Available online at: http://journal.uinsgd.ac.id/index.php/kp
Khazanah Pendidikan Islam, Vol. 7 No. 3: 209-219

DOI: 10.15575/kpi.v7i3.48332

Innovative STEAM Learning: Crafting a Stop Motion Video to Promote Environmental Care for Prospective Elementary School Teachers

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Abstract

This study aims to measure the effectiveness of project-based learning through the creation of stop motion videos as a medium for environmental awareness campaigns among prospective primary school teachers, within the framework of innovative STEAM learning. The model used is project-based learning integrated with the STEAM approach. Tools included smartphones with the Stop Motion Studio app, storyboard templates, and video editing software. The research design is a case study using a weak one-shot experimental method, involving pre-tests, post-tests, and questionnaires administered to 80 prospective teachers. Research instruments included observation sheets, Likert-scale questionnaires, and expert validation forms. The results showed that STEAM-based project learning significantly enhanced students' creativity, collaboration, and understanding of environmental concepts. The production of stop motion videos also contributed to the improvement of digital literacy and communication skills. This approach effectively increased student engagement and awareness of the importance of environmental education. Quantitative data indicated a significant improvement in learning outcomes after the intervention. This study introduces stop motion video production as an innovative tool in STEAM project-based learning, making a meaningful contribution to the development of 21st-century skills and environmental awareness in teacher education programs.

Keywords: Environmental Care Campaign, Project-Based Learning, Prospective Elementary Teachers, STEAM Learning, Stop Motion Video, 21st Century Skills Development

Abstrak

Penelitian ini bertujuan untuk mengukur efektivitas pembelajaran berbasis proyek melalui pembuatan video stop motion sebagai media kampanye kesadaran lingkungan di kalangan calon guru sekolah dasar, dalam kerangka pembelajaran STEAM yang inovatif. Model yang digunakan adalah pembelajaran berbasis proyek yang diintegrasikan dengan pendekatan STEAM. Alat yang digunakan meliputi smartphone dengan aplikasi Stop Motion Studio, template storyboard, dan perangkat lunak pengedit video. Desain penelitian ini adalah studi kasus dengan metode one-shot eksperimen yang lemah, melibatkan pra-tes, pasca-tes, dan kuesioner yang diberikan kepada 80 calon guru. Instrumen penelitian meliputi lembar observasi, kuesioner skala Likert, dan lembar validasi ahli. Hasil penelitian menunjukkan bahwa pembelajaran berbasis proyek dengan pendekatan STEAM secara signifikan meningkatkan kreativitas, kolaborasi, dan pemahaman siswa terhadap konsep lingkungan. Produksi video stop motion juga berkontribusi pada peningkatan literasi digital dan keterampilan komunikasi. Pendekatan ini secara efektif meningkatkan keterlibatan siswa dan kesadaran akan pentingnya pendidikan lingkungan. Data kuantitatif menunjukkan adanya peningkatan signifikan dalam hasil belajar setelah intervensi. Penelitian ini memperkenalkan produksi video stop motion sebagai alat inovatif dalam pembelajaran berbasis proyek STEAM, memberikan kontribusi yang bermakna terhadap pengembangan keterampilan abad ke-21 dan kesadaran lingkungan dalam program pendidikan guru.

Kata kunci: Calon Guru, Pembelajaran Berbasis Proyek, Pembelajaran STEAM, Pengembangan Keterampilan Abad 21, Sekolah Dasar, Video Stop Motion

Received: July 7, 2025; Revised: August 18, 2025; Accepted: September 4, 2025

BACKGROUND

In the 21st century, prospective elementary school teachers must be equipped not only with pedagogical knowledge but also with the creative capacity to communicate educational values in ways that resonate with young learners. Among these values, environmental care has become increasingly urgent, given the global environmental challenges faced today. Early childhood is a critical period for shaping attitudes and behaviors, and therefore, introducing environmental awareness from a young age is essential in cultivating responsible and environmentally conscious citizens.

To be effective, environmental education at the elementary level must go beyond theoretical explanations. It requires engaging, meaningful, and imaginative methods that capture children's interest and foster deep emotional connections to nature. Creative campaigns—especially those incorporating visual and interactive media—serve as powerful tools to achieve this goal. They can simplify complex issues, stimulate curiosity, and inspire active participation. In this context, the ability of prospective teachers to design such campaigns is a crucial skill that bridges educational content with creative expression, enabling environmental values to be communicated more effectively to students.

However, in practice, many prospective elementary school teachers still face significant challenges in designing and delivering environmental education materials that are both engaging and meaningful for young learners. Despite the growing emphasis on environmental awareness in the curriculum, the methods used by teacher candidates often rely on conventional, lecture-based approaches that fail to spark students' curiosity or invite active participation. As a result, learning becomes passive, student motivation declines, and crucial opportunities to internalize environmental values are lost.

This lack of creativity and innovation in teaching strategies reflects a deeper issue in the way teacher training programs are structured. Many of these programs still emphasize theoretical knowledge without providing sufficient opportunities for students to apply concepts through interdisciplinary and creative projects. In particular, the pedagogical approaches used are often disconnected from the real developmental characteristics of elementary students, who respond better to visual, hands-on, and exploratory learning experiences. Without strategies that are aligned with how children naturally learn, even well-intentioned content can become ineffective.

These shortcomings point to the urgent need for rethinking how environmental education is embedded within teacher preparation—by equipping future educators with tools and approaches that promote both creativity and pedagogical relevance. The root of the problem lies in the absence of integrated learning approaches that meaningfully connect pedagogical skills with the core values emphasized in elementary education, such as environmental responsibility, empathy, collaboration, and critical thinking. Many teacher education programs still adopt compartmentalized teaching methods, where content is delivered in isolated subject areas without real-world context or cross-disciplinary integration. This siloed approach limits the ability of future teachers to design learning experiences that reflect the complexity of real-life issues and the holistic nature of children's learning.

Recent research shows that environmental education in primary schools requires a more creative and interdisciplinary approach to build ecological awareness from an early age (Ernst & Tornabene, 2012). A study by (Attai et al., 2021) found that conventional lecture-based methods

often fail to foster active student engagement, necessitating more dynamic strategies such as STEAM-based projects. This approach combines science, art, and technology to create meaningful learning experiences (Liao et al., 2016). Although STEAM is recognised as an innovative solution, its implementation in teacher training programmes remains limited (Peppler & Wohlwend, 2018). Research (Davis et al., 2019) reveals that many teacher education institutions remain focused on mastering theoretical content without providing opportunities for creative application. This results in prospective teachers struggling to design materials that align with children's developmental characteristics, which tend to be responsive to visual and exploratory learning (Eickelmann & Vennemann, 2017). There is a gap between theory and practice in STEAM-based environmental education. A study (S. Kahn & Zeidler, 2019) shows that while interdisciplinary approaches like stop-motion video are effective in improving student understanding, there is limited research evaluating their long-term impact on environmental behaviour change. Additionally, the need for more structured teacher training in using creative technology remains unmet (Hsu et al., 2021)

The integration of STEAM (Science, Technology, Engineering, Arts, and Mathematics) approaches in environmental education has emerged as a transformative strategy to foster ecological literacy among elementary school students (Herro et al., 2019) However, a critical gap persists in preparing prospective teachers to design and implement such interdisciplinary methods effectively (Peppler & Wohlwend, 2018). Stop-motion video, as a creative pedagogical tool, offers unique potential to bridge this gap by combining artistic expression with scientific inquiry, thereby enhancing both engagement and conceptual understanding (E. Chung et al., 2020)

Stop-motion video production aligns with constructivist and experiential learning theories, where learners actively construct knowledge through hands-on projects(Peterson et al., 2015). This method integrates *multimodal literacy*—combining visual, digital, and scientific competencies to address complex environmental issues (Jewitt, 2008). Studies show that STEAM-based approaches, particularly those incorporating arts, enhance *systems thinking* and ecological awareness among pre-service teachers (Guyotte et al., 2015). Recent research demonstrates that stop-motion projects significantly improve environmental care competencies in teacher education. For example, (C. Chung et al., 2019) found a 32% increase in pre-service teachers' ability to design sustainability lessons after creating stop-motion narratives. Similarly, (J. P. Kahn & others, 2020) reported enhanced pedagogical creativity when participants used stop-motion to visualize local ecological problems. However, these studies primarily focus on short-term outcomes, leaving gaps in longitudinal impact assessments (Avraamidou, 2024).

This study seeks to the effectiveness of stop-motion video as a STEAM tool for fostering environmental care competencies in pre-service elementary teachers. This study introduces stop motion video production as a novel element within the STEAM-based project learning model. By integrating multimedia creation into educational projects, it offers a new and effective way to foster creativity, digital literacy, and environmental awareness in future educators. This innovation not only enhances the quality of teacher training but also contributes to the advancement of creative teaching methods in environmental education.

RESEARCH METHOD

This study employed a weak experimental design using the one-shot case study approach to investigate the effectiveness of project-based learning within a STEAM framework. The single-case

study design is one of the weakest experimental approaches in educational research. This design involves administering a treatment followed by a single posttest observation, without a control group or baseline measurement (Campbell & Stanley, 2015). In an educational context, these limitations pose a serious problem when evaluating the effectiveness of interventions, as they cannot distinguish the effects of the intervention from other contextual variables (Trochim et al., 2006). However, this is done at the beginning of the research as supporting data for developing digital media or towards behaviour or attitudes that can be repeated.

The research was conducted with prospective elementary school teacher students who were assigned to collaboratively create a stop motion video campaign on environmental care as the main learning project. The participants in this study were 80 students from a primary teacher education program at a university in Indonesia. They were selected through purposive sampling based on their enrollment in a STEAM-integrated instructional media course.

Treatment	Observation
X	O

Figure 1. One-Shot Case Study Design, X: Treatment, O: Observation

The research was conducted over several stages following the principles of Project-Based Learning (PjBL), including: Determining the essential question (environmental issues for children), Designing the project (storyboarding and scripting), Creating the product (stop motion video), Presenting the product, and Evaluating the outcomes. Students used smartphones, tripods, storyboard templates, Stop Motion Studio for video capture, and video applicition for editing. Product Assessment – The stop motion videos created by students were assessed using a detailed rubric designed to measure both the quality and feasibility of the media as a learning tool.

Table 1. Assessment indicators for the feasibility of stop motion animation video for environmental care campaigns

Item	Indicator	Sub Indicator
Eligibility of Stop Motion Animation Video Media for environmental care campaigns	Functions and Benefits	Clarify and simplify message delivery
		Arousing students' interest and motivation
		Awakening students' creativity
	Aspects of truth, breadth and depth of material	Biological concepts developed according to material references
		The video concept presented is easy to understand
		The terms used in the video exactly match the reference
	Visual Aspects of Media	The attractiveness of colors, backgrounds, images and animations.
		Image sizing conformity
		Image clarity
		Lighting accuracy

ISSN 2715-968X (online)

Item	Indicator	Sub Indicator
		Image movement speed
		Sound Rhythm
	Audio Media Aspects	Clarity of Voice
		Music Suitability
	Typographic Aspects	Text Type Selection
		Text size accuracy
	Language Aspects	Language accuracy
	Media Programming Aspects	Time Duration

This comprehensive rubric ensured that the student-produced stop motion videos were not only creative and technically sound but also pedagogically valuable and suitable for elementary environmental education. Effectiveness of Learning – The effectiveness of the PjBL-STEAM model was evaluated using a Likert-scale questionnaire with six indicators: Perception (students' views of the learning process), Motivation (level of enthusiasm and interest), Understanding (comprehension of environmental content), Analysis (ability to interpret and connect issues), Activity (participation and collaboration in the project), Impression (students' overall experience and satisfaction)

Quantitative data from the Likert-scale questionnaires were analyzed using descriptive statistics (mean and percentage) to determine students' responses for each indicator. Meanwhile, the video products were evaluated through expert validation using the rubric to determine the overall quality and relevance of the media created. The data obtained from the validation test and response questionnaires are data to analyze the feasibility of the media, while the pre-test and post-test data are the data used to analyze the data on the effectiveness of the media. The expert validation score that has been obtained then is to determine the value into the formula according to.

$$P = \frac{\sum Score}{\sum Maximum\ Score} x\ 100 \qquad (1)$$

Information: P = eligibility score or media quality. After obtaining the assessment score of each validator, then look for the average using the formula description:

$$x = \frac{\sum X}{N} \qquad (2)$$

$\sum X$= total value
X = average
N = number of evaluators

Based on the above calculation categories, it can be seen that the STREAM lecture model product for prospective teacher students is declared feasible if it is in the feasibility score between 61 - 80, which is in the Good category. Descriptive analysis of Likert-scale data has proven particularly effective in evaluating student responses to instructional interventions (Joshi et al., 2023) . Studies employing this approach have successfully identified trends in student satisfaction, engagement levels, and perceived learning outcomes across various educational settings. The percentage breakdown of responses adds valuable context by revealing the proportion of students at different points along the response continuum (Norman, 2023). This dual approach (mean +

percentage) helps mitigate some limitations of treating ordinal data as interval-level by providing multiple perspectives on the response distribution (Harpe, 2024)

RESULTS AND DISCUSSION

Designing and making STEAM Learning: Creating A Stop Motion Video About The Environmental Care Campaign

The implementation of the PjBL STEAM lecture model for prospective teacher students has been carried out in the elementary school teacher education study program, UPI Cibiru Campus in 2024. A total of 80 seventh semester prospective teacher students participated in this activity. The results obtained from this study are the design of lecture activities with a STEAM (Science, Technology, Engineering, Arts and Mathematics) approach for prospective teacher students in making environmental campaign educational video projects using stop motion animation techniques as presented in Figure 2 below.

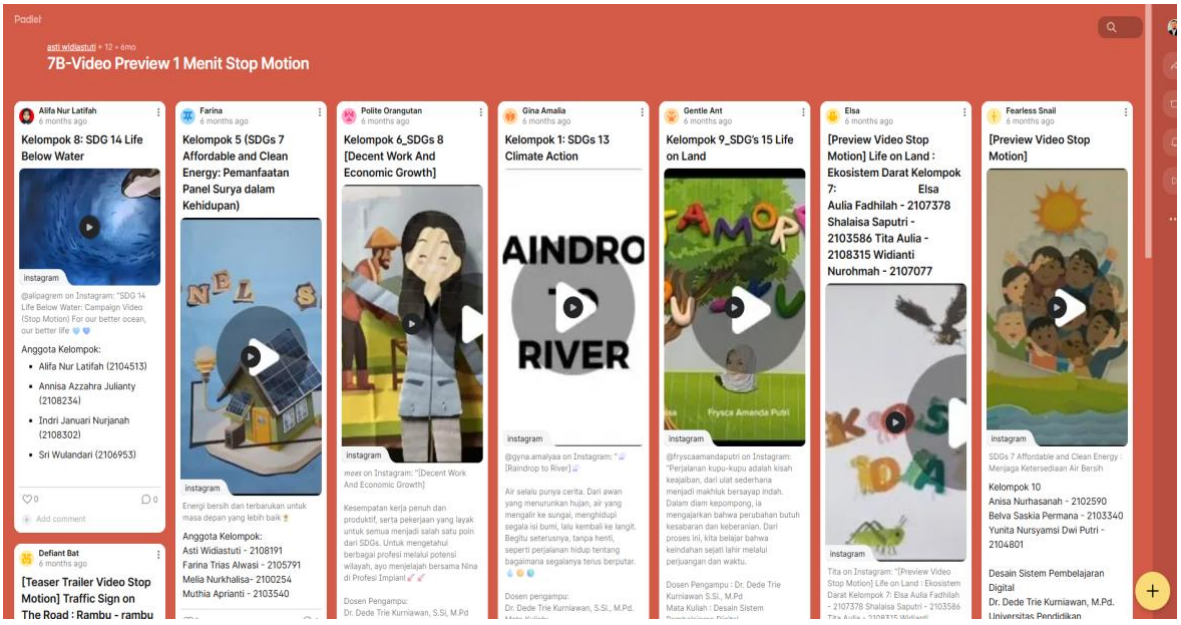
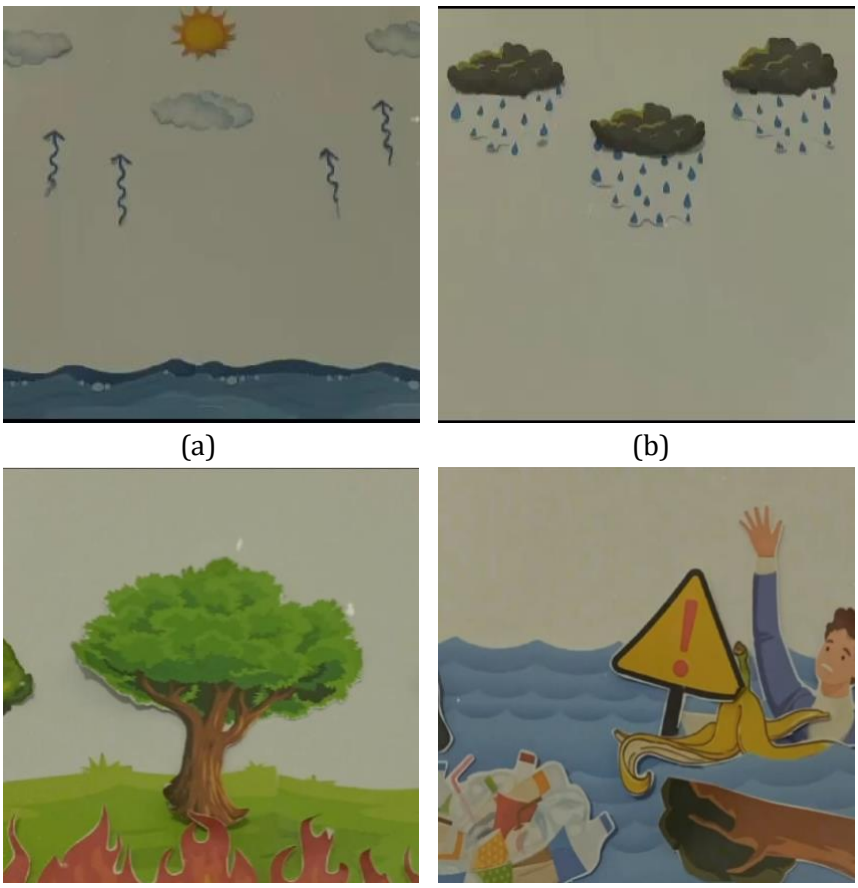


Figure 2. Educational video product of environmental campaign using Stopmotion Animation Technique made by Elementary School Teacher Candidates of UPI Cibiru Production Year 2024
https://padlet.com/astiiwidiaaa/7b-video-preview-1-menit-stop-motion-babac5000dxjpecq

Validators assess through the Padle platform, shown in Figure 1 to easily access campaign videos created using stop motion. Stop motion videos created with an environmental theme are then promoted through Instagram so that they can be conveyed to the public without compromising privacy. The following image 2 shows video clips that were screenshotted as one of the validated stop motion products.

ISSN 2715-968X (online)



(a) (b)

(c) (d)

Figure 3. (a), (b), (c), (d) are screenshots from a stop motion video that has been validated by experts and is a product of stop motion learning media collected through Padlet.

The Environmental Campaign Video that has been created is assessed by four experts in the fields of media, materials, learning, and language to ensure its suitability for use in education for elementary school students. Table 3 summarizes the results of expert validation of the environmental campaign video products of elementary school teacher candidates. Figure 3 illustrates the water cycle on Earth, which continues to cycle. However, if deforestation or human activities in exploiting trees and natural resources occur without restraint, it will lead to disasters. Therefore, the campaign created urges us to protect nature, and nature will protect us through a perfect cycle for the sake of human needs. The hope of this campaign is not only to raise awareness of sustainability, but also to train people to be more environmentally conscious, because humans and nature need each other.

Table 2. Recapitulation of Expert Validation Results for Environmental Care Campaign Video Products Produced by Elementary School Teacher Candidate Students

Assessment Aspects	Assessment Indicators	Assessment Results
STEM Asesment	The existence of scientific elements in the model, the existence of technological elements in the model, the existence of technical elements in the model, the existence of religious elements in the model, the existence of artistic elements in the model, and the existence of mathematical elements in the model, their relationship to life, the ability to think creatively and the ability to think critically.	The four validators stated that the stages in the STEAM learning model for prospective teacher students have been fulfilled for higher education levels. However, further confirmation and reinforcement are needed in the fields of mathematics and religion.
Design Validation	Sequence of presentation, Completeness of STEAM information, Use of fonts: type and size, layout, illustrations, graphics and images, display design	The four validators stated that the illustrations, graphs and images provided sufficient completeness and support for the lecture process for prospective teacher students with the STEAM model.
Content Eligibility	Suitability with learning outcomes, accuracy of materials, suitability with student needs, suitability with teaching material needs, truth of teaching material substance, benefits for increasing insight and presentation.	The four validators stated that the phenomena presented were related to the sharpening of knowledge integration through the STEAM model in prospective teacher students.
Linguistic Validation	Readability, clarity of information, conformity to good and correct Indonesian language rules and effective and efficient use of language (clear and concise)	The four validators stated that the grammar used in the STEAM Products produced by prospective teacher students was in good criteria and could be used.

Evaluation of the Effectiveness of PjBL-STEAM Learning

The effectiveness of the Project-Based Learning (PjBL) model integrated with the STEAM approach (Science, Technology, Engineering, Arts, Mathematics) was evaluated using a Likert-scale questionnaire. The majority of research on stop-motion in teacher training employs qualitative case study designs with small sample sizes. While these studies provide rich descriptions of implementation processes, they lack the methodological rigor to establish causal relationships between stop-motion training and teaching effectiveness (Creswell, 2024). The instrument

consisted of six indicators that represent students' experiences during the learning process: perception, motivation, understanding, analysis, activity, and impression.

1. Perception refers to students' views of the overall learning process, including the relevance of the content and methods used.
2. Motivation assesses the level of enthusiasm and interest demonstrated by students during the project.
3. Understanding evaluates how well students comprehend the environmental content addressed in the learning.
4. Analysis measures students' ability to interpret environmental issues and connect them with real-world contexts.
5. The activity looks at students' participation and collaboration throughout the project.
6. Impression captures the students' overall experience and satisfaction with the learning model.

Table 3 shows the summary of the questionnaire results based on responses from 80 students.

Table 3. Questionnaire Results

Indicator	Average Score (out of 5)	Category
Perception	4.5	Very Good
Motivation	4.6	Very Good
Understanding	4.3	Good
Analysis	4.2	Good
Activity	4.7	Very Good
Impression	4.6	Very Good

In general, the evaluation results show that the PjBL-STEAM learning model is effective in enhancing student engagement and understanding of environmental issues. The overall average score is 4.48, which falls under the "Very Good" category, indicating that most students felt satisfied, motivated, and actively involved throughout the learning experience. The majority of students gave very positive responses to the guidance, direction, and project provisions provided by the Lecturer. In general, they considered that the instructions given were very clear, structured, and easy to understand, both verbally and through written materials. This helped them to carry out the project systematically, without experiencing significant difficulties. Several comments highlighted that the direct examples and steps of making the project, from making the GBPM to uploading it to social media, were very helpful in understanding the workflow. Not a few students said that this learning improved critical and technical thinking skills, as well as fostering an appreciation for the digital production process that requires precision and time. Several inputs were also provided, such as requests to adjust the project duration to be more concise, as well as suggestions for a longer working time because the production process was quite complex. Overall, the narratives that emerged reflected the impression that the Lecturer had provided very good, communicative, inspiring guidance, and had a positive impact on the students' learning experience in the stop motion project.

This study has methodological limitations in line with, who state that despite methodological limitations, several studies using a single-case design have reported a positive correlation between PBL implementation and student engagement in STEAM subjects. These findings suggest that even

within a limited research framework, project-based approaches can enhance interdisciplinary learning. However, researchers caution that these results should be interpreted as preliminary findings and require verification through more robust experimental designs. To strengthen the evidence base, experts recommend shifting to quasi-experimental or mixed designs that combine pre-post testing and comparative analysis (Kim & Park, 2024). Such an approach would better capture the complex and multidimensional outcomes of PBL in STEAM education while maintaining ecological validity (Taylor, 2023). The data obtained are not yet comprehensive and still have many limitations. Special emphasis should be placed on developing standardised assessment tools specific to STEAM competencies

CONCLUSION

The findings of this study indicate that prospective primary school teachers can acquire better environmental care skills by implementing STEAM-based learning projects, especially by creating stop-motion videos. The results show that this innovative method not only improves students' technical and pedagogical skills but also encourages them to become more involved with environmental issues. The excellent results in terms of perception, motivation, and activity indicate that the STEAM-based project learning model successfully connects theoretical concepts to the real world, making learning more interactive and meaningful. However, the study also highlights limitations, particularly in its experimental design, which lacks pre-test comparisons and long-term evaluations. Additionally, the study emphasises that teacher training programmes should shift from conventional lesson-based methods to more interdisciplinary and practical approaches that align with how children naturally engage with the material. This is an increasingly evolving discussion about innovative pedagogical approaches to environmental education. By equipping future teachers with innovative tools such as stop-motion video, the education system can help foster an environmentally conscious society from an early age. Moving forward, teacher training programmes must prioritise learning that is integrated with STEAM and experiential learning. This will ensure that teachers not only have sufficient knowledge but can also inspire the next generation to care for the Earth.

REFERENCES

Attai, S. L., Reyes, J. C., Davis, J. L., York, J., Ranney, K., & Hyde, T. W. (2021). Investigating the impact of flexible furniture in the elementary classroom. *Learning Environments Research*, *24*(2), 153–167.

Avraamidou, L. (2024). Can we disrupt the momentum of the AI colonization of science education? *Journal of Research in Science Teaching*, *61*(10), 2570–2574.

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Ravenio books.

Chung, C., Hwang, G., & Lai, C. (2019). A review of experimental mobile learning research in 2010--2016 based on the activity theory framework. *Computers \& Education*, *129*, 1–13.

Chung, E., Subramaniam, G., & Dass, L. C. (2020). Online learning readiness among university students in Malaysia amidst COVID-19. *Asian Journal of University Education*, *16*(2), 46–58.

Creswell, J. W. (2024). My 35 years in mixed methods research. *Journal of Mixed Methods Research*, *18*(3), 203–215.

Davis, C., Greenaway, R., Moore, M., & Cooper, L. (2019). Online teaching in social work education: Understanding the challenges. *Australian Social Work*, *72*(1), 34–46.

Eickelmann, B., & Vennemann, M. (2017). Teachers 'attitudes and beliefs regarding ICT in teaching and learning in European countries. *European Educational Research Journal*, *16*(6), 733–761.

Ernst, J., & Tornabene, L. (2012). Preservice early childhood educators' perceptions of outdoor settings as learning environments. *Environmental Education Research*, *18*(5), 643–664.

Guyotte, K. W., Sochacka, N. W., Costantino, T. E., Kellam, N. N., & Walther, J. (2015). Collaborative creativity in STEAM: Narratives of art education students' experiences in transdisciplinary spaces. *International Journal of Education \& the Arts*, *16*(15).

Harpe, S. E. (2024). A Survey of Open Science Attitudes and Behaviors among US Pharmacy Faculty. *MedRxiv*, 2006–2024.

Herro, D., Quigley, C., & Cian, H. (2019). The challenges of STEAM instruction: Lessons from the field. *Action in Teacher Education*, *41*(2), 172–190.

Hsu, C.-C., Zhang, Y., Ch, P., Aqdas, R., Chupradit, S., & Nawaz, A. (2021). A step towards sustainable environment in China: The role of eco-innovation renewable energy and environmental taxes. *Journal of Environmental Management*, *299*, 113609.

Jewitt, C. (2008). Multimodality and literacy in school classrooms. *Review of Research in Education*, *32*(1), 241–267.

Joshi, D. R., Sieverding, H. L., Xu, H., Kwon, H., Wang, M., Clay, S. A., Johnson, J. M., Thapa, R., Westhoff, S., & Clay, D. E. (2023). A global meta-analysis of cover crop response on soil carbon storage within a corn production system. *Agronomy Journal*, *115*(4), 1543–1556.

Kahn, J. P., & others. (2020). *Digital contact tracing for pandemic response: Ethics and governance guidance*. Johns Hopkins University Press.

Kahn, S., & Zeidler, D. L. (2019). A conceptual analysis of perspective taking in support of socioscientific reasoning. *Science \& Education*, *28*(6), 605–638.

Liao, J. C., Mi, L., Pontrelli, S., & Luo, S. (2016). Fuelling the future: microbial engineering for the production of sustainable biofuels. *Nature Reviews Microbiology*, *14*(5), 288–304.

Norman, D. A. (2023). *Design for a better world: Meaningful, sustainable, humanity centered*. MIT Press.

Peppler, K., & Wohlwend, K. (2018). Theorizing the nexus of STEAM practice. *Arts Education Policy Review*, *119*(2), 88–99.

Peterson, K., DeCato, L., & Kolb, D. A. (2015). Moving and learning: Expanding style and increasing flexibility. *Journal of Experiential Education*, *38*(3), 228–244.

Taylor, C. (2023). Interpretation and the Sciences of Man. In *The Philosophy of Society* (pp. 156–200). Routledge.

Trochim, W. M., Cabrera, D. A., Milstein, B., Gallagher, R. S., & Leischow, S. J. (2006). Practical challenges of systems thinking and modeling in public health. *American Journal of Public Health*, *96*(3), 538–546.