JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S12

DIDACTIC MEDIATION OF GAMIFICATION TO PROMOTE ENVIRONMENTAL AWARENESS: A SYSTEMATIC REVIEW FROM THE TEACHER'S HOUSE

Shariff Girón Polo*, María Junco Camaño*, *** Erick Fruto Silva**, Edgardo Sánchez Montero** , Liliana Canquiz-Rincón **, Diana García Leyva** , Judith Castillo Martelo**, Inírida Avendaño Villa** , Arnold Díaz Jiménez*****

**Estudiante del programa Licenciatura en Educación Básica Primaria – Universidad de la Costa*
*** Departamento de Humanidades -Universidad de la Costa.*
**** Universidad Metropolitana de Educación, Ciencia y Tecnología*

Abstract.
This article explores the potential of gamification as an innovative tool to develop and promote environmental awareness, so fundamental today due to the challenges that are presented at a global level, and recognizing the significant role of educational institutions in the formation of future generations committed to sustainability. Methodologically supported by qualitative research, with emphasis on documentary review and analysis, it examines scientific publications over the last five (5) years, how gamification has been successfully used in other educational contexts to promote environmental awareness and encourage pro-environmental behaviors. Success stories are highlighted in which gamification has been shown to improve understanding and commitment to environmental education, as well as the adoption of sustainable practices, thus contributing to the achievement of the Sustainable Development Goals (SDG). The article concludes about the benefits of gamification in students at all levels of the educational system, promoting motivation, self-regulated learning, creativity, critical thinking, among other skills.
Keywords: gamification, environmental awareness, techniques, pro-environmental skills

Introduction.

Environmental awareness is a vitally important issue today, given the growing concern about the environmental challenges we face. In this context, gamification emerges as a promising tool to promote pro-environmental attitudes and educate new generations about the importance of preserving the environment. Various studies have explored the potential of gamification in this area, showing encouraging results in different educational contexts.

Gamification, defined as the application of game design elements in non-playful contexts (Werbach & Hunter, 2014), has emerged as an innovative strategy to promote pro-environmental behaviors and foster an environmental culture. This approach has been explored in various educational and organizational contexts, showing promising results in motivation and behavior change towards sustainability.

For his part, Kapp (2012) defines gamification as the use of mechanisms, aesthetics and the use of thought, to attract people, incite action, promote learning and solve problems". From this perspective, gamification is understood as a strategy supported by the context, using games or games to convey a message; in education, the use of gamification extends to capturing the student's interest, awakening motivation, as well as the development of other skills such as self-regulated learning (Baars, Khare., & Ridderstap, 2022).

In this sense, this systematic review focuses on analyzing and discussing the role of gamification as an effective strategy to promote environmental awareness in basic education. Through an exhaustive analysis of previous research, it seeks to understand how the implementation of game elements can influence the perception and behavior of individuals towards the environment.
In the educational field, gamification has proven to be effective in increasing students' motivation and commitment to environmental issues, improving their learning and scientific skills (Fernandez-Ceacero & Moreno, 2021; Ouarriachi, Li, & Elving, 2020; Arufe-Giráldez, Sanmiguel-Rodríguez, Ramos-Álvarez, Navarro-Patón, 2022).
Based on this analysis, it is intended to provide a comprehensive vision on the use of gamification as a tool to promote environmental awareness in the educational context, highlighting its potential to promote sustainable behaviors and contribute to the construction of a more environmentally friendly future.

Methodology.
This study is based on a systematic review with the intention of obtaining exhaustive and orderly analyses of the didactic mediations of gamification as a strategy to promote environmental awareness at the basic education level.
To this end, various scientific publications from international databases such as Scopus, WOS, Latindex, Scielo, Dialnet, presented between 2019 and 2024, related to the application of gamification in education, were examined in order to analyze the different perspectives that authors have in this regard, which allows a more detailed understanding of the situation to be obtained.
From this analysis, categories such as pro-environmental attitudes, environmental awareness and culture, pro-environmental competitions, environmental education, gamification techniques, playfulness in education, sustainable development and education emerged. following a qualitative methodology based on content analysis; which allowed to obtain advantages, conditions and limitations when incorporating gamification in the educational system.
These categories, among others, confer meaning and relevance to the research in question.

Results and discussion.

Year.	Author.	Title.	Category of analysis.	Argumentative position.
2024	Yupanqui-Guevara, Rocsana del Pilar, & Leyva-Aguilar, Nolberto Arnildo.	Environmental Awareness: Empowering Change through Literacy	Environmental awareness and literacy.	The article by Yupanqui-Guevara and Leyva-Aguilar (2024) highlights the importance of environmental education and educational strategies to promote environmental awareness in schools. Its objective is to analyze educational techniques for this purpose, using a qualitative design and documentary analysis of research since 2019. The results show a positive relationship between environmental literacy and environmental awareness in students and

				members of the educational community, attributing this to implemented strategies.
2023	Ceballos, K. M. A., & Chapuesgal, S. M. C.	Gamification to promote environmental attitudes.	Environmental attitudes and gamification	The study by Ceballos and Chapuesgal (2023) seeks to promote environmental attitudes in seventh-grade students at the José Asunción Silva Rural Educational Institution. It uses a mixed approach and gamification. It is expected to improve environmental awareness and promote good habits with the implementation of virtual applications and game elements. The research highlights gamification as an effective tool for environmental education in young people.
2023	Martínez, S., & Rojas, M. F.	Design of learning environments with gamification techniques to promote ecological awareness	Gamification techniques for ecological awareness	Martínez and Rojas (2023) propose using gamified virtual learning environments to develop ecological awareness in students aged 14 to 17. Their study highlights the positive impact of this methodology on environmental learning, suggesting its integration into educational projects to strengthen environmental education from an early age.
2023	Portocarrero Gutiérrez, C. A., & Zavaleta Llanos, N. Y.	Environmental Awareness and Ecological Attitudes in Higher Education Students	Environmental awareness and ecological attitudes	Gutiérrez and Llanos (2023) found a significant correlation between environmental awareness and the ecological attitudes of students in Apurimac, Peru. They highlight the importance of environmental education to improve attitudes towards caring for the environment, highlighting the crucial role of educational institutions in this process.
2023	Pérez Arango, Diana, & Camacho, Andrés.	Environmental education and behavior. A Case Study	Environmental education and behaviour	This research analyzes how education influences environmental behavior in Sabaneta. Using data from the 2018 Citizen Perception of Quality of Life Survey, they find that, the higher the educational level, the more positive attitudes towards the environment are. However, these attitudes vary according to age and rural environment. These findings are useful for improving environmental education in the community.
2023	Tang, K.	Gamification to Improve Participation in an Environmental Science Course: An Educator's Reflection	Gamification in education	Gamification in environmental science courses can improve student engagement, but a mix of locally developed platforms and platforms is needed to achieve stability and diversified experiences.

2023	Rada, Ibón Silvera, Palma, Sabina Guerra, & Olivo-Franco, José Luis.	Appropriation of the concept of sustainable development by teachers in a teacher training school	Sustainable development.	This study seeks to integrate sustainable development into the curriculum of the Santa Ana Higher Normal School through the space-context strategy. Using a qualitative approach, they carried out action research that strengthened the concept of sustainable development in the teaching staff. As a result, a proposal was developed to adjust the curricular plan and it was possible to raise awareness among the teaching staff to redesign it effectively.
2023	Ramírez-Ramírez, Gloria Elizabeth, Esteves-Fajardo, Zila Isabel, & Chávez-Salazar, Crysthian Manuel.	Land of children and young people methodology and the construction of environmental awareness in Ecuador	Building environmental awareness	The Tini Methodology, part of the Land of Children and Youth for Good Living Project in Ecuador, is an educational practice that strengthens environmental awareness in students, according to Ramírez-Ramírez, Esteves-Fajardo, and Chávez-Salazar (2023). Their study, based on documentary research, shows that this methodology generates positive changes in the perception and attitude towards nature, offering an innovative and interdisciplinary approach to teaching and learning.
2023	Monroy Carreño, Roberto, & Domínguez Pacheco, Flavio Arturo.	Model for environmental awareness based on contextualization in upper secondary education	Environmental Awareness	The authors propose integrating environmental awareness into education. Implemented at the National School of Sciences and Humanities Plantel Vallejo, it reduced the failure rate by 20% in Physics, decreased household energy consumption by 2.15%, and increased participation in scientific events.
2022	Campoverde-Robledo, F. N., & Soplapuco-Montalvo, J. P.	Sustainable environmental culture in education.	Environmental culture in education	Campoverde-Robledo and Soplapuco-Montalvo (2022) analyzed the relationship between environmental culture in education and sustainability during the Covid-19 pandemic, highlighting the importance of strengthening environmental culture from educational institutions for a safer and more sustainable society.
2022	Ricoy, M., & Sánchez-Martínez, C	Raising Ecological Awareness and Digital Literacy in Primary School Children through Gamification	Gamification in education.	A gamification-based learning program for primary school students improved ecological awareness and digital literacy, leading to new water, electricity, and recycling habits, and more efficient online information searching.

2022	Miao, H., Saleh, M., & Zolkepli, I.	Gamification as a Learning Tool for Pro-Environmental Behavior: A Systematic Review.	Gamification for environmental education	Gamification effectively teaches pro-environmental behaviours, in particular by improving energy efficiency and reducing carbon emissions, using elements of reward, feedback, competition and goal setting.
2021	Márquez, D., Hernández, A., Márquez, L., and Casas, M.	Environmental education: conceptual and methodological evolution towards the objectives of sustainable development	Sustainable development	This article examines the evolution of environmental education towards the Sustainable Development Goals from 1972 to the present. It highlights its importance in various areas and its focus on sustainability. It highlights the ongoing relevance of environmental education in the search for sustainable solutions to contemporary challenges.
2021	Andrade Caveduque, M. J. ., & Gonzales Sánchez, A. del C.	Strengthening environmental awareness in early education students.	Strengthening environmental awareness	The study highlights the effectiveness of environmental education in strengthening the environmental awareness of students in the second cycle of RBE students, especially during the COVID-19 pandemic. Their quantitative research shows that a specific program had a positive impact in this regard, highlighting the importance of integrating such programs into the school curriculum to promote a society more committed to the preservation of the environment.
2021	Gavilanes-Capelo, R.M., & Tipán-Barros, B.G	Environmental Education as a Strategy to Face Climate Change	Environmental education	It highlights the importance of environmental education to address climate change in the global environmental crisis. Its study in Cuenca provides a complete vision of the perception and application of environmental education in the educational community, identifying challenges and opportunities. This is crucial to integrate environmental education into the school curriculum and empower future generations with skills to promote an eco-friendly culture and increase resilience to environmental challenges.
2021	Marlés-Betancourt, C., Hermosa-Guzmán, D., & Correa-Cruz, L.	Promotion of water awareness in university students through a game as a didactic strategy.	Promoting water awareness	This study proposes to use cooperative play to promote water awareness in Business Administration students at the University of the Amazon, Colombia. It highlights the effectiveness of this strategy to change habits in the use of water and develop skills such as teamwork and decision-making, preparing

				students to address environmental and social challenges.
2021	Fernandez, P., & Ceacero-Moreno, M.	Study of the Training of Environmentalists through Gamification as A University Course	Gamification-based teaching models	An innovative didactic model using gamification and the computer game Cities: Skylines effectively developed scientific and professional competencies in students.
2021	Palomino, M. D. C. P	Implications of gamification in higher education: a systematic review of student perception.	Gamification in higher education	Palomino (2021) reviews the perception of university students about gamification in learning. After analysing 20 studies between 2010 and 2019, he finds a growing interest in gamification in Higher Education. The results show a favorable disposition of students towards these practices, with benefits such as greater motivation, interest, participation and academic performance, as well as development of professional skills.
2021	Manzano-León, A., Camacho-Lazarraga, P., Guerrero, M., Guerrero-Puerta, L., Aguilar-Parra, J., Trigueros, R., & Alías, A	Between Level Up and Game Over: A Systematic Literature Review of Gamification in Education	Gamification in education.	Educational gamification has a potential impact on student motivation and academic performance, but more research is needed on the needs and challenges of learning with gamified techniques.
2020	Ardoin, N., Bowers, A., & Gaillard, E.	Environmental education outcomes for conservation: A systematic review.	Environmental education	Environmental education positively impacts conservation and environmental quality by developing attitudes, values, and skills, and connecting research results with practices on the ground.
2020	Douglas, B., & Brauer, M.	Gamification to prevent climate change: a review of games and apps for sustainability..	Gamification for environmental education.	Gamification shows promising results in promoting pro-environmental behaviors, such as sustainability education, energy reduction, transportation, air quality, waste management, and water conservation, potentially preventing climate change.
2020	Bowers, A., & Creamer, E	A grounded theory systematic	Environmental education	Authentic environmental education programs are key to creating environmentally literate

		review of environmental education for secondary students in the United States		high school students in the U.S., as identified in the Authentic Environmental Education Program Implementation (IAEEP) model.
2020	Pascuas Rengifo, Y., Perea Yara, H. C., & García Quiroga, B	Ecoliteracy and gamification for the construction of environmental culture: TECO as a case study.	Eco literacy and gamification	The study by Pascuas Rengifo et al. (2020) presents TECO, a didactic-technological mediation to address e-waste in the Colombian Amazon. It combines a gamified virtual scenario with activities to promote sustainable environmental practices, highlighting its effectiveness in building a solid environmental culture and in raising awareness about the proper management of this waste.
2020	Amado, L. Y. D., Hernández, A. A. R., Vega, J. A. N., & Morales, F. H. F.	Gamified educational material for teaching-learning ecology concepts in middle school students	Gamification in environmental education	Amado et al. (2020) developed gamified educational material to teach ecology in secondary education in Colombia. Validated by students and teachers, it improved attention and readiness for learning, as well as the classroom environment. Teachers considered it appropriate and relevant to the level of teaching. This highlights the importance of adapting gamified educational materials to address environmental issues and enhance the learning experience.
2020	Zocher, J., & Hougham, R	Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education	Ecopedagogy. Environmental education	Ecopedagogy, when integrated with experiential education, can alter cultural patterns of environmental oppression and empower young people to explore solutions in their communities.
2020	Flandoli, A. M. B., & Romero-Riaño, E	The role of gamification in environmental awareness: a bibliometric review.	Role of gamification in environmental awareness.	Flandoli and Romero-Riaño (2020) analyse research on gamification for environmental awareness using scientometrics. They identify patterns, trends and connections between disciplines, contributing to the advancement of knowledge in this area from a scientific and multidisciplinary perspective.
2020	Mahmud, S., Husnin, H., & Soh, T.	Teaching Presence in Online Gamified Education for		Teacher presence in online gamification improves knowledge about sustainability, pro-environmental behavior, and student achievement, while addressing time constraints and barriers to social interaction.

		Sustainability Learning.		
2020	Yeşilyurt, M., Özdemir Balakoğlu, M., & Erol, M.	The impact of environmental education activities on the environmental awareness and visual expressions of primary school students.	Impact of Environmental Education on Environmental Awareness	The results of this research seek to improve environmental awareness in primary school students. Using an action research approach and qualitative methods, it was found that students exposed to environmental education showed enthusiasm in their drawings and reflected increased environmental awareness, demonstrating empathy towards nature and producing aesthetically appreciated images.
2020	Sailer, M., & Sailer, M.	Gamification of in-class activities in flipped classroom lectures.	Gamification	Gamified classroom activities in flipped classrooms have a positive impact on application-oriented knowledge, intrinsic motivation and social relationships, but not on the satisfaction of the need for competence
2020	Ouariachi, T., Li, C., & Elving, W.	Gamification Approaches for Education and Engagement on Pro-Environmental Behaviors: Searching for Best Practices	Pro-environmental behavior and gamification	Gamification platforms like SaveOhno and JouleBug can effectively engage users in pro-environmental behavior change by incorporating meaning, ownership, social influence, feasibility, challenge, and credibility.
2019	Miranda Esteban, A, GUZMAN IBARRA, I, Rodríguez Alviso, C, Beltrán Rosas, J, SAMPEDRO, M and Aparicio López, J.	Mainstreaming the environment axis in higher education: the case of the UACYTI-UAGro	Mainstreaming of the environment axis.	The study by Miranda Esteban et al. (2019) proposes to integrate environmental content into the curriculum of Information Sciences and Technologies at the Autonomous University of Guerrero. The low initial integration of environmental competence and the willingness of teachers to contribute to the training of environmentally responsible graduates stand out.
2019	Mendoza Vargas, E. Y., Boza Valle, J. A., & Escobar Terán, H	Environmental education and the practice of values of university students	Environmental education and the practice of values.	The study by Mendoza, Boza, and Escobar (2019) highlights the importance of environmental education to cultivate sustainable awareness. It highlights the gap between theoretical knowledge and its practical application, underlining the key role of teachers. It urges immediate action to ensure a sustainable future and emphasizes

				the need to intensify efforts in environmental education and promote sustainability values.
2019	Quintana, J. G., & Jurado, E. P.	Games and gamification: Educational innovation in a society in continuous change.	Gaming and gamification	Quintana and Jurado (2019) address the role of games and gamification in education, highlighting their increasing integration into educational practices. They highlight the importance of play in learning, supported by historical studies and the pedagogical current of the new school. They identify advantages such as increased participation, interaction, motivation and fun in the classroom. They conclude that gamification is effective in engaging students with curricular objectives, promoting a more enriching and participatory educational experience.
2019	Lopera Pérez, M., Díaz Posada, L. E., Villagrá Sobrino, S. L., Charro Huerga, M. E., & Molpeceres Sanz, C	The theory of multiple intelligences applied to environmental education in inclusive scenarios	Multiple intelligences in environmental education	The study by Lopera Pérez et al. (2019) describes how a teacher in training integrates the theory of multiple intelligences with environmental education. The objective is to investigate the implementation of a didactic strategy on water in first grade students, some with functional diversity. Using research-based design and team collaboration, the study shows the process of designing and executing the strategy, as well as its implications for initial teacher training.

Conclusions.

Gamification is presented as a powerful tool to promote an environmental culture in both educational and organizational contexts. By activating intrinsic and extrinsic motivation, this approach can promote pro-environmental behaviours, enhance learning and develop key competences in sustainability. The integration of play elements into educational and organizational strategies can be an effective way to address current and future environmental challenges.

Gamification as a strategy and approach has been explored in various educational contexts, showing promising results in motivation and behavior change towards sustainability. The research consulted coincides in affirming that they improve the training experience provided to the student, being able to use virtual or face-to-face scenarios. In any case, its application favors the development of the student's motivation when carrying out their activities; in many cases becoming a meaningful experience.

Gamification applied in the teaching of environmental education, promotes pro-environmental behavior changes and improves digital knowledge and skills. Their effectiveness is observed at various educational levels and fields of study, and the active presence of the teacher is a key factor for the success of these initiatives. The presence of the teacher, as a mediator of the cognitive processes that the student must develop, is crucial to maintain their active participation and improve learning results.

Gamified programs have shown significant improvements in knowledge about sustainability and in the adoption of eco-friendly habits, such as efficient use of water and electricity, and recycling. It is considered significant to integrate gamification into educational programs on an ongoing basis and not as isolated experiences, favoring sustained environmental awareness. Every day it is more urgent to form a new generation of citizens who are aware, responsible and committed to the preservation of the environment. In this sense, gamification not only generates interest but also allows the appropriation of ecological values and sustainable practices, as demonstrated in the research consulted.

It can be said that gamification fosters experiential learning that turns students into the protagonists of their learning. Active participation and the possibility of making decisions in simulated environments strengthen their commitment to environmental care; representing one of the advantages of including gamification as a strategy for the development of environmental education. It is recommended to continue with the study and analysis of gamification as an active strategy in the classroom, emphasizing its impact on the development of pro-environmental competencies, considering the adaptation of strategies in different contexts.

References.

Amado, L. Y. D., Hernández, A. A. R., Vega, J. A. N., & Morales, F. H. F.(2020) Gamified educational material for the teaching-learning of ecology concepts in middle school students. bol.redipe [Internet]. Jun. 1; 9(6):144-156.https://revista.redipe.org/index.php/1/article/view/1008

Ardoin, N., Bowers, A., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. Biological Conservation, 241, 108224. https://doi.org/10.1016/j.biocon.2019.108224.

Andrade Caveduque, M. J. ., & Gonzales Sánchez, A. del C. . (2021). Strengthening environmental awareness in Early Childhood Education students. Journal of Educational Proposals, 3(6), 120–128. https://doi.org/10.33996/propuestas.v3i6.705

Arufe-Giráldez, V., Sanmiguel-Rodríguez, A., Ramos-Álvarez, O., & Navarro-Patón, R. (2022). Gamification in Physical Education: A Systematic Review.*Education Sciences*. https://doi.org/10.3390/educsci12080540.

Baars, M., Khare, S., & Ridderstap, L. (2022). Exploring Students' Use of a Mobile Application to Support Their Self-Regulated Learning Processes. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.793002.

Bowers, A., & Creamer, E. (2020). A grounded theory systematic review of environmental education for secondary students in the United States. International Research in Geographical and Environmental Education, 30, 184 - 201. https://doi.org/10.1080/10382046.2020.1770446

Campoverde-Robledo, F. N., & Soplapuco-Montalvo, J. P. (2022). Sustainable environmental culture in education. UCSA Scientific Journal, 9(2), 112-128.

Ceballos, K. M. A., & Chapuesgal, S. M. C. (2023). Gamification to promote environmental attitudes. Fedumar Pedagogy and Education, 10(1), 47-55.

Douglas, B., & Brauer, M. (2020). Gamification to prevent climate change: a review of games and apps for sustainability.. Current opinion in psychology, 42, 89-94 . https://doi.org/10.31219/osf.io/3c9zj.

Flandoli, A. M. B., & Romero-Riaño, E. (2020). The role of gamification in environmental awareness: A bibliometric review. Revista Prisma Social, (30), 161-185.

Fernández, P., & Ceacero-Moreno, M. (2021). Study of the Training of Environmentalists through Gamification as A University Course. Sustainability. https://doi.org/10.3390/SU13042323.
Gavilanes-Capelo, R.M., & Tipán-Barros, B.G. (2021). Environmental Education as a strategy to face climate change. Alterity, 16(2), 286-298. https://doi.org/10.17163/alt.v16n2.2021.10
Gutiérrez, C. A. P., & Llanos, N. Y. Z. (2023). Environmental awareness and ecological attitudes in higher education students. SUMMA, 5(2), 1-10.
Kapp, K. M. (2012). The gamification of learning and instruction: Case-based methods and strategies for training and education. New York, NY: Pfeiffer.
Lopera Pérez, M., Díaz Posada, L. E., Villagrá Sobrino, S. L., Charro Huerga, M. E., & Molpeceres Sanz, C. (2019). The theory of multiple intelligences applied to environmental education in inclusive scenarios. *Science Teaching: Journal of Research and Didactic Experiences*.
Mahmud, S., Husnin, H., & Soh, T. (2020). Teaching Presence in Online Gamified Education for Sustainability Learning. Sustainability. https://doi.org/10.3390/su12093801.
Marlés-Betancourt, C., Hermosa-Guzmán, D., & Correa-Cruz, L. (2021). Promotion of water awareness in university students through a game as a didactic strategy. Rev.investig.desarro.innov., 11 (2), 361-372
Martínez, S., & Rojas, M. F. (2023). Design of learning environments with gamification techniques to promote ecological awareness. Journal of Scientific and Technological Research, 7(1), 31-42.
Márquez Delgado, Dora Lilia, Hernández Santoyo, Alain, Márquez Delgado, Luis Humberto, & Casas Vilardell, Mayra. (2021). Environmental education: conceptual and methodological evolution towards the sustainable development goals. University and Society Journal, 13(2), 301-310. Epub Apr 02, 2021.
Mendoza Vargas, E. Y., Boza Valle, J. A., & Escobar Terán, H. (2019). ENVIRONMENTAL EDUCATION AND THE PRACTICE OF VALUES OF UNIVERSITY STUDENTS. Cognosis Journal. ISSN 2588-0578, 4(2), 25–40. https://doi.org/10.33936/cognosis.v4i2.1837
Miranda Esteban, A., Aparicio López, J. L., Guzmán Ibarra, I., Rodríguez Alviso, C., Beltrán Rosas, J., & Sampedro Rosas, M. L. (2019). Mainstreaming the environment axis in higher education: The case of the UACYTI-UAGro. *Culture Education Society*, *10*(1), 9–24. https://doi.org/10.17981/cultedusoc.10.1.2019.01
Miao, H., Saleh, M., & Zolkepli, I. (2022). Gamification as a Learning Tool for Pro-Environmental Behavior: A Systematic Review. Malaysian Journal of Social Sciences and Humanities (MJSSH). https://doi.org/10.47405/mjssh.v7i12.1881.
Monroy Carreño, Roberto, & Domínguez Pacheco, Flavio Arturo. (2023). Model for environmental awareness based on contextualization in upper secondary education. *RIDE. Ibero-American Journal for Educational Research and Development*, *13*(26), e063. Epub Oct 09, 2023.https://doi.org/10.23913/ride.v13i26.1517

Ouariachi, T., Li, C., & Elving, W. (2020). Gamification Approaches for Education and Engagement on Pro-Environmental Behaviors: Searching for Best Practices. Sustainability, 12, 1-14. https://doi.org/10.3390/su12114565.

Pegalajar Palomino, M. del C. (2021). Implications of gamification in Higher Education: a systematic review of student perception. *Journal of Educational Research*, *39*(1), 169–188. https://doi.org/10.6018/rie.419481

Pascuas Rengifo, Yois, Perea Yara, Haner Camilo, & García Quiroga, Bernardo. (2020). Ecoliteracy and gamification for the construction of environmental culture: TECO as a case study. *Mexican Journal of Educational Research*, *25*(87), 1123-1148. Epub 2021 Feb 19. Retrieved September 30, 2024, from http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-66662020000401123&lng=es&tlng=es.

Pérez Arango, D. & Camacho Murillo, A. 2022. Environmental education and behavior. A case study. *Journal of Institutional Economics*. 25, 48 (Dec. 2022), 193–213. DOI:https://doi.org/10.18601/01245996.v25n48.11.

Portocarrero Gutiérrez, C. A., & Zavaleta Llanos, N. Y. (2023). Environmental awareness and ecological attitudes in higher education students. *SUMMA, 5*(2), 1-10. https://doi.org/10.47666/summa.5.2.9

Quintana, J. G., & Jurado, E. P. (2019). Games and gamification: Educational innovation in a society in continuous change. Journal of Pedagogical Essays, 14(1), 91-121.

Rada, Ibón Silvera, Palma, Sabina Guerra, & Olivo-Franco, José Luis. (2023). Appropriation of the concept of sustainable development by teachers in a normal school. *Journal of Environmental Sciences*, *57*(1), 16721. https://dx.doi.org/10.15359/rca.57/1.5

Ramírez-Ramírez, Gloria Elizabeth, Esteves-Fajardo, Zila Isabel, & Chávez-Salazar, Crysthian Manuel. (2023). Land Methodology of Children and Youth and the Construction of Environmental Awareness in Ecuador. *Episteme Koinonia. Electronic Journal of Education Sciences, Humanities, Arts and Fine Arts*, *6*(11), 146-161. Epub 2023 Jul 15.https://doi.org/10.35381/e.k.v6i11.2428

Ricoy, M.-C.; Sánchez-Martínez, C. Raising Ecological Awareness and Digital Literacy in Primary School Children through Gamification. *Int. J. Environ. Res. Public Health* **2022**, *19*, 1149. https://doi.org/10.3390/ijerph19031149

Rojas-López, A., Rincón-Flores, E., Mena, J., García-Peñalvo, F., & Ramírez-Montoya, M. (2019). Engagement in the course of programming in higher education through the use of gamification.*Universal Access in the Information Society*, 18, 583 - 597. https://doi.org/10.1007/s10209-019-00680-z

Sailer, M., & Sailer, M. (2020). Gamification of in-class activities in flipped classroom lectures. Br. J. Educ. Technol., 52, 75-90. https://doi.org/10.1111/bjet.12948

Tang, K. H. D. (2023). Gamification to Improve Participation in an Environmental Science Course: An Educator's Reflection. *Acta Pedagogia Asiana*, *2*(2), 54–63. https://doi.org/10.53623/apga.v2i2.192

WERBACH, Kevin; HUNTER, Dan. For the win: how game thin-king can revolutionize your business. Philadelphia: Wharton Digital Press, 2012.

Yeşilyurt, M., Özdemir Balakoğlu, M., & Erol, M. (2020). The Impact of Environmental Education Activities on Primary School Students' Environmental Awareness and Visual Expressions. *Qualitative Research in Education, 9*(2), 188-216. doi:10.17583/qre.2020.5115

Yupanqui-Guevara, . R. del P., & Leyva-Aguilar, N. A. (2024). Environmental Awareness: Empowering Change through Literacy. *UCSA Scientific Journal*, *11*(1), 108–128. https://doi.org/10.18004/ucsa/2409-8752/2024.011.01.108

Zocher, J., & Hougham, R. (2020). Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education. Journal of Experiential Education, 43, 232 - 247. https://doi.org/10.1177/1053825920908615.