REVISTA CÁTEDRA

E-book: a gamified didactic resource for learning Natural Sciences

E-book: Un recurso didáctico gamificado para el aprendizaje de las Ciencias Naturales

Rossana Benavides-Velasco
Instituto Nacional Mejía, Quito, Ecuador
rossana.benavides@educacion.gob.ec
https://orcid.org/0000-0002-5055-7857

(Received on: 09/05/2023; Accepted on: 15/06/2023; Final version received on: 19/07/2023

Suggested citation: Benavides-Velasco, R. (2023). E-book: a gamified didactic resource for learning Natural Sciences. *Revista Cátedra, 6*(2), 68-84.

Abstract

This research responds to the need to improve teaching and learning processes through the use of Information and Communication Technologies (ICT), as a reality of the low use of technological tools by teachers in the classrooms, with this background, the application of the e-book as a gamified didactic resource in the ninth years of the Instituto Nacional Mejía was proposed. The methodology is quasi-experimental, consisting of two groups: 135 students in the experimental group (GE) and 115 in the control group (GC). A pretest and posttest were used with a questionnaire validated through expert judgment; Cronbach's alpha was 0.80, which proves the reliability of the questionnaire. The data of the activities developed were processed through the T test, allowing to reject the null hypothesis by having a p (value) less than 0.05 in the arithmetic means of the pretest and posttest, graphic organizers and workshops, the final decision was to reject the null hypothesis and accept the alternative hypothesis, which mentions the gamified didactic resource e-book that allows improving the teaching and learning processes, and achieving a higher academic performance in Natural Sciences in the experimental groups. The results were relevant as they significantly improved the interest and motivation of the students to learn, directly influencing their academic performance, which was demonstrated in the averages obtained: the GE reached an increase of up to 4 points as opposed to the GC, which decreased one point when performing the activities in a traditional way.

Keywords
E-book, teaching and learning, teaching resource, academic performance, ICT, teaching and learning.

Resumen
La presente investigación responde a la necesidad de mejorar los procesos de enseñanza y aprendizaje a partir del uso de las Tecnologías de Información y Comunicación (TIC), como realidad del bajo uso de herramientas tecnológicas por parte de los docentes en las aulas, con este antecedente se planteó la aplicación del *e-book* como recurso didáctico gamificado en los novenos años del Instituto Nacional Mejía. La metodología es de tipo cuasiexperimental conformado por dos grupos: 135 estudiantes del grupo experimental (GE) y 115 del grupo control (GC). Se utilizó un pretest y postest con un cuestionario validado a través de juicio de expertos, el Alfa de Cronbach fue de 0.80 que comprueba la confiabilidad del cuestionario. Los datos de las actividades desarrolladas se procesaron mediante la prueba de T, permitiendo rechazar la hipótesis nula al tener un *p* (valor) menor a 0.05 en las medias aritméticas del pretest y postest, organizadores gráficos y talleres, la decisión final fue rechazar la hipótesis nula y aceptar la hipótesis alternativa, la cual menciona el recurso didáctico gamificado *e-book* que permite mejorar los procesos de enseñanza y aprendizaje, y lograr un mayor rendimiento académico en Ciencias Naturales en los grupos experimentales. Los resultados fueron relevantes al mejorar significativamente el interés y motivación de los estudiantes por aprender, influyendo directamente en su rendimiento académico lo que se demostró en los promedios obtenidos: el GE alcanzó un incremento de hasta 4 puntos a diferencia del GC que disminuyó un punto al realizar las actividades de manera tradicional.

Palabras clave
E-book, enseñanza y aprendizaje, recurso didáctico, rendimiento académico, TIC.

1. Introduction
The current digital era is a true technological revolution that has made people's lives easier and changed their habits, creating a new digital culture that arises from the creation of ICTs that have transformed the world and the way in which people interact in it. ICT offers a world of opportunities that should be taken advantage of, especially in the educational field, since technological resources have produced a significant change in the teaching and learning processes; making education break down barriers, allowing the presentation of information in a very different way by replacing old traditional resources (books, blackboard and notebooks).

E-book is a didactic resource with great benefits that allows to be used in any type of computer, tablet or cell phones; it has different gamified digital tools becoming something innovative and modern, managing to awaken the motivation, interest and active participation of the students generating a significant learning. E-book seeks to create different gamified educational didactic materials that use elements such as: components, mechanics and dynamics, which will facilitate the creation of: games oriented to learning results, generation of rules and rewards. In this regard, Ortiz-Colón et al. (2018) state that.:

> Gamification processes in education are highly beneficial for students, such as: motivation, immersion to enable the anticipation and planning

> of situations; engagement and socialization through interactivity and interaction; as well as the variety of elements involved, which makes the educational activity more motivating and stimulating for students (p.44).

Gamification is an emerging methodology that consists of using games or game mechanics in playful contexts; developing in the classroom the motivation of students, which must be actively integrated into the teaching-learning process. The application of the e-book with gamified tools optimizes learning, improves academic performance, and teachers feel committed to continue preparing themselves in the use of these technological tools that dynamize learning environments.

In this research, which is the result of a thesis, the research questions are: what is the degree of use of didactic resources with gamification tools in the teaching and learning process of Natural Sciences in the ninth years of the Instituto Nacional Mejía? how to configure a pedagogical didactic structure based on gamification in the meaningful learning of contents related to Natural Sciences? how is the e-teaching structure used in the teaching and learning process of Natural Sciences? How is the e-book with gamification tools used as a didactic resource in the teaching and learning process of Natural Sciences in the ninth years of the Instituto Nacional Mejía in Quito? And what is the level of mastery of the contents of Natural Sciences before and after the use of the e-book with digital tools based on gamification? The main objective of the research is to determine the impact of the application of an e-book as a gamified didactic resource for the teaching and learning process of Natural Sciences in the ninth years of the Instituto Nacional Mejía , and as specific objectives we have proposed to analyze the degree of use of didactic resources with gamification tools in the teaching and learning process of Natural Sciences; to configure a didactic pedagogical structure for the application of the e-book as a gamified didactic resource; to apply an e-book based on gamification tools; and to determine the impact of the e-book as a gamified didactic resource in the teaching-learning process of Natural Sciences. It is thus understood the importance of promoting the use of other didactic resources based on ICT, since it constitutes an opportunity for students to experience new ways of learning, leaving aside the use of traditional media.

According to the criteria required for the realization of a research work, the following sections are developed: section 2 presents the theoretical contextualization, which consists of the review of the bibliographical sources that address the issue under study. Section 3 establishes the hypotheses raised about the application of the e-book. Section 4 determines the objectives. Section 5 details the methodology used to develop the research. Section 6 shows the results, analysis and discussion. In section 7, conclusions are drawn according to the results obtained.

2. Theoretical contextualization

2.1 Communication and information technologies

Information and communication technologies (ICT) are all those tools and programs that process, manage, transmit and share information with the help of technical supports. Computers, the Internet and telecommunications are the most common information and communication technologies, although their growth and development continue to produce new models. For this reason, "ICTs are a set of advanced techniques, developments and devices that integrate data storage, processing and transmission functionalities" (Rodriguez, 2009, para. 1).

On the other hand, Moya (2009) states that:

> Most governments and educators recognize that the use of ICT in education improves its quality. However, it is a matter of using ICT in the classroom and using them from a pedagogical perspective, not as a complement to traditional teaching but as an innovative way that, by integrating technology into the curriculum, improves teaching-learning processes and students' school processes (p. 2).

It is important to understand that learning in education should be a motivating and interactive process in which technology plays a very important role in the acquisition of knowledge, skills and significant abilities. Advances in technologies are greatly influencing the educational field by developing quality learning and improving the performance of both students and teachers in the teaching and learning process. Guerrero (2016) argues that:

> ICT in education is teaching and learning with technological tools and applications offered by Information and Communication Technologies. The use and emergence of new technologies today is no longer a novelty, it is part of our daily life, noting that young people are the most inclined to use technological tools (p.18).

There is no doubt that when the intercessor of the teaching and learning process uses only textbooks to transmit knowledge to students, the impacts generated are low and not very useful. It is important to recognize that in the digital era we live in today, the current society is audiovisual and interactive, especially in young people. Today the new generations are considered digital natives who have been surrounded from an early age by new technologies and devices, their inclination for both is based on learning new things, which is striking and fun at the same time.

2.2 ICT as a teaching resource

ICTs are transforming and becoming an educational tool, improving the quality of education, creating didactic structures and integrating meaningful learning based on enabling technologies. Peña and Calmaestra (2007) state that:

> ICTs are presented as an innovative resource in the classroom, but for this tool to be truly useful in the educational environment and not used as an end in itself, it is necessary to comply with a series of premises that are applicable to any teaching-learning process (p. 9).

To make a good use of technology, and that this is really useful in the educational field should emphasize important keys to the development of the teaching-learning process, the student must form a significant development of thinking. The teaching-learning process must reach a significant learning to reach the objective; the students must be in a high level of motivation achieving that they easily grasp the new knowledge.

2.3 Learning and gamification

In order to develop learning to occur, certain environmental and psychological conditions are required. The environmental conditions refer to the environment in which information is received or learning activities are performed, in this sense, playful environments have characteristics that allow attention and concentration despite external or distracting elements.

In this regard, Posada (2014) argues that playful environments are "an opportunity for the student, the protagonist of the teaching-learning process, to take ownership of what he/she wants to learn and how, to make the playful activity the creative, constructive, open way to interact with knowledge" (p. 28). The psychological conditions have to do with the skills used in the face of challenges and problem solving, motivation and inclination towards playful and recreational aspects. In this sense, gamification offers learning optimal conditions for its development; the success of learning lies in the motivation and interest produced in the student within the learning experience itself. Therefore, it is not the content of the class topics that is significant, but the learning experience itself.

In this sense, a motivated student will be a student with a positive disposition to learning. In this order of ideas, this same disposition can be observed in the attitude of some children towards video games, which in most cases is opposite to the attitude they have towards learning in schools.

Moreira and González (2015) state that:

> Gamification allows removing boredom from the class and generates greater interest in the student, thus representing a significant strategy in the achievement of learning objectives". Based on the above, it is asserted that gamification is a necessary tool in the classroom because through motivation and interest students improve the teaching and learning processes (p. 15-38).

Every process has its advantages and disadvantages, and gamification is no exception, in Table 1 both can be clearly identified, it is therefore necessary to know how to implement gamification in the classroom because if the activities lose their formative character they become unproductive.

Caparrós (2017) state that:

> Gamification enhances the socializing capacity since the game stimulates the social competence of the participants and their ability to relate to each other as teams can be formed. At the same time, it avoids frustration through a progressive increase in difficulty, personalizes the teaching-learning process and provides practical information to the teacher, which allows him to rethink the organization of the subject according to the results obtained in the application of the game in the classroom..

On the contrary, Giménez (2016) mentions that:

> He warns of certain disadvantages of gamification, such as the promotion of competitiveness, which can sometimes be misunderstood by students, the deviation of students towards the superficial objectives of the proposal or even the increase in expenditure on the acquisition and renewal of materials and tools, software and even teacher training.

ADVANTAGES	DISADVANTAGES
▪ Motivation, which stimulates interest in learning activities or tasks that are not very attractive to them. ▪ Concentration, the game contributes to a longer lasting concentration. ▪ Improves cognitive skills, the mechanics of gamification affects the improvement of memory, logical reasoning and deductive inferences. ▪ Time use, by improving motivation and concentration, the student makes better use of time. ▪ Improves self-esteem, the dynamics of gamification allows the student to overcome levels or problems without significant frustration..	▪ The possibility of creating a temporary motivation. Motivation based exclusively on obtaining rewards is diminished once it ceases to be something novel. ▪ To obtain the rewards, all players must assume the same objectives, which makes it difficult to accommodate different interests and learning styles. ▪ The balance between fun and learning is very difficult to achieve, and if the activity loses its learning character, it will be unproductive. ▪ Gamification is very good for developing a whole series of skills, but others such as oral expression are very difficult to develop.

Table 1. Advantages and disadvantages of gamification

2.4 E-book in education

It is a digital tool which is designed with different gamification techniques, it is considered a didactic resource of great benefit because it uses different educational gamification applications and can be read on any type of computer or cell phone.

It is an opportunity for students to experience new ways of learning, leaving aside the use of traditional media such as blackboards, texts with extensive readings and the use of notebooks that only allow them to copy what the teacher dictates or what is already in a text.

The creation and application of the e-book will allow the classes to be striking and innovative; it will make it possible to positively influence the behavior of students in relation to learning, through the activities developed based on gamification, the student can experiment, discover, be fascinated and want to continue playing to overcome the challenges and difficulties present in the topics of Natural Sciences, whose information constitutes the content of the game. In this regard, Hernández (2016) argues that:

> Several aspects were considered in the structuring of the e-book. First, the learning channels of the students, the following inclusion of sounds, music and videos, so that the students are stimulated visually, aurally and kinesthetically, for which interactive activities based on gamification were designed (p. 33).

In structuring the e-book, several aspects were considered. Firstly, the learning channels of the students in the sample, and then the inclusion of sounds, music and videos, so that the students were visually, aurally and kinesthetically stimulated, for which interactive activities were designed.

Their application with gamified tools optimizes learning, improving academic performance and teachers feel committed to continue preparing themselves in the use of these technological tools that dynamize learning environments.

2.5 E-book features

E-book, being a versatile technological tool, has several features that allow it to arouse the interest of both the teacher and the student. A learning environment that relies on resource-based teaching methods should be deeply motivating in the sense that it offers students and teachers a variety of opportunities, benefits and changing roles, problem-solving, decision-making and assessment skills. The following are the main features of the e-book (See figure 2)

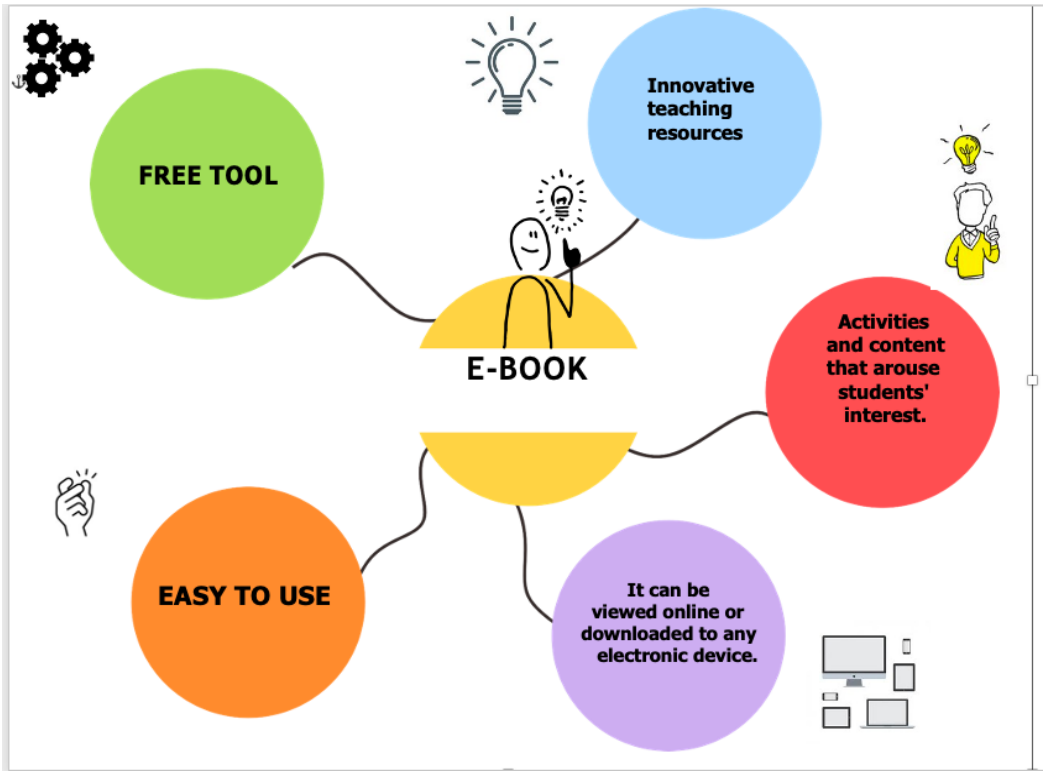


Figure 2. e-book features

3. Methodology

The present research is of an experimental-exploratory type, the modality applied in the research was carried out through a mixed approach: starting from a qualitative basis, having an interpretative approach with the study subjects, and as a second point, with a quantitative approach through data tabulation. Once completed, the survey technique was used with its instrument, the questionnaire structured on a four-point Likert scale.

To collect the information, a structured questionnaire was used as the research technique. This questionnaire was composed of questions related to the topic of study to find out if students in the ninth year of basic general education use ICT and gamified tools to improve

their academic performance. Thus, with the information collected, possible conclusions were drawn based on the results obtained.

The structured questionnaire was composed of 15 questions on a Likert scale. This questionnaire allowed the researcher to obtain the required information based on the objectives set for this research. This survey was applied to ninth grade students with the objective of determining the students' reality regarding the use of ICT and gamified tools according to their educational level and the didactic sequence of the class.

The researcher worked with the entire population of 250 students and 6 teachers of the Natural Sciences Area of higher basic general education. For this research work, it was hypothesized that the gamified didactic resource E-book improves the teaching and learning process of Natural Sciences of ninth grade students.

In the e-book, test activities, graphic organizers and quizzes were developed using gamified tools: wordwall, canva and liveworksheets respectively. This emerging methodology consists of using games or game mechanics in playful contexts, providing motivation for students in education, which is why it should be actively integrated into the teaching and learning process.

4. Analysis and results

To test the hypotheses, the two-sample test statistic was applied; therefore, the most appropriate statistic for this sample (pre-post test averages) was the T-test for related samples, having a p (0.04) less than 0.05, the null hypothesis is rejected and the alternative hypothesis is accepted. (See figure 3).

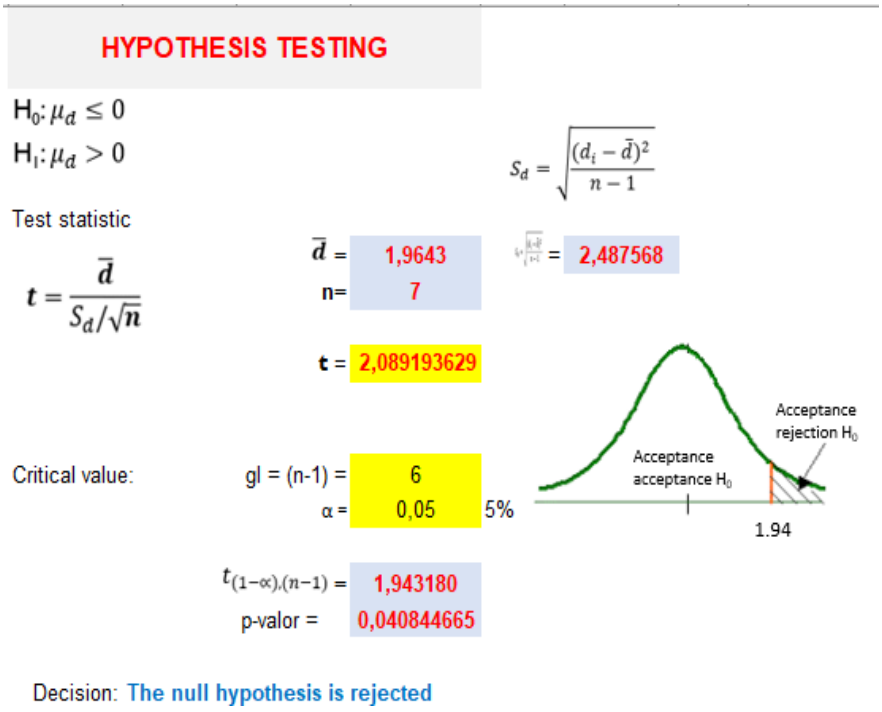


Figure 2. Pre and post test hypothesis testing

Null hypothesis	Activity	Test	Sig	Decision
	Test		0.04	
The gamified e-book didactic resource does not allow improving teaching and learning processes and achieving higher academic performance in Natural Sciences in experimental groups..	Organizer graphic	Related-samples t-test	0.03	Reject the null hypothesis
	Workshop		0.04	

Table 2. Summary of hypothesis testing

Having a p (value) less than 0.05 in the arithmetic means of the pre and post test in the graphic organizer and workshops developed by the students for this research, the final decision is to reject the null hypothesis (H0) and accept the alternative hypothesis (H1); which mentions that the gamified didactic resource e-book allows improving the teaching and learning processes and achieving a higher academic performance in Natural Sciences in the experimental groups.

The results presented below were taken from the instrument, which consists of 15 questions on a Likert scale, in turn, the most representative questions within the research were selected.

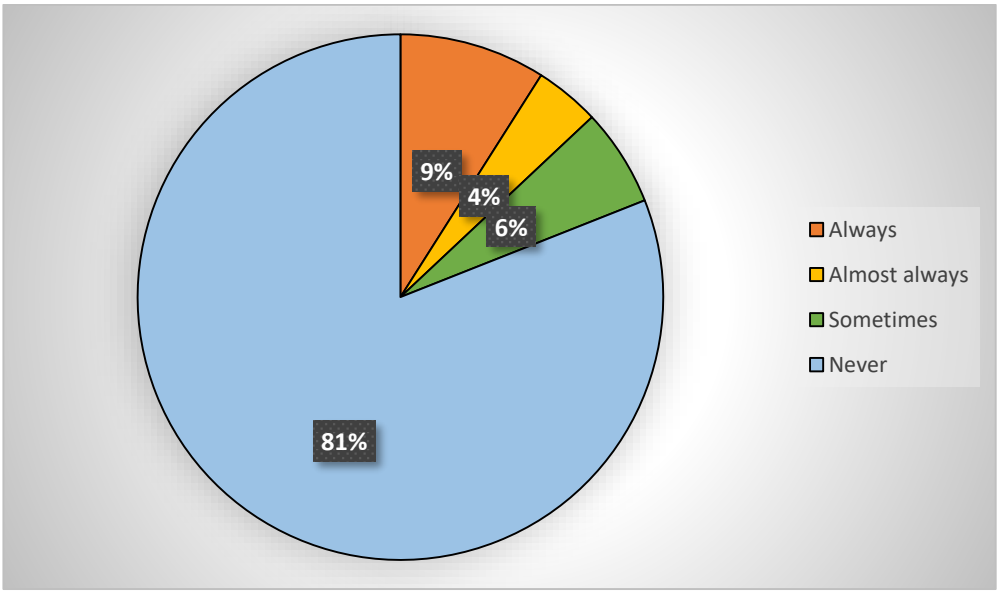


Figure 3. In all the Natural Sciences classes taught, the teacher uses technological teaching resources such as: interactive books, educational platforms, educational videos, interactive games, etc.?

Regarding the opinion of technological didactic resources, 81% mentioned that the teacher never uses this type of resources, while 9% affirmed that almost always, 6% sometimes, and concluding 4% always. The majority of students affirm that their teacher never uses

technological didactic resources such as interactive books, educational platforms, educational videos, interactive games. One of the major problems facing education today is boredom. Today's students no longer learn in the same way; faced with this situation, educators seek to innovate their classes and create fun and interactive environments.

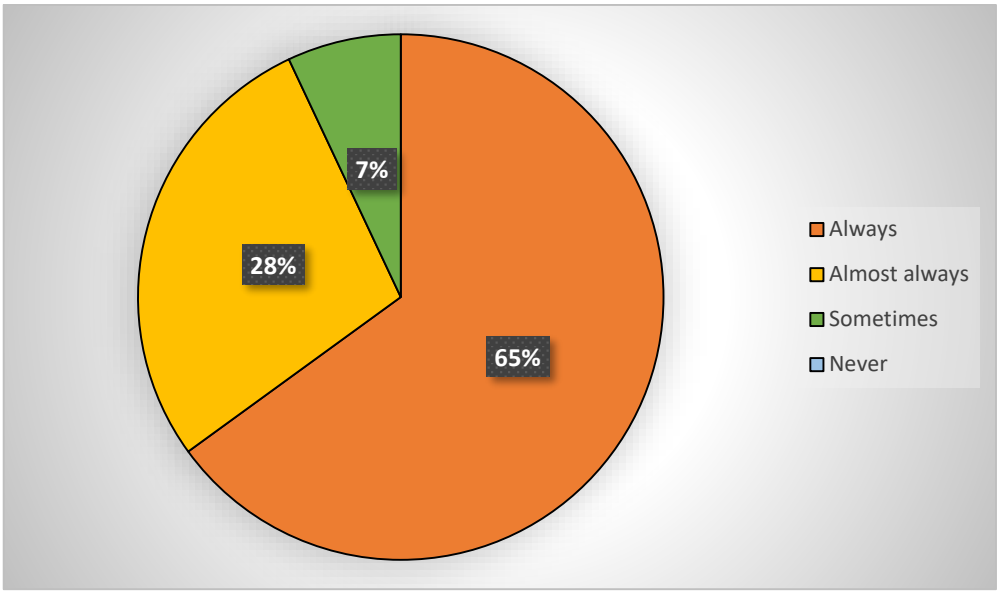


Figure 4. Do you consider that the use of gamification (a technique that uses game elements) is an innovative aspect in the learning of Natural Sciences??

Regarding the opinion of the use of gamification, 65% of students affirm that it is always an innovative aspect, 28% affirm that it is almost always and finally 17% mention that it is sometimes. Most of the students affirm that the use of gamification is an innovative aspect, for this reason it should be implemented in the educational environment, because it uses game elements that allow to involve students, motivate them to action and promote learning and problem solving.

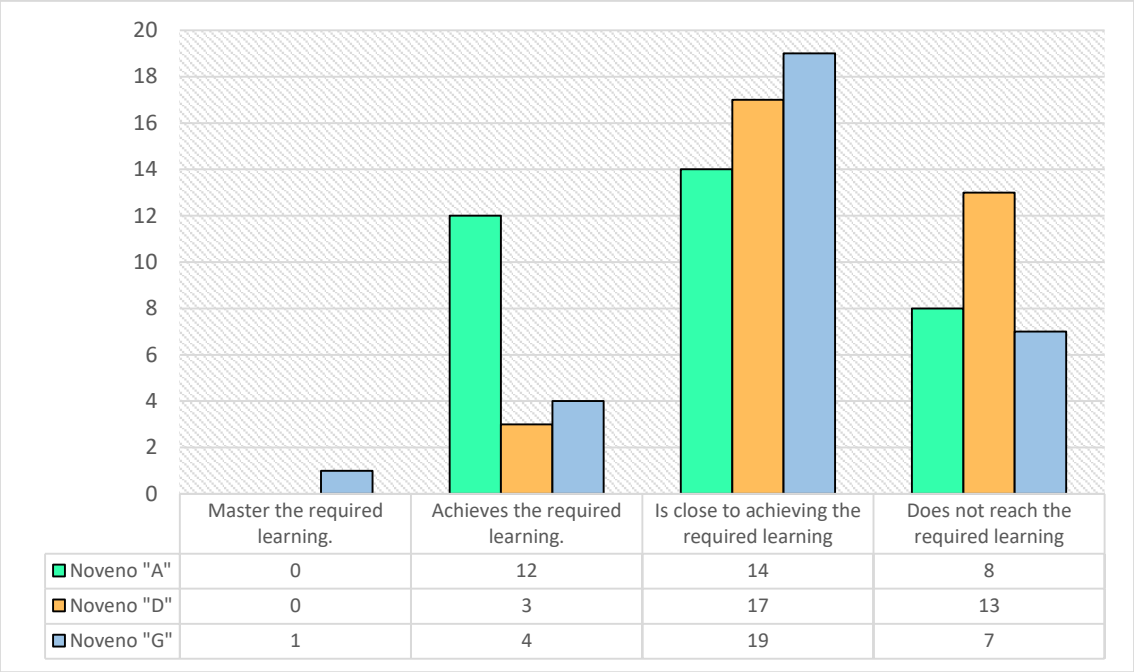
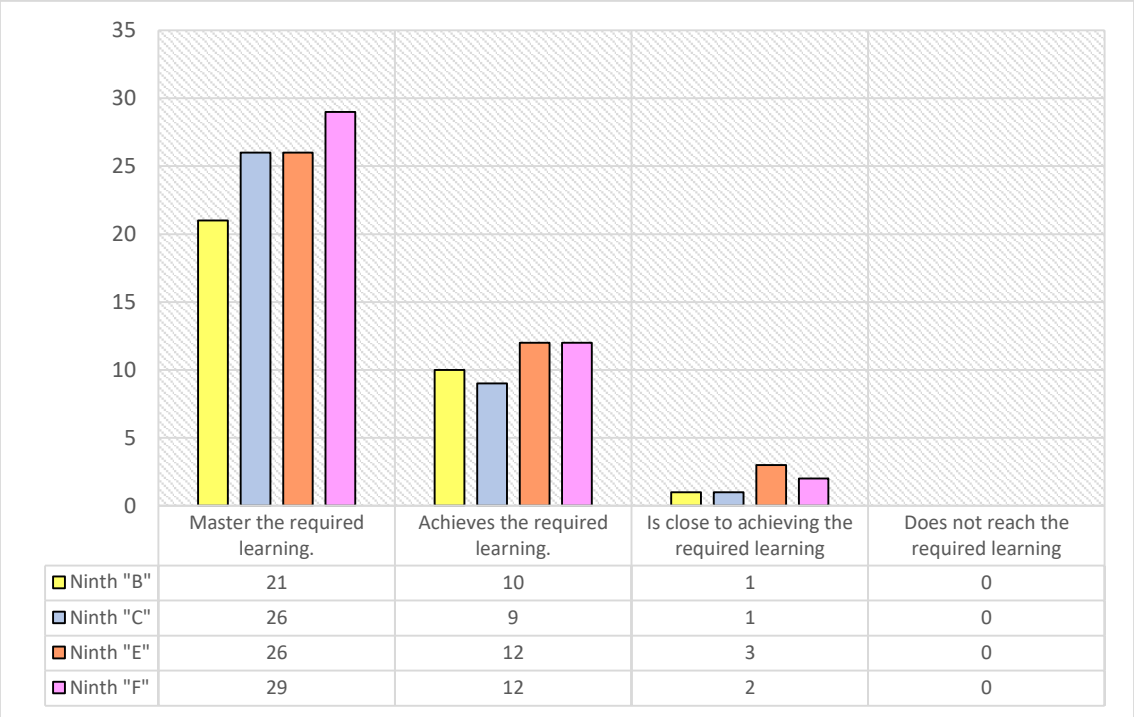


Figure 5. Post-test result without applying the e-book

The respective analysis of Figure 8 informs that 1 student masters the required learning, 19 students reach it, with a total of 50 students representing the majority are in the range of are close to reach the required learning and a total of 28 do not reach it, with these data and when comparing with Figure 9 it is concluded that by not applying the e-book students remain in the ranges close to and do not reach the required learning, which shows that the teaching and learning processes do not improve by using a traditional methodology and the use of conventional resources.



	Master the required learning.	Achieves the required learning.	Is close to achieving the required learning	Does not reach the required learning
Ninth "B"	21	10	1	0
Ninth "C"	26	9	1	0
Ninth "E"	26	12	3	0
Ninth "F"	29	12	2	0

Figure 6. Post-test result with application of the e-book

In the results obtained in Figure 9 it can be identified that a total of 102 students master the required learning, while 43 students reach it, 7 students are in the range of are close to reach it and 0 students do not reach the required learning, with this premise and in comparison with Figure 8 it is affirmed that the application of the e-book as a gamified didactic resource reinforced the subject of cell, considerably improving the teaching and learning processes and therefore the academic performance.

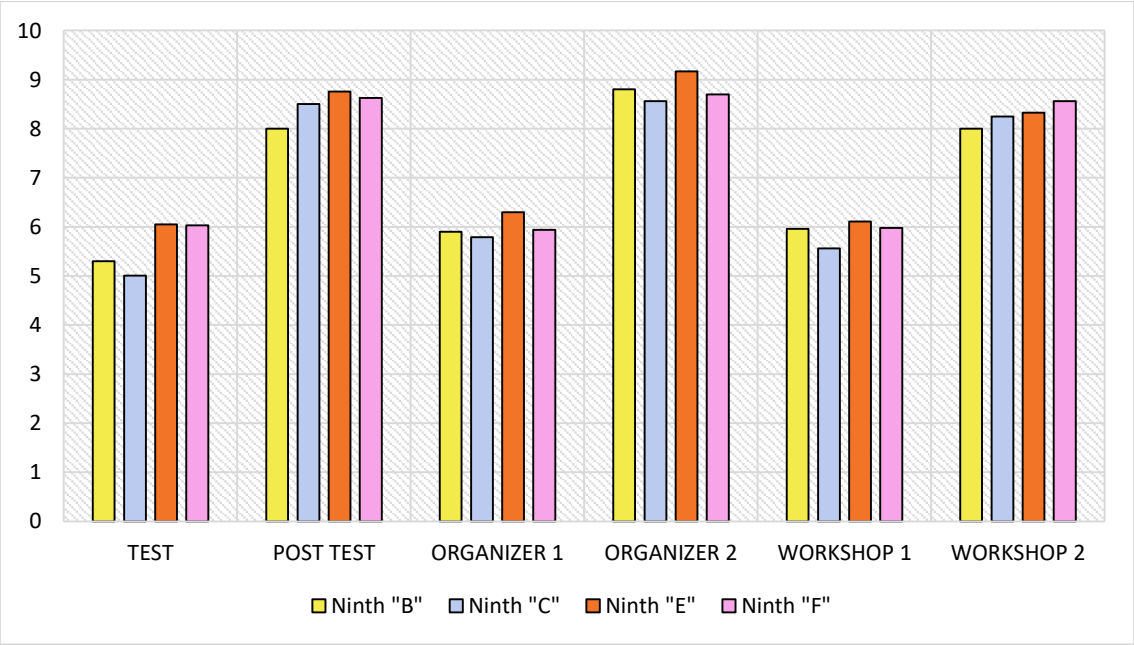


Figure 7. Results of overall averages in experimental groups Ninth B, C, E, and F

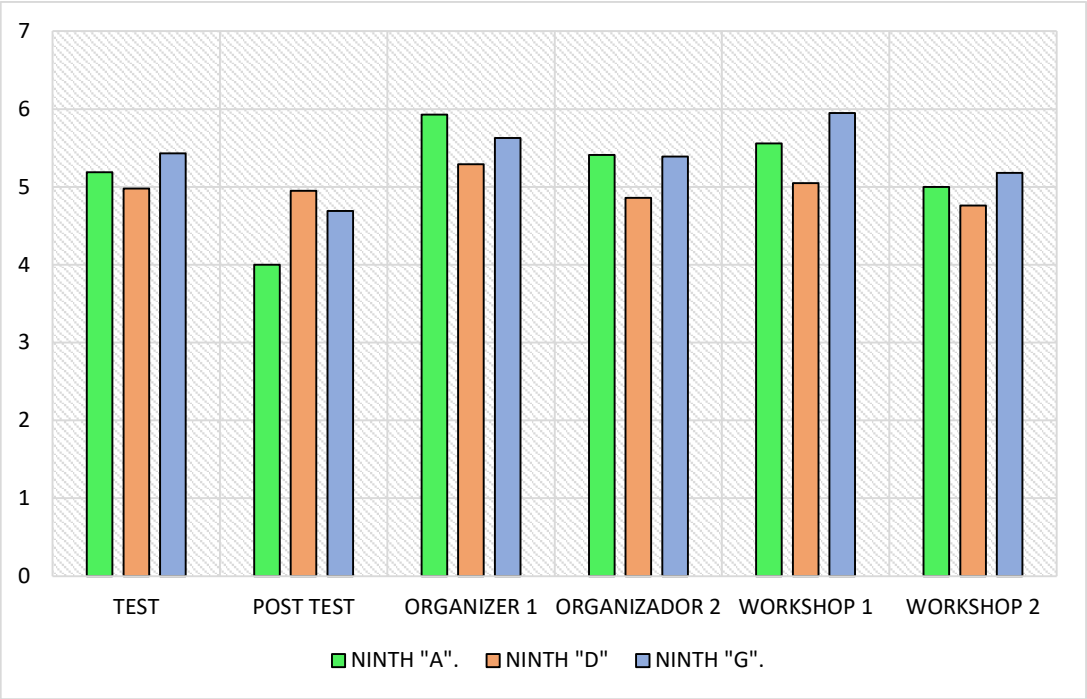


Figure 8. Results of the overall averages in non-experimental groups Ninth A, D and G

In the educational field it is necessary to implement the use of technology in the classes to make it motivating, dynamic and interactive. Based on the results obtained from the averages of the activities performed in the parallel sevens with and without the application of the e-book it can be visualized that in the case of Figure 10 used virtual tools introduced in the e-book such as: Wordwall, Canva and Liveworksheets generated an increase in their grades and facilitated the teaching and learning process of the different topics reviewed in class, generating significant learning in each of the students and resulting in better academic performance in the three activities performed compared to the non-experimental groups observed in Figure 11 in which it is represented that their academic performance did not improve and in many cases decreased.

The use of ICT in the teaching and learning process provides different benefits for students, awakening their motivation, interest and active participation in classes, and with this, their grades improve, as in the case of this research, the increase in grades is visible, thus making learning meaningful. In relation to the General Objective "to determine the influence of the e-book as a gamified didactic resource for the teaching and learning process of Natural Sciences in the ninth years of the Instituto Nacional Mejía, period 2021-2022", 93% of students consider that the use of gamified didactic resources are an innovative aspect. This shows that applying this teaching methodology allows involving students and offering them a different way of learning, while 100% of teachers express that it stimulates interest, motivates and improves the understanding of the subject of Natural Sciences. Therefore, it is worth mentioning that the influence of the E-book as a gamified didactic resource is very positive and relevant since it is a tool that allows motivating, interacting and awakening student participation, among other aspects. It is a tool with numerous advantages for both the teacher and the student. On the other hand, there is very little knowledge about didactic resources with gamification tools and in the educational institution it is not widely used by

teachers, due to different factors such as lack of updating and training, which prevents the quality or educational level to be improved over time.

The interactive e-book applied to an experiential pedagogy and the use of emerging technologies in education, manages to stimulate in the student and the teacher their power of analysis in the process of research and awareness, giving a critical look to the student. Therefore, it can be inferred that the use of the E-book optimizes learning, improves academic performance and the teacher feels committed to continue preparing in the use of these technological tools that energize learning environments (Medina, 2017, pp. 34-40).

The specific objective 1 "To analyze the degree of use of didactic resources with gamification tools in the teaching and learning process of Natural Sciences" shows that 81% of students think that the teacher never uses technological resources to teach the subject of Natural Sciences, while teachers point out that 66% sometimes use technological resources to teach the subject. It can be seen that teachers use few of these tools or didactic resources, which make the student awaken greater interest in the subject, investigate, interact, generate unknowns and above all achieve a more motivating and enriching class.

The use of diverse didactic resources in the classroom allows a greater approximation to the positive standard, linking empirical reflection and scientific models. The latter are the ones that the student must internalize and adapt, in the end being part of their prudent knowledge to enrich their knowledge, the use of these attracts the student's attention and is of great importance for the development of the teaching-learning process for the same reason a teacher should always use these resources to achieve meaningful and innovative learning (Chango and Sailema, 2017, pp. 30-52).

The specific objective 2 "Configure a didactic pedagogical structure for the application of the e-book with gamification tools in the teaching and learning process of Natural Sciences" Based on the results obtained, 84% of students affirm that gamification as a technological didactic resource will improve their learning in Natural Sciences after obtaining a different, positive and full teaching experience while teachers point out in 87% that implementing this resource in their classes is a different experience, allowing to improve the teaching and learning processes in the subject of Natural Sciences.

Gamification tools provide teachers with many opportunities to ensure that students carry out self-regulated learning in an enjoyable and active way and, above all, to achieve significance in what they have learned (Zambrano-Álava et al, 2017, pp. 349-369).

The specific objective 3 "To apply an e-book based on gamification tools for the teaching and learning process of Natural Sciences in the ninth years of the Instituto Nacional Mejía de Quito in the school year 2021-2022" is stated according to students in 90% consider that the application of didactic resources through educational ICT facilitate the acquisition of knowledge through the identification, observation and analysis of the facts that happen in nature and reinforce the contents of Natural Sciences while teachers indicate in 83% that ICT are important in the educational field in addition to allowing them to improve their personal satisfaction, strengthen the contents of Natural Sciences, The teachers (83%) say that ICTs are important in the educational field, besides allowing them to improve their personal satisfaction, their work performance and their relationship with the students, due to the wide range of possibilities they offer.

It is clear that just capitalizing on new technology is not enough; new educational models must use new tools, technologies and services to engage students at a deeper level and ensure academic quality (Falco, 2017, pp. 59-76).

The specific objective 4 "to determine the impact of the e-book with gamification tools in the teaching and learning process of Natural Sciences in the ninth years of the Instituto Nacional Mejía de Quito in the school year 2021-2022". It is affirmed that 83% of the students consider that the use of gamification as a technological didactic resource improves their learning in Natural Sciences after obtaining a different experience, positive and full of teaching, while 87% of the teachers are predisposed to implement this resource in their classes because it is a different experience, allowing to improve the teaching and learning processes in the subject of Natural Sciences.

It is necessary to present multimedia materials that promote reading comprehension in an interactive, fun, creative way, in an environment of enjoyment, starting from their previous knowledge, supporting them in case of difficulties without pointing out in a negative way, expressing positive reinforcements, since it depends on this that there is a potentially adapted reading society and taking advantage of new technologies (Hernández, 2016, pp. 57-63).

5. Conclusions

The impact of the application of the e-book in the ninth grade students of the Instituto Nacional Mejía was satisfactory; by implementing a new gamified didactic resource in the classroom, a great interest and curiosity to use it was awakened in the students. On the other hand, the activities developed motivated the students to learn about the different topics reviewed in Natural Sciences classes, allowing them to improve the teaching and learning processes and their academic performance, which could be seen in the averages obtained in both the experimental and control groups.

The e-book tool is a didactic resource that, due to its versatility and ease of use, has become ideal for developing the teaching and learning process of Natural Sciences in the ninth years of general basic education. In addition, it contributes from its application to activate and innovate knowledge, taking students and teachers out of the monotony by learning new technological tools and developing the gamified activities found in it, such as maze games, word searches, interactive quizzes, quiz games, quizzes, vokis, among others, in order to improve the teaching and learning processes, and thus the academic performance of students which was reflected in their grades.

Hernández (2016) state that:

> The e-book is intended for visual perception, but there are elements that complement the content, such as audio, video, animations, etc. Its objective is to provide the possibility of improving the teaching and learning processes, that is, it is necessary to present and use attractive and captivating materials, focused on the fact that today's society is inclined to digital, electronic and audiovisual, adequate content, according to the tastes, interests and needs of the student (p. 19).

The impact of the application of the e-book was positive and relevant, this was proven through the T-test of related samples when having a p (value) less than 0.05, the final decision is to reject the null hypothesis (H0) and accept the alternative hypothesis (H1), which mentions that the gamified didactic resource e-book allows improving the teaching

and learning processes and achieving a higher academic performance in Natural Sciences. In the experimental groups it was observed that the students mastered the required learning, while the non-experimental groups that were subjected to traditional pedagogical procedures kept their grades low, demonstrating that it is necessary to incorporate meaningful and lasting learning strategies.

Biliographic references

Chango, W., y Sailema, M. (2017). *"Recursos didácticos interactivos."* http://repositorio.utc.edu.ec/bitstream/27000/4087/1/T-UTC-0300.pdf

Caparrós, M. (2017, octubre). Gamificación en educación: una guía práctica. Recuperado el 18 de Junio de 2023, de https://www.trespuntoelearning.com/gamificacion-en-educacion-guia-practica/

Falco, M. (2017). Reconsiderando las prácticas educativas: Tics en el proceso de enseñanza-aprendizaje. *Tendencias Pedagógicas*, *29*(2017), 59–76. https://doi.org/10.15366/TP2017.29.002

Giménez, M. (Noviembre de 2016). *Ventajas y desventajas de la gamificación (entrada blog)*. Recuperado el 18 de Junio de 2023, de http://maritagimenez.blogspot.com/2016/11/ventajas-y-desventajas-de-la.html

Guerrero, Y. (2016, mayo). *Los weblogs como recursos didácticos en el manejo de la tabla periódica de los estudiantes de primero de bachillerato de la Unidad Educativa Particular bilingüe "María Magdalena" período lectivo 2015-2016*. http://www.dspace.uce.edu.ec/bitstream/25000/8802/1/T-UCE-0010-1534.pdf

Hernández, M. (2016). Diseño de e-book "Góru, el mágico". *Universidad Iberoamericana Puebla Repositorio Institucional http://repositorio.iberopuebla.mx*. http://hdl.handle.net/20.500.11777/2119http://repositorio.iberopuebla.mx/licencia.pdf

Medina, R. (2017). *Uso del eBook en el aula. Un medio introductorio en el manejo de las tecnologías emergentes | Medina Rodríguez | Revista de Investigación Educativa del Tecnológico de Monterrey*. https://rieege.mx/index.php/rieege/article/view/183/325

Moreira, M. A., y González, C. S. G. (2015). *De la enseñanza con libros de texto al aprendizaje en espacios online gamificados*. Educatio Siglo XXI, 33(3 Noviembre), 15–38. https://doi.org/10.6018/J/240791

Moya, A. (2009, septiembre). *https://archivos.csif.es/archivos/andalucia/ensenanza/revistas/csicsif/revista/pdf/Numero_24/ANTONIA_M_MOYA_1.pdf*. https://archivos.csif.es/archivos/andalucia/ensenanza/revistas/csicsif/revista/pdf/Numero_24/ANTONIA_M_MOYA_1.pdf

Ortiz-Colón, A. M., Jordán, J., y Agredai, M. (2018). Gamification in education: An overview on the state of the art. *Educacao e Pesquisa*, *44*. https://doi.org/10.1590/S1678-4634201844173773

Peña, A., y Calmaestra, J. (2007, enero). *(PDF) Las TICs como recurso innovador en el aprendizaje presencial*.

https://www.researchgate.net/publication/50862217_Las_TICs_como_recurso_innovador_en_el_aprendizaje_presencial

Posada, R. (2014). *La lúdica como estrategia didáctica*. Universidad Nacional de Colombia https://repositorio.unal.edu.co/bitstream/handle/unal/47668/04868267.2014.pdf?sequence=1&isAllowed=y#:~:text=La%20l%C3%BAdica%20se%20toma%20entonces,juego%20y%20del%20accionar%20l%C3%BAdico

Rodríguez, E. (2009, noviembre). *Ventajas e inconvenientes de las tics en el aula.* https://www.eumed.net/rev/ced/09/emrc.htm

Rodríguez, R. M. (2017). Uso del eBook en el aula. Un medio introductorio en el manejo de las tecnologías emergentes. *Revista de Investigación Educativa Del Tecnológico de Monterrey*, *8*(15), 34–40. https://www.rieege.mx/index.php/rieege/article/view/183

Zambrano-Álava, A. P., Lucas-Zambrano, M. D. L. Á., Luque-Alcívar, K. E., y Lucas-Zambrano, A. T. (2017). La Gamificación: herramientas innovadoras para promover el aprendizaje autorregulado. *Dominio de Las Ciencias*, *6*(3), 349–369. https://doi.org/10.23857/DC.V6I3.1402

Authors

ROSSANA BENAVIDES-VELASCO obtained her master's degree in Pedagogy of Experimental Sciences from the Faculty of Philosophy, Letters and Education Sciences of the Central University of Ecuador in 2023. She obtained her bachelor's degree in education sciences mention in Natural and Environmental Sciences, Chemistry and Biology from the Central University of Ecuador in 2016.

She is currently a full professor at the Instituto Nacional Mejía. She is a leading teacher at the Institution of the project "Youth in Action" of the Ministry of Education. Her main research topics include application of e-books in education, gamified resources, and gamification in the classroom. In recent years she has focused on ICT learning and the use of different gamified tools in the classroom to improve the teaching and learning processes of students.