriented thinking among pre-service teachers. This tudy adopted a qualitative exploratory classroom design, which involved a FIDS- based learning activity, in which pre-service teachers worked collaboratively on real-world educational challenges derived from SDG 4 themes identified by UNESCO and UNICEF. During this activity, participants empathized with stakeholders, generated possible solutions, developed one practical educational solution and shared their ideas for peer feedback. Data was collected through FIDS worksheets and group presentations were analyzed using thematic analysis. The findings demonstrate the potential of a simplified Design Thinking framework to foster sustainability-oriented pedagogical thinking in teacher education and contribute to the integration of education for Sustainable development into pre-service teacher preparation.

Keywords: Design Thinking, FIDS Model, SDG 4, Pre-service Teacher education.

INTRODUCTION

Sustainable Development Goal 4 (SDG) demands that everyone have access to high- quality inclusive education and opportunities for lifelong learning. However, access to and quality of education are still severely hampered by poverty, violence, displacement and social exclusion and progress toward a number of SDG 4 targets is still unattainable. According to the most recent data from Global Education Monitoring, millions of children and young people are still not attending school, progress toward a number of SDG 4 targets is uneven and issues with teacher availability, qualifications, learning environments and equity continue to limit the quality of education (UNESCO 2024a). Teachers that are able to adapt to the varied needs of their students and comprehend complicated educational realities are needed to address these issues. As a result, UNESCO (2024b) highlights the significance of preparing and empowering educators as crucial players in changing educational systems.

In this regard, teacher education bears a higher responsibility for preparing future educators for practices that are focused on sustainability. Education for Sustainable Development (ESD) demands that educators go beyond simply imparting knowledge about sustainability to cultivate the ability to analyze complicated circumstances, take into account different perspectives, work collaboratively and put ideas into practice. According to Fischer et al. (2022), a comprehensive study of Teacher Education for Sustainable Development (TESD) emphasizes the significance of using participatory and practice-oriented learning environments to expose aspiring educators to complex socio-environmental concerns. This highlights the need for pedagogies that allow pre-service teachers to engage with and address sustainability issues rather than merely study about them conceptually.

Such opportunities are made possible by experiential and interactive pedagogies. Design Thinking (DT) is especially pertinent since it encourages individuals to empathize with others, investigate alternatives, formulate and consider solutions (Alvarado, 2025). According to recent studies, DT is a promising teaching strategy for encouraging innovation, creativity, problem-solving and teamwork (Pandit et al., 2024). Its collaborative and human-centered approach further enhances ESD's action-oriented style (Yu as al., 2024). However, there is a need for more straightforward, practical methods to link DT with real-world sustainability issues in teacher preparation.

In light of this, the present study engaged pre-service teachers with real SDG 4 difficulties using the FIDS (Feel-Imagine- Do-Share) developed Kiran Bir Sethi through Design for Change (Design for Change, 2009), a DT methodology as a simplified framework. Participants take into account the experiences of stakeholders, come up with potential solutions, create workable solutions and discuss and consider their ideas throughout the four stages, The study investigated how pre-service teachers are engaged in sustainability-oriented pedagogical thought through this activity and what aspects of Design thought are revealed as a result of their involvement. In order to link Design Thinking, ESD and SDG 4 in pre-service teacher education, the study investigates the viability of a brief FIDS exercise.

REVIEW OF RELATED LITERATURE

Education for Sustainable Development (ESD) has evolved as a framework that focuses on cognitive, socio-emotional and behavioral learning to solve global concerns like climate change, inequality and poverty. UNESCO (2020) places teachers as key agents in achieving Sustainable Development Goal 4 stressing their role in fostering critical thinking, collaboration, responsible decision-making and action for sustainable development. Accordingly, teacher education programmes are increasingly expected to train pre-service teachers not only with disciplinary knowledge but also with the abilities required to integrate sustainable principles into educational practice. Recent research increasingly centers the importance of developing sustainability-related knowledge, skill and attitude among pre-service teachers (Koculu &Sert, 2024).

In their study, Nousheen et al. (2024) reported that teaching practicum experiences greatly improved pre-service teachers' self- efficacy, perceived content knowledge and pedagogical knowledge related to ESD, emphasizing the importance of authentic learning experiences in developing sustainability-related competencies. Similarly, Brandt et al. (2022) found that carefully designed ESD courses improved pre-service teachers' professional action competence. Summers et al. (2004) found that pre-service teachers generally understood the environmental aspects of sustainability, frequently ignoring broader aspects like social, economic and ethical perspectives, highlighting the need for more holistic approaches. Recent evidence also suggests that sustainability knowledge and positive attitudes do not necessarily translate into sustainable action (Crespo-Martin et al., 2025). This reinforces the need for experiential learning that enables pre-service teachers to engage with authentic sustainable challenges.

Design Thinking offers a promising experiential approach for addressing complex educational problems through empathy, creativity and iterative problem solving (Guaman-Quintanilla et al., 2023). A systematic review by (Pandit et al., 2024) identified these competencies as important outcomes of DT-based educational practices. Baran and Alzoubi (2024), using qualitative reflections from pre-service teachers, found that DT supported participants' understanding of teachers as designers and innovators, while Lasak et al. (2023) demonstrated its value for student teachers' professional learning. FIDS, a four-stage Design Thinking framework has also been applied to educational challenges. Pandit et al. (2025), using a qualitative case study, reported that FIDS- based engagement with social challenges supported empathy, creativity, critical thinking and collaboration among school learners.Such findings suggest that DT can provide pre-service teachers with opportunities to engage actively in solving complex problems. However, its application with pre-service teachers in sustainability-oriented contexts remains less explored.

Researchers have emphasized the value of instructional experiences that promote reflection and classroom implementation as well as knowledge acquisition. While Boeve-de Pauw et al.(2022) demonstrated that ongoing professional development strengthened teachers' ESD practices over time, self-efficacy varied as teachers faced

actual classroom challenges.Similarly, Andersson (2017) discovered that ESD interventions shaped pre-service teachers' more discussion-oriented and participatory approaches to teaching sustainability. All of these studies indicate the importance of practice- oriented learning opportunities, opportunities for group reflections and meaningful engagement with real sustainability challenges. Design Thinking is particularly relevant in this context because sustainability challenges are complex, context-dependent and require multiple perspectives and solutions. Avsec (2023) found associations between DT and interpersonal and evaluative skills among students in teacher education, while Alvarez Ariza and Olatunde- Aiyedun (2024) emphasized the value of interdisciplinary approaches in sustainability oriented teacher education. Qualitative approaches can further illuminate how learners experience and make sense of DT processes. This was demonstrated through studies using reflections, self-study and phenomenological approaches (Girgin, 2021).

Altogether, the literature reveals a gap at the intersection of ESD, DT and Teacher Education. ESD research has largely examined pre-service teachers' knowledge, self- efficacy, professional competence and instructional practices The majority of DT research has addressed creativity, problem solving and teacher learning. Short-term, classroom-based pedagogical interventions connecting DT with real-life SDG related challenges remain unexplored. In particular, qualitative evidence on how pre-service teachers engage with sustainability problems with collaborative problem -solving through a structured DT process is limited. The present study addresses this gap by using the FIDS model as a short, structured DT activity through which pre-service teachers analyze authentic SDG 4 challenges and collaboratively develop contextually relevant educational solutions.

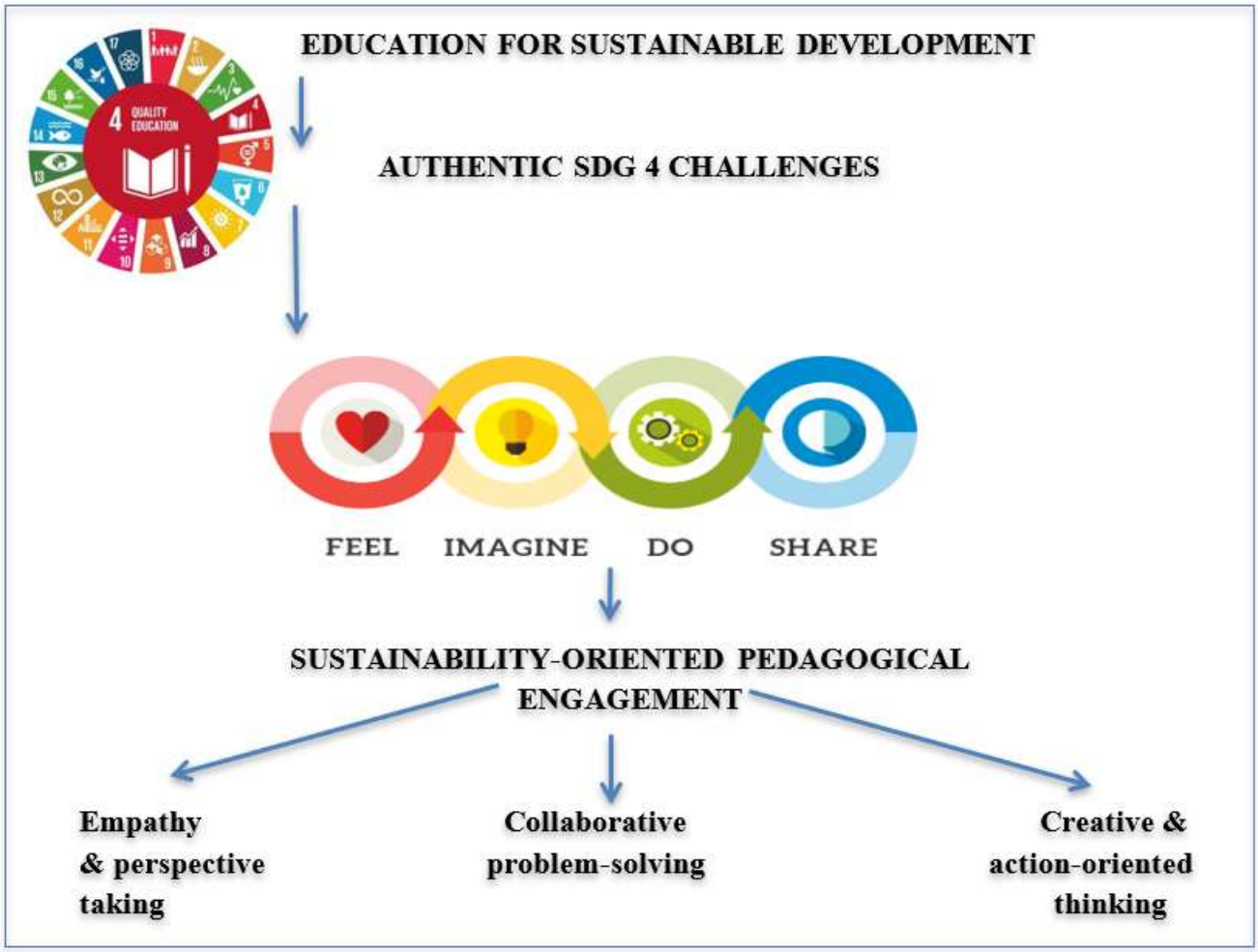
CONCEPTUAL FRAMEWORK

Sustainable Development Goal 4 (SDG 4) recognizes education as a fundamental driver of sustainable development by promoting equitable, inclusive and quality learning opportunities for all (United Nations, 2015). Within this broader goal, Education for Sustainable Development (ESD) provides a framework for developing the knowledge, skills , attitudes and values needed to respond to complex and interconnected challenges (UNESCO, 2024). In the present study, SDG 4 challenges provide the authentic problem context through which pre-service teachers engage with sustainability- oriented pedagogical thinking.

Design Thinking has emerged as a pedagogical approach for addressing such complex challenges because it promotes human-centered inquiry, empathy, creativity, collaboration and iterative problem-solving (Henriksen et al., 2020). Instead of focusing solely on generating innovative products, Design Thinking encourages learners to empathize with stakeholders, understand their needs, explore multiple possibilities and develop practical solutions to complex real-world problems. These characteristics complement the participatory, reflective and action-oriented principles of ESD (OECD, 2017).

Building upon these principles, the present study adopts the FIDS (Feel-Imagine-Do-Share) Model (Sethi, 2009) as a simplified classroom adaptation of Design Thinking. The Feel stage encourages participants to empathize with stakeholders affected by SDG 4 challenges. Imagine stage promotes collaborative exploration of multiple solutions, in Do stage, the participants focus on designing feasible educational interventions. Finally, in the Share stage, the participants are provided opportunities for peer interaction, reflection and refinement of solutions. These interconnected stages of the FIDS model enable Design Thinking within a regular classroom setting while maintaining its human-centered and collaborative nature.

Thus, the framework positions SDG 4 challenges as the authentic context, FIDS as the Design Thinking process and sustainability-oriented pedagogical thinking as the emergent learning outcome. These processes are expected to enable future teachers to engage more meaningfully with sustainability-related educational challenges. It contributes to the integration of Education for Sustainable Development within teacher education.



Research Questions

1. How does the FIDS Design Thinking model engage pre-service teachers in analyzing authentic educational challenges related to Sustainable Development Goal 4?

2. How does participation in the FIDS Design Thinking activity shape pre-service teachers' perspectives on sustainability and educational practice?

Research Objectives

1. To engage pre-service teachers with authentic SDG 4 challenges using the FIDS Design Thinking model.

2. To explore how participation in the FIDS activity supports pre-service teachers' perspectives on sustainability and educational practice.

METHODOLOGY

Research Design and Learning Activity

The study employed a qualitative exploratory classroom design to examine how pre-service teachers engaged with authentic SDG 4 challenges through the FIDS Design Thinking model. A qualitative approach was considered as the study sought to explore participants' perspectives, collaborative discussions and action-oriented solutions rather than measure learning outcomes. The study was conducted as a single classroom activity of one hour in which participants collaboratively address one of five authentic educational case scenarios developed from UNESCO's Global Education Monitoring reports and UNICEF State of the World's Children

reports on SDG 4. The cases addressed authentic SDG 4 related challenges including exclusion from schooling, education during crisis and conflict, child poverty, mental health and educational access. Each scenario presented an authentic educational problem requiring participants to analyse stakeholder needs and propose contextually relevant solutions. Five cases were used to expose participants to diverse SDG 4 challenges within the exploratory activity these cases were not intended for comparative analysis of both the FIDS process and solutions identified by participants. During the Feel stage, participants identified stakeholders and explored their needs. In the Imagine stage, they brainstormed multiple possible solutions. During Do, each group translated their selected idea to develop one practical educational intervention, while the Share stage involved presenting their ideas and receiving peer feedback.

Participants

The participants were third year pre-service teachers enrolled in the Integrated Teacher Education programme (ITEP). A convenience sampling method was used and participants were organized into five small collaborative groups of four members each. Each group was assigned one SDG 4 case scenario and completed the FIDS activity through discussion, collaborative decision-making and reflection.

Group	Theme
G1	Out-of - School children
G2	Education in emergencies
G3	Child Poverty and Education
G4	Mental Health and Education
G5	Education during War and Conflict

Data collection and analysis

The researcher facilitated the activity, collected the materials and conducted the coding. Data was collected through researcher developed FIDS worksheets and group presentations. The worksheets were used as a qualitative, written evidence of participants' understanding of educational challenges, collaborative discussions, proposed solutions and reflections on the learning experience, enabling a complete analysis of their involvement in the FIDS process. Data were analyzed using thematic analysis. The FIDS worksheets and group presentations were reviewed and coded to identify recurring patterns and organized into themes. The four themes reported in the results represent patterns identified across the group-level outputs, rather than independently measured competencies.Although the FIDS stages provided the instructional structure of the activity, the themes were used to interpret the broader patterns evident in participants' responses rather than to treat each FIDS stage as a separate analytical theme. The group presentations were analyzed based on the ideas presented, the relevance of the proposed solutions to the assigned SDG 4 challenge, and evidence of collaborative and sustainability-oriented thinking. The analysis focused on participants' empathy, collaborative problem-solving, creativity, action- oriented thinking and sustainability-oriented perspectives that emerged during the FIDS activity.

RESULTS AND DISCUSSION

The FIDS Design thinking activity enabled pre-service teachers to engage with authentic SDG 4 challenges. It encouraged them to analyse educational problems from multiple stakeholder perspectives, collaboratively generate solutions and reflect on the role of teachers in promoting quality education. Thematic analysis of five group worksheets revealed four interconnected themes: (i) developing empathy towards diverse educational challenges (ii) collaboratively generating context-sensitive educational solutions (iii) translating ideas into practical educational action and (iv) reconceptualising teachers as agents of sustainable educational change.

(i) Developing empathy towards diverse educational challenges

The *Feel* stage enabled participants to understand educational issues from the perspectives of affected learners and communities instead of merely viewing them as isolated academic challenges. Participants acknowledged

the close connections between poverty, safety, mental health, social inclusion and equity. They demonstrated a deeper comprehension of the variables affecting educational results by regularly identifying the demands of various stakeholders, including kids, parents, teachers and communities. This broader perspective was evident in group one's reflection:

"*It is not only important to make every student to get into the school, but it is also important to prevent the dropout*."

This reflection indicates their awareness and understanding that quality education does not only refer accessibility to schools but also addressing factors that may lead learners to disengage from schooling.

This result implies that FIDS activity created opportunities for participants to engage with the human-centered perspective of Design Thinking. In line with the ideas of Design Thinking (Brown, 2009; Leidtka, 2018) and ESD, the activity promoted holistic thinking about educational difficulties by encouraging participants to empathize with learners before offering solutions. The results also support earlier studies that empathize the significance of teaching pre-service teachers to recognize the social and pedagogical aspects of sustainability issues in addition to environmental ones (Summers et al., 2004).

(ii) Collaboratively generating context-sensitive educational solutions

Participants worked together to create ideas that addressed each case's contextual reality during the Imagine stage. Inclusive teaching methods, counselling services, community awareness initiatives, financial assistance for underprivileged students, teacher capacity building and partnerships between local communities and schools were frequently suggested solutions. Participants concentrated on strategies that are practical and potentially low-cost suited to educational contexts rather than relying exclusively on idealized solutions. For example, while addressing barriers to schooling in remote areas, G3 proposed " propose a satellite classroom in remote areas instead of waiting for a new school."

This illustrates how participants translated their understanding of contextual barriers into an alternative educational arrangement rather than relying solely on conventional school. Given the activity's collaborative nature, participants were able to examine various viewpoints and create workable solutions to challenging educational problems. This illustrates how both Design Thinking and ESD are action- oriented and engaging with collective inquiry and contextual understanding leading to sustainable solutions, Studies showing that Design Thinking improves creativity, teamwork and problem-solving in educational contexts have shown similar results (Henriksen et al., 2020).

(iii) Translating ideas into practical educational action

During the *Do* stage, the participants translated their proposed solutions into practical educational actions. Participants from all five groups suggested proposed interventions, including school counselling programs, peer mentoring, flexible learning options, awareness campaigns and partnerships with neighborhood organizations. The solutions reflected an emphasis on actions that educators and schools could potentially implement within existing educational contexts.

The findings suggest that the FIDS activity encouraged participants to go beyond problem identification to solution design, hence supporting action-oriented pedagogical thinking. This meets the goals of ESD, which promote enabling future educators to react proactively to sustainable concerns (Brandt et al., 2022). It is consistent with Design Thinking's emphasis on creating workable solutions through iterative problem-solving (Liedtka, 2018).

(iv) Reconceptualising teachers as agents of sustainable educational change

During the *Share* stage, participants reflected on both their proposed solutions and the broader role of educators in promising quality education. Their reflections portrayed teachers as advocates, mentors, counsellor and facilitators who may help students with their social, emotional and intellectual needs. Participants also

emphasised cooperation among schools, families, communities and governemnts in addressing educational challenges.

These reflections suggest that the activity provided opportunities for participants to consider teaching in relation to social responsibility, empathy and collaboration,. The results are in line with other research showing that ESD experiences promote more engaging and learner-centered conceptions of teaching (Andersson, 2017) and with ESD literature that portrays educators as important agents of sustainable development (UNESCO, 2020). Therefore, by encouraging participants to re-evaluate their future professional duties, the reflective component of the FIDS paradigm extended learning beyond solution development.

Overall, the results indicate that the pre-service teachers were engaged with real SDG 4 concerns in an organized yet adaptable learning environment credited to the FIDS Design Thinking paradigm. Throughout the four phases, participants showed empathy for various educational circumstances, worked together to develop workable solutions, converted concepts into useful educational actions, and reflected on teachers' role in promoting sustainable educational change. Collaborative thinking was reflected in group discussions and collective decision-making and learning orientation was demonstrated through participants' willingness to explore multiple alternatives before selecting practical interventions. The proposed school- and community based interventions also illustrated participant orientation towards addressing educational challenges.

As the study did not quantitatively measure Design Thinking abilities or include a comparison group, the findings should be interpreted as evidence of learning- related perspectives expressed during the activity rather than proof of improved DT competencies.

Educational Implications

The findings suggest that the FIDS Design Thinking model offers a practical and classroom feasible approach for incorporating ESD into teacher education. In a short-duration classroom activity, pre-service teachers engaged meaningfully with authentic educational challenges, expressing empathy, collaborative problem solving and action-oriented thinking. For ITEP, the FIDS model can be integrated into existing coursework and practicum-related activities to provide pre-service teachers with opportunities to connect theoretical knowledge with real- world educational challenges. From a classroom pedagogy perspective, teacher educators can use simple DT activities to promote collaborate learning, inquiry based learning, reflection and practical solution development. The FIDS model also provides a structured framework for designing experiential learning activities that encourage empathy, collaboration and sustainability-oriented thinking. Teacher education institutions may therefore consider incorporating simplified Design Thinking activities to strengthen sustainability competencies and prepare future teachers to address complex educational issues aligned with Sustainable Development Goal 4.

CONCLUSION

This exploratory classroom study examined the use of the FIDS Design Thinking model to engage pre-service teachers with real educational challenges related to SDG 4 (Quality education) through an one- hour activity. The findings indicate that the structured Design Thinking activity encouraged participants to empathize with diverse learner contexts, collaboratively generate context-sensitive solutions and reflect on their roles as future educators. The study therefore provides preliminary qualitative evidence that a brief, structured FIDS activity can create opportunities for pre-service teachers to engage with sustainability- related educational challenges through perspective-taking, collaborative solution generation and action- oriented thinking. The findings reflect participants' engagement, rather than evidence of measurable change in Design Thinking or sustainability competencies.

The findings should, however, be interpreted in light of certain limitations. The study involved a relatively small group of pre-service teachers from a single teacher education institution and was based on a one-time classroom activity. Thus, limiting the transferability of the findings to other educational settings. In addition, the analysis relied on collaborative researcher- made worksheet responses without employing standardized measures to

assess changes in Design Thinking competencies or sustainability-related learning. Future studies may build on this study by implementing the FIDS model with larger and more diverse samples and adopting longitudinal or mixed- methods designs to examine sustained learning outcomes. Follow-up assessments could examine whether the patterns observed in this exploratory study sustained over time and whether participants transfer their learning to teaching practice.

REFERENCES

1. Alvarado, L. F. (2025). Design thinking as an active teaching methodology in higher education: A systematic review. Frontiers in Education, 10, 1462938. https://doi.org/10.3389/feduc.2025.1462938
2. Álvarez Ariza, J., & Olatunde-Aiyedun, T. G. (2024). A systematic literature review on STEAM pre- and in-service teacher education for sustainability: Are teachers ready? EURASIA Journal of Mathematics, Science and Technology Education, 20(9), em2498. https://doi.org/10.29333/ejmste/14982
3. Andersson, K. (2017). Starting the pluralistic tradition of teaching? Effects of education for sustainable development (ESD) on pre-service teachers' views on teaching about sustainable development. Environmental Education Research, 23(3), 436–449. https://doi.org/10.1080/13504622.2016.1174982
4. Avsec, S. (2023). Design thinking to envision more sustainable technology-enhanced teaching for effective knowledge transfer. Sustainability, 15(2), 1163. https://doi.org/10.3390/su15021163
5. Baran, E., & Alzoubi, D. (2024). Design thinking in teacher education: Morphing preservice teachers' mindsets and conceptualizations. Journal of Research on Technology in Education, 56, 1–19. https://doi.org/10.1080/15391523.2023.2170932
6. Boeve-de Pauw, J., Olsson, D., Berglund, T., & Gericke, N. (2022). Teachers' ESD self-efficacy and practices: A longitudinal study on the impact of teacher professional development. Environmental Education Research, 28(6), 867–885. https://doi.org/10.1080/13504622.2022.2042206
7. Brandt, J.-O., Barth, M., Hale, A., & Merritt, E. (2022). Developing ESD-specific professional action competence for teachers: Knowledge, skills, and attitudes in implementing ESD at the school level. Environmental Education Research, 28(12), 1691–1729. https://doi.org/10.1080/13504622.2022.2064973
8. Brown, T. (2009). Change by design: How design thinking transforms organizations and inspires innovation. HarperCollins.
9. Crespo-Martín, J., Corbacho-Cuello, I., & Muñoz-Losa, A. (2025). Teacher education as an agent for sustainability: Validation of an SDGs-focused knowledge, attitude, and behavior questionnaire for pre-service primary teachers. Sustainable Development, 33(6), 8057–8071. https://doi.org/10.1002/sd.70084
10. Design for Change. (2009). FIDS for kids: Feel, Imagine, Do, Share. https://www.dfcworld.org/site/fids
11. Fischer, D., King, J., Rieckmann, M., Barth, M., Büssing, A. G., Hemmer, I., & Kimmig, A. (2022). Teacher education for sustainable development: A review of the research. Sustainability Science, 17, 229–245.
12. Girgin, D. (2021). A sustainable learning approach: Design thinking in teacher education. Journal of Teacher Education and Educators, 10(3), 359–382.
13. Guaman-Quintanilla, S., Everaert, P., Chiluiza, K., & Valcke, M. (2023). Impact of design thinking in higher education: A multi-actor perspective on problem solving and creativity. International Journal of Technology and Design Education, 33, 217–240. https://doi.org/10.1007/s10798-021-09724-z
14. Henriksen, D., Richardson, C., & Mehta, R. (2020). Design thinking: A creative approach to educational problems of practice. Thinking Skills and Creativity, 37, 100669. https://doi.org/10.1016/j.tsc.2020.100669
15. Koçulu, A., & Sert, H. (2024). From awareness to attitude and behavior? Relationships among pre-service science teachers' awareness of sustainable development, attitudes and behaviors towards environmental issues. Journal of Teacher Education and Lifelong Learning.
16. Lasak, P., Chaichowarat, R., & Saeueng, A. (2023). When teacher educators use design thinking (DT) to design learning experiences for mathematics student teachers. Journal of Asian Language Teaching and Learning, 4(3), 1–10.
17. Liedtka, J. (2018). Why design thinking works. Harvard Business Review, 96(5), 72–79.

18. Nousheen, A., Zia, M. A., & Waseem, M. (2024). Exploring pre-service teachers' self-efficacy, content knowledge, and pedagogical knowledge concerning education for sustainable development. Environmental Education Research, 30(3), 321–333. https://doi.org/10.1080/13504622.2022.2128055
19. UNESCO. (2017). Education for sustainable development goals: Learning objectives. https://doi.org/10.54675/CGBA9153
20. Pandit, R., Shastri, I., & Surana, A. (2024). Design thinking as a pedagogical approach in educational settings: A systematic review. Scope, 14, 214–235.
21. Pandit, R., Shastri, I., & Surana, A. (2025). Design thinking approach to developing empathetic, reflective and inclusive learners in K-12 education: A case study. Scope, 15(2), 323–351.
22. Summers, M., Corney, G., & Childs, A. (2004). Student teachers' conceptions of sustainable development: The starting-points of geographers and scientists. Educational Research, 46(2), 163–182. https://doi.org/10.1080/0013188042000222449
23. UNESCO. (2020). Education for sustainable development: A roadmap. UNESCO.
24. UNESCO. (2024a). Global education monitoring report 2024/5: Leadership in education—Lead for learning. UNESCO.
25. UNESCO. (2024b). Global report on teachers: Addressing teacher shortages and transforming the profession. UNESCO.
26. United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations.
27. Yu, Q., Yu, K., & Lin, R. (2024). A meta-analysis of the effects of design thinking on student learning. Humanities and Social Sciences Communications, 11, Article 1227. https://doi.org/10.1057/s41599-024-03237-5