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Patina con Sonic: Efectos de un entorno de aprendizaje gamificado basado en el videojuego Sonic en una muestra de adolescentes en clase de Educación Física

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Abstract

The inclusion of competencies in the curriculum requires, in turn, that educational centers and their teachers bet on the use of active methodologies that direct the teaching-learning process of students. The study presented here aims to analyze the effects of a gamified learning environment based on the Sonic video game in a sample of adolescents in Physical Education class. This is a non-experimental, descriptive and longitudinal study that shows the proposal of a gamified unit based on the world of Sonic. To assess the learning process, two ring

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register cards and a class diary are used. The results reveal the great involvement and motivation of the students and good learning results in relation to the didactic objectives of the unit. It is concluded that this experience is an ideal and motivating proposal to be used with adolescents in the content of inline skates. Likewise, we hope that this experience will inspire other teachers to continue innovating and gamifying in Physical Education.

Keywords

Physical education; motivation; active methodologies; gamification; adolescence.

Resumen

La inclusión de las competencias en el currículo exige a su vez que los centros educativos y sus docentes apuesten por el uso de metodologías activas que direccionen el proceso de enseñanza-aprendizaje del alumnado. El estudio que aquí se presenta tiene como fin analizar los efectos de un entorno de aprendizaje gamificado basado en el videojuego Sonic en una muestra de adolescentes en clase de Educación Física. Se trata de un estudio no experimental, descriptivo y longitudinal, que muestra la propuesta de una unidad gamificada basada en el mundo de Sonic. Para valorar al proceso de aprendizaje se utilizan dos fichas de registro de anillos y un diario de clase. Los resultados desvelan la gran implicación y motivación del alumnado y buenos resultados de aprendizaje en relación a los objetivos didácticos de la unidad. Se concluye que esta experiencia es una propuesta idónea y motivante para ser utilizada con adolescentes en el contenido de patines en línea. Así mismo, esperamos que esta experiencia sirva de inspiración a otros docentes para continuar innovando y gamificando en Educación Física.

Palabras clave

Educación física; motivación; metodologías activas; gamificación; adolescencia.

Introduction

The education of the 21st century demands the implementation of methodologies that have the student at the center of the teaching-learning process, where he applies, experiments, builds and interacts with his equals; making the teacher guide this process. In the area of Physical Education, from the work of Delgado (1991) and later Sicilia and Delgado (2002) in relation to teaching styles, there is a trend of Physical Education towards the study and use of pedagogical models, active methodologies and the use of educational innovation (Ruiz-Ariza and López-Serrano, 2021).

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In relation to the pedagogical models, while the teaching styles focus attention on 2 elements of the teaching-learning process, teacher and student, the pedagogical models focus attention on 4: teacher, student, content and context (Fernández-Río, Hortigüela-Alcalá and Pérez-Pueyo, 2021). "Pedagogical models do not replace teaching styles, but are incorporated into their structures whose current trend is focused on a student-centered approach of varied use and long-term" (Fernández-Río, Calderón, Hortigüela, Pérez-Pueyo and Aznar, 2016, 57). On the other hand, active methodology is understood as that which places students at the center of the teaching-learning process, making them active in said process, that is, making them reflect, criticize, cooperate, resolve, investigate, discover, assess, apply... For Navarro, Pellícer and Collado, active methodologies have a more punctual use in some didactic unit, while the models are usually more prolonged in time (Ruiz-Ariza and López-Serrano, 2021). And with regard to educational innovation, Bennasar (2020, 273) "indicates that innovation in Physical Education should be understood as the faculty of students and teachers to promote different spaces, with novel content and alternate conceptions, of what it means learning and training. Barraza cited by Pérez-Pueyo and Hortigüela-Alcalá (2020) indicates that the important thing about innovation is the introduction of new content, materials, technologies, approaches and strategies and that it generates a change in the pedagogical beliefs of the different educational actors.

For all the aforementioned, as can be seen in Table 1, gamification has been understood in the specific bibliography as a pedagogical model (Fernández-Río et al., 2021; Flores-Aguilar, Fernández-Río and Prat-Grau, 2021), as an active methodology (Rodríguez Parra, Bermejo Palomares and García Lázaro, 2019; Ruiz-Ariza and López-Serrano, 2021) and of course, as an innovate way (Arufe, 2019; Rodríguez Parra et al., 2019); given that its application in Spain, according to León-Díaz, Martínez-Muñoz and Santos-Pastor (2019), is quite recent, with the first work on gamification in Physical Education being published in 2015 by Monguillot, González, Zurita, Almirall and Guitert (2015) with the title "Play de Game: gamification and healthy habits in Physical Education". Regarding the use of this pedagogical model, "not everything that is intended to be taught in the classroom by playing

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can be called gamification" (Navarro, Martínez and Pérez, 2017, 76); gamification “is mainly based on transferring the essential elements present in games and video games to different non-play areas, that is, their mechanics” (Arufe and Navarro, 2021, 66) with the intention of promoting greater learning (Ortega and Chacón-Borrego, 2022). In other words, “a methodology where an imaginary story or narrative is used, as a common thread, in order to consolidate skills or learning objectives from the introduction of game or video game mechanics (challenges, missions, rewards...)” (Flowers, 2019, 529).

Table 1

Pedagogical models in Physical Education and active methodologies

Pedagogical models (Pérez-Pueyo et al., 2021)	Active methodologies (Ruiz-Zurita et al., 2021)
Cooperative Learning	Flipped Learning
Teaching Games for Understanding (TGfU)	Service-learning
Sport Education	Learning for life
Teaching Personal and Social Responsibility	Game-based Learning (GBL)
Attitudinal Style	Poyect-based Learning (PBL)
Health-Based Physical Education (HBPE)	Escape Rooms / BreakOut Edu
Service-learning	Gamification
Adventure Pedagogy	Challenge-based Learning (CBL) (Navarro et al., 2017)
Self-construction of materials	
Ludotechnical Model	
Self-regulated Learning	
Gamification	
Formative and Shared Assessment	
Literacy Motor (Fernández Río et al., 2016; Navarro et al., 2020)	
Physical Neuroeducation (Navarro et al., 2020)	

The elements used to gamify educational contexts can be grouped into three basic categories (Werbach and Hunter cited in Fernández-Río and Flores Aguilar, 2019):

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- Dynamics (first level). Basic elements of the approach: narrative, progression, limitations, emotions, relationships...
- Mechanics (second level). Elements that make the action progress: rules, challenges, feedbacks, competition...
- Components (third level). Tangible elements of the approach: avatars, prizes or rewards, points, levels, rankings...

Arufe-Giráldez, Sanmiguel-Rodríguez, Ramos-Álvarez and Navarro-Platón (2022a) indicate that in the educational field it is more correct to speak of the creation of Gamified Learning Environments (GLE) whose design is made up of 4 main blocks and more than 25 key elements. According to Arufe and Navarro (2021), these blocks are: 1) Educational elements. 2) Motivational elements. 3) Game elements. 4) Previous knowledge recommended.

Regarding the didactic adaptation of the world of Sonic, we make a brief contextualization of it: Sonic the Hedgehog is the emblematic character of the Sega video game franchise whose debut in these came in 1991, its success made it appear later in other media such as anime and comics (Flynn, 2021). For the people of Nintendo (a "competitor" video game brand), it was nothing more than an attempt to copy Super Mario Bros with the same type of game, but they soon realized that "maybe it was not such a bad product" (Kent, 2016). And although he began his walks in the 90s, he is still successful and his last two films of the year 2020 and 2022 demonstrate this. As for the character, Sonic is a blue hedgehog that Flynn (2021) defines as the fastest thing alive, characterized by skills such as the "Spin Jump" or the "Spin Attack" in addition to his fight against injustice. His main enemy is Doctor Eggman, a mad genius who wants to conquer the world with his machines. This villain looks for the Chaos Emeralds or Miracle Gems so that his mechanical empire grows. The progress of his sagas has included allied characters such as Tails, Knuckles, Amy Rose, among others (Flynn, 2021).

This study aims to analyze the effects of a GLE based on the Sonic video game in a sample of adolescents in Physical Education class.

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Materials and methods

A non-experimental or observational design is carried out, with a descriptive purpose and longitudinal temporal sequence. This design has been used by other authors such as Ortega and Chacón (2022) to describe gamified interventions in Physical Education.

Participants

The participants were 84 students from four units of the second year of Compulsory Secondary Education (“2º de ESO”) of the academic year 2021/2022, from an educational center in the “Sierra de Cádiz” (Andalusia, Spain); this being a sample obtained by ease of access. The mean age of the students was 13.68 years (± 0.83), with 47.62% being girls. The distribution in each unit was: 22, 18, 22 and 22 students in groups A, B, C and D, respectively. The exclusion criteria were: absenteeism or missing more than 50% of the classes in the unit (13), refusal to work in all or almost all the subjects of the curriculum (9), pathology or injury that prevents physical exercise during the period of the unit (4) and exclusive refusal to practice skating (2).

Information search

In the first place, information was sought on gamified experiences already published in the last 6 years "to alleviate the difficulties that the teacher may encounter" (Flores, 2019, 534), as well as to see the chosen media and the worlds used for inspiration for the narratives, which we summarize with examples in Table 2.

Table 2

Medios usados y mundos de inspiración para las narrativas

Media used and worlds of inspiration for the narratives	
Video games:	Real life:
- Super Mario Bros (Flores, 2019)	- “Carrera X-PYR” (Flores and Prat, 2018).
- Fornite (Arufe, 2019).	

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- Pokémon Go (Sotoca, 2019) T.V. series:	- Solar system (Navarro et al., 2017). Others:
- Game of Thrones (Pérez, Rivera and Trigueros, 2019).	- “Malvado sedentaris” (Magaña et al., 2020).
- Money Heist (Arufe and Navarro, 2021).	- “Carrera Espartana” (Acebes-Sánchez y Ros, 2022).
- Dragon Ball (Flores-Aguilar and Fernández-Río, 2021). Movies and books:	- Play de Game (Monguillot et al., 2015).
- Harry Potter (Ortega and Chacón-Borrego, 2022).	- Motor skills (Rodríguez et al., 2019).
- Star Wars (Navarro and Pérez, 2021).	- Fitness Royale (Sánchez-Silva and Lamonedá, 2021)

Starting from video games as a media, several worlds were searched (Mario Kart, Crash Bandicoot, Sonic...) trying to find the points of union with the content of skates, opting for Sonic. Finally, information about Sonic was searched on the internet to better understand the character, his skills and abilities, and the 2020 film ("Sonic the Hedgehog") was viewed.

Instruments and data analysis

To assess student learning outcomes, the following instruments were used:

- Self-assessment: Checklist to assess the pre and post mastery of the skates; classifying the levels as low (I have never taken the skates and if I have taken them I am not able to move with them), medium (I move but I do not know how to stop or turn) and high (I move 20 meters I turn a cone, I reach the starting point and brake). Record sheet for emerald rings (theoretical-practical group activities) and "Sonic diary" (class diary that each student calls with the name of his avatar / character).
- Heteroevaluation: Record sheet of sapphire rings (attitudes and values).
- Co-assessment: Record sheet for gold rings (individual practical activities).

To evaluate the unit as well as the degree of satisfaction of the students, an *ad hoc* anonymous questionnaire was used: What did you like the most? What did you like least?

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What would you improve? Write a sentence or word that summarizes the unit. Rate the experience in this unit from 0 to 10.

The variables analyzed in this study were the grades per unit, by sex and by evaluation tool used, the previous and final mastery of the skates, as well as the degree of student satisfaction. Data are expressed by mean data, standard deviation, frequency and percentages. A comparison of the mean values was made based on the evaluation tool and gender variables, using the parametric Student's t-test, for which the differences obtained with a significance level of $p < 0.05$ were considered significant.

Procedure

The experience takes place during the second and third quarters of the 2021/2022 academic year (from March to May), in 13 sessions that are distributed as follows:

- Initial phase (session 1 and 2). Initial evaluation, presentation and standards
- Intermediate phase (session 3 to 10). Portals 1, 2, 3 and X.
- Final phase (session 11 to 13). Portal 4, final battle to recover the 7 Chaos Emeralds.
- Extension of the red emerald (complementary activity). Final phase of the roller hockey tournament.

Elaboration and development of the unit

The presented unit has as objectives those established in Table 3, which are related in turn to the objectives of area, stage and key competencies (CC).

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Table 3

List of objectives of the unit “Skate with Sonic”

Didactic	Area	Stage	CC
1. Learn to skate or improve specific in-line skating skills.	1, 2, 5, 7	a, k	CCL, SIEP, CMCT
2. Prevent and control injuries and risks derived from bad falls with skates.	8	a, k	CCL, CSC
3. Show attitudes of respect and care for the material.	11	a, c, k	CSC
4. Show attitudes of teamwork, cooperating to achieve common goals.	4, 6, 11, 12	a, b, k, 1	CAA, CSC, CD, CCL
5. Recreation with the practice of activities with skates.	6	K	CSC, CAA

Note: The area objectives and CC indicated here are extracted from “Orden de 15 de enero de 2021”, the stage objectives of “Real Decreto 1105/2014”. CCL (Competence in Linguistic Communication), CMCT (Competence in mathematics and basic competences in science and technology), CAA (Competence in learning to learn), SIEP (Sense of initiative and entrepreneurial spirit), CSC (Social and civic competence), CEC (Consciousness and Cultural Expressions) and CD (Digital Competence).

The contents to be worked in this unit are shown in Table 4, in which reference is made to the contents of the “Orden de 15 enero de 2021” and to the specific contents specified for this unit.

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Table 4

Unit contents

“Orden de 15 de enero de 2021”	Unit specific
Block 1. Health and quality of life	
<ul style="list-style-type: none"> - Injuries and the potential risk of practicing physical and artistic-expressive activities. 	<ul style="list-style-type: none"> - Common injuries from falls without protection. - Common back fall injuries. - Use of protections, preventive measures and correct technique for falling forward.
Block 3. Games and sports	
<ul style="list-style-type: none"> - Technical foundations and specific motor skills of individual and collective physical-sports activities. - Development of teamwork and cooperation skills from respect for the individual level. 	<ul style="list-style-type: none"> - Basic roller hockey technique. - Development of teamwork and cooperation skills from respect for the individual level.
Block 4. Body expression	
<ul style="list-style-type: none"> - Mime and dramatic play. 	<ul style="list-style-type: none"> - Dramatization of Sonic scenes.
Block 5. Physical activities in the natural environment	
<ul style="list-style-type: none"> - Practice of urban physical-sports activities such as: skateboarding, parkour, rollerblades and so on. - Awareness towards safety regulations when traveling on foot or by bicycle in urban and natural environments. 	<ul style="list-style-type: none"> - Practice of urban physical-sports activities: in-line skates and the main skills for their learning. - Awareness towards the safety regulations for moving around with skates in urban environments.

At a methodological level, this proposal is guided by the initial card (Figure 1), the individual sheets (Figure 2), the team sheet (Figure 3) and the battle sheet (Figure 4). Highlight that in addition to using gamification as a pedagogical model, we put service-learning into practice at the end of the unit, but in the latter case the students you study here

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are only the recipients of the service, so the design and preparation of the service it is carried out by three more advanced courses (“1º de bachillerato”). As a start, the students watch an explanatory video of the web page used as didactic material, in which the portals, the objectives, the rewards, the rankings, among other elements of the unit are indicated (<https://patina-con-sonic.webnode.es/>). This website facilitates formative and shared evaluation, bearing in mind in this unit the seven suitability and quality criteria established by Pastor cited in Pérez-Pueyo, Hortigüela-Alcalá, Gutiérrez-García and López-Pastor (2021); among them the essential criterion, "formative", which according to the previous authors "seeks that the evaluation serves, above all, to improve the process and learn more" (p. 406). Thus, in the unit, the students have their progress reflected on the web and in their registration forms, which allows them to know their process and improve it during the course of the unit.

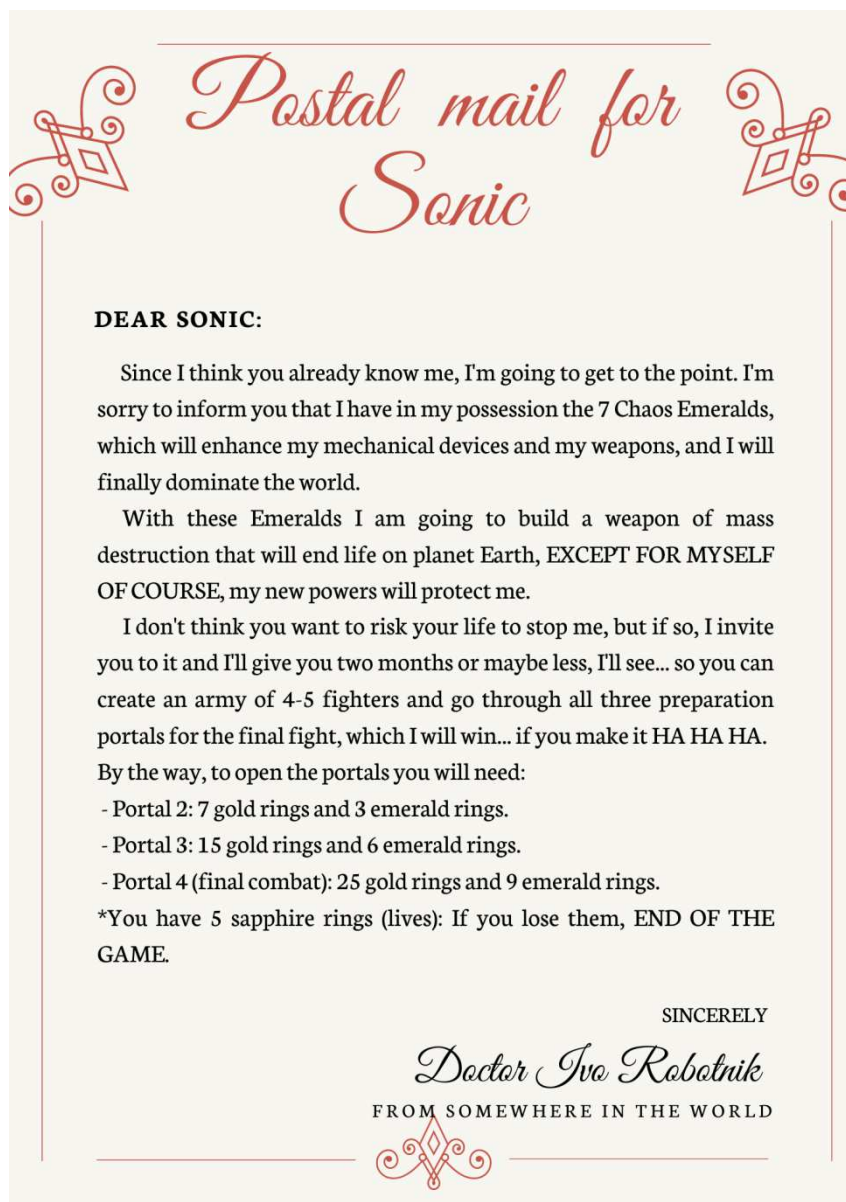
To set the unit in the presentation, “Tails” interrupts the class, who apparently receives a letter from "Doctor Ivo Robotnik-Eggman" addressed to Sonic, he meets with his friends to read it and form a team that he decides to train for a final battle. (The soundtrack of the 2020 film is used at this time).

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Figure 1

Initial letter for the presentation of the unit



From that moment, "Longclaw", Sonic's protective anthropomorphic owl (teacher) delivers, to each group of 4-5 members, the individual sheets (one for each team player:

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Sonic, Amy Rose, Tails, Sticks and Knuckles) and the team sheet (there is one type of sheet for groups of 4 and another for groups of 5).

In the individual sheet appear the portals (which are the levels to overcome), the mission (which is the objective of each portal) which is made up of a series of challenges (tests that show that you have a basic mastery of the skates) and the rings that will be drawn like the three that appear as an example (which are the rewards obtained by overcoming the challenges). The rings in this form will be gold (individual events) or sapphire (you start with 5, you win with good behavior and you lose for not respecting the rules established for the skate unit; being able to make a Game Over if you reach 0 and go to a modality of theoretical learning with exam). Depending on the performance in the individual tests, they will get 0, 1, 2 or 3 gold rings after them.

Figure 2

Individual sheet

INDIVIDUAL SHEET (KNUCKLES)

	CHALLENGES	GOLD RINGS	CHALLENGES	GOLD RINGS
1. MASTER YOUR POWERS	Equipped	○○○	Penguin costume	
	I get up stronger		Zombie costume	
	First steps		Stealth roll	
	First jumps		Speed sparks	
2. ARRIVAL TO EARTH	Roll after push		4. BATTLE If all the members of your team have managed to open portal 4, "Longclaw" will give you the Battle Sheet. You are close to defeating Robotnik!	
	Hit the brakes!			
	I lost a shoe			
	Dangerous curves!			
NAME:		 SAPPHIRE RINGS LIVES ○○○○○		
GRADE:				

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Note: The title and avatar image changes depending on the character. The image of the character has been extracted from <https://www.deviantart.com/>.

For its part, the team sheet shows the X portal, the mission, the challenges (cooperative practical tests and group theoretical tests carried out at <https://quizizz.com/>) and the emerald rings that they will be drawing. Depending on their performance, they will also be able to obtain 0, 1, 2 or 3 emerald rings after them.

Figure 3
 Team sheet


TEAM SHEET

	CHALLENGES	EMERALD RINGS	QUIZIZZ	EMERALD RINGS
PORTAL X. TRAIN YOUR TEAM	2-car train	○○○	Initial knowledge 1	
	4-car train		Initial knowledge 2	
	Formula 1		Skating technician 1	
	Coordinated movements		Skating technician 2	

Team name

Team members:

- Sonic -----
- Tails -----
- Amy Rose -----
- Knuckles -----
- Sticks -----



Note: This sheet is for teams of 5 members, teams of 4 members have one less character in the avatar photo. The image of the characters has been extracted from <https://www.nintenderos.com/>.

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The last sheet corresponds to the battle sheet, it shows the team tests that you must perform to defeat the evil Doctor Robotnik. This and his team of robots created with the powers of the Chaos Emeralds, will fight in different scenarios. You will try to beat them to get each of the emeralds and their powers. The fight scenarios are battles between groups, for which in the gamification your team is the real one and the one you face are the robots and vice versa, that is, you represent both at the same time depending on who is looking at you. The Chaos Emeralds that you get will be pasted on your sheet. The tests and powers are:

- Red: Tournament in roller hockey league format (6-minute games). The champion team wins the emerald.
- Yellow: Relay race taking hoops from different areas of the field. The first team to arrive wins the emerald.
- Gray: All the team in their zone puts on their skates and protections, does a skill circuit, returns to their zone and takes off their protections and their skates. The first team to remove all pads and skates wins the emerald.
- Green: All the teams move around the field, their components are eliminated as they step on a line of the track. The team that after a set time has the most members still in play wins the emerald.
- Blue: A member transports his wounded, they hold on to a rope and will make a straight line without being touched, if the wounded lift their feet off the ground they will be eliminated. The team that manages to carry all the components in less time wins the emerald.
- Light blue: Relays trying to score five baskets. The team that gets it first emerald.
- Violet: In the established time you must color the masks of your characters, cut them out and take photographs and videos representing games and challenges seen in class; to later make a video montage to immortalize. The highest rated team in the activity wins the emerald.

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Figure 4

Battle sheet



Note: The teams will paste here the cards of the emerald obtained.

Some of the powers the emeralds grant to team members are those shown on the example Chaos Emeralds cards in Figure 5.

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Figure 5

Examples of Chaos Emeralds



Note: These letters have been made using the web: <http://www.hearthcards.net/>.

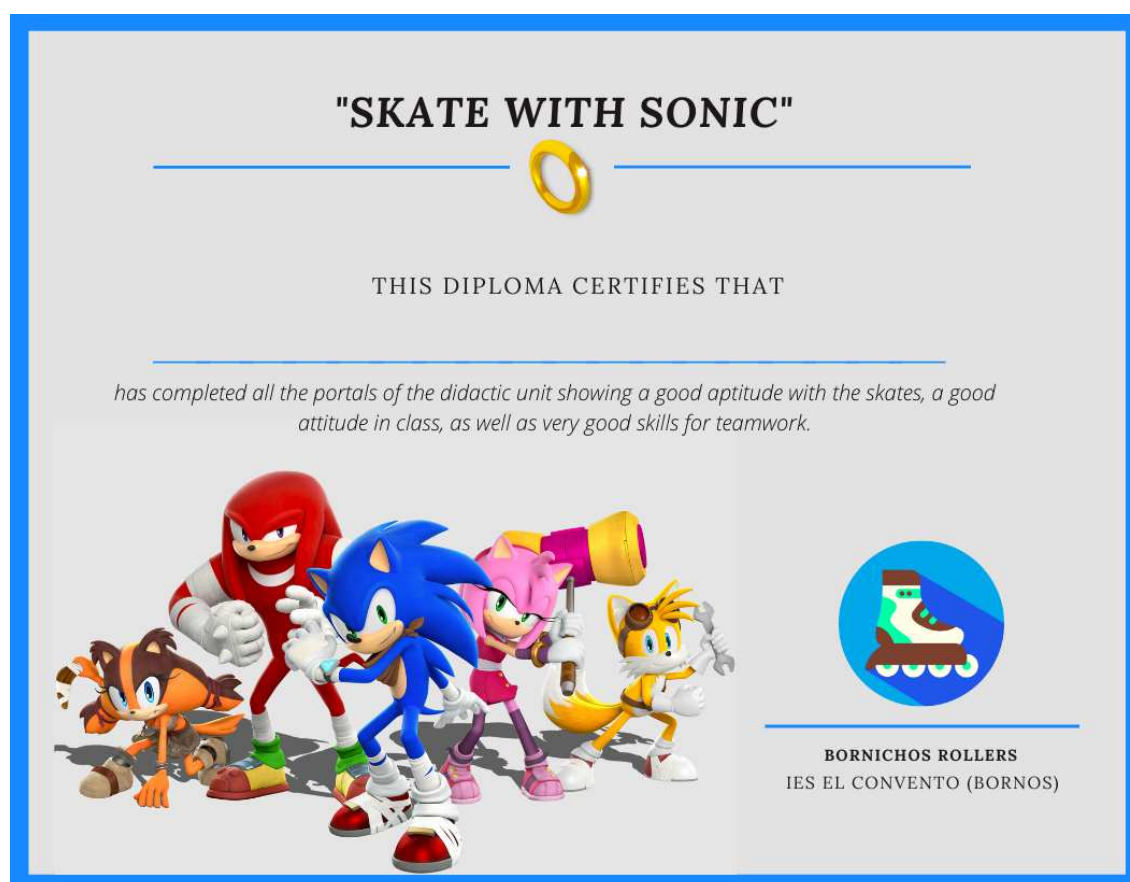
At the end of the unit, diplomas were given to all those students who managed to open portal 4, regardless of the groups that obtained the emeralds, given that portal 4 has a recreational-festive purpose of applying what was learned in the previous portals and that therefore, getting or not getting a emerald would not influence the rating.

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Figure 6

Diploma awarded at the end of the unit



Note: The image of the characters has been extracted from <https://www.gamerfocus.co/>.

Due to the good level achieved and the motivation of the students to achieve emerald 5, it was decided to extend the roller hockey tournament.

This roller hockey tournament began with a group phase within each class and during the Physics schedule. (achievement of the red gem) and concluded with a final phase in a complementary activity in which the best team of each class participated, with two “signings” chosen from among the entire class to represent the class and a coach also elected from among the entire class, through anonymous individual voting. In addition, the Service-

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learning pedagogical model was applied, carried out by the "1º de bachillerato" students who at that time were working on the organization of tournaments in a sports specialization unit. The latter were in charge of addressing the notes on the subject with the regulations of the tournament, as well as delivering the diplomas and medals (federative technicians); carried out arbitration management (arbitration committee); they managed all the audiovisual subject (radio and television technicians); and they were in charge of the technical training for the clubs and their players and the training in good values for the fans of all the "2º de ESO" courses who were witnessing and encouraging their classes in the tournament (training technicians). All this with the possibility of delegating functions and making use of the help of volunteer students of "2º de ESO" (link to the final video of the tournament <https://www.youtube.com/watch?v=yqNaKQl6wLc&t=16s>).

Figure 7

Roller hockey tournament



Note: Group stage results on the left and final tournament pairings on the right.

Student evaluation

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To evaluate the learning results of the students, the gamification tools are used, that is, the cards with the rings and the Sonic diary, in Table 5 we can see their relationship with the objectives, criteria, CC and evaluable learning standards.

Table 5

Relationship of objectives with the criteria, CC, standards and evaluation tools

Didactic objective	Criteria and CC	Learning standards and weighting of the final grade	Tool
1	1 (CMCT, SIEP)	1.4. Improves their level of execution and application of technical actions with respect to their starting level, showing attitudes of effort, self-demand and self-improvement with the skates (30%).	Gold rings
2	9 (CCL, CSC)	9.3. Adopt preventive and safety measures with skates (10%).	Sapphire rings
3	7 (CSC)	7.3. Respect others within teamwork, regardless of skill level on the skates, and show care for equipment (20%).	Sapphire rings
4	7 (CAA, CSC)	7.2. Collaborates in group activities assuming responsibilities for the achievement of objectives (30%).	Emerald rings
5	8 (CAA, CSC)	8.1. Learn about the possibilities of skating as a form of active leisure, recreate yourself and enjoy your practice (10%).	Sonic diary

Note: The evaluation criteria indicated here are extracted from the "Orden de 15 de enero de 2021", for their part, the evaluable learning standards have been adapted from said order. For criterion 9 and the adaptation of standard 9.3, what is indicated in the curriculum of "3º de ESO" is taken into account.

The challenges to get the gold rings and the emerald rings have their specific rubrics assessing the performance in the tasks (automated execution 3 rings, is destabilized or slightly

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loses balance during its execution 2 rings, makes an effort but does not succeed 1 ring, don't try 0 rings), having all the rings will represent the maximum percentage and having none will represent a lower percentage obtained with a "rule of 3". In the case of sapphire rings, everyone starts with 5 rings (lives) they are lost by not respecting any of the class rules for the skating unit (pushes their partner, laughs, does not take care of the material, does not deposit it correctly, the protections are not placed...) and you win by complying with them, by collaborating in class and by not falling as a way of taking care of the material (these are added or removed at the end of each class). A positive disposition and enjoyment towards skating shown in the diary will be valued with full marks, as well as constructive criticism.

Results

In the first instance, the data of the initial evaluation carried out is shown, in which the students are divided, according to the domain of inline skates, into low, medium or high level. After repeating the same evaluation at the end of the unit, it can be seen how the results shown in Tables 6 and 7 are quite positive.

Table 6

Previous and posterior mastery of the skates

Total	Low	Meidum	High	Total
Beginning	n=44 52%	n=11 13%	n=29 35%	n=84 100%
Final	n=0 0%	n=12 14%	n=72 86%	n=84 100%

Table 7

Changes in the level of skating

Paso de nivel	Students	Level crossing	Students
Low to low	0	Medium to medium	0
Low to medium	12	Medium to high	11
Low to high	32	High to high	29

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Regarding the results at the end of the unit, Table 8 shows how the average grade of "2º de ESO" is 8.47 (± 1.19), being very similar in all courses.

Table 8

Average grade of "2º de ESO" overall and by units

2º de ESO	Group A	Group B	Group C	Groupo D
8.47 (± 1.20)	8.26 (± 1.39)	8.24 (± 1.18)	8.60 (± 1.21)	8.73 (± 0.79)

Regarding the qualifications by sex (rounded to the unit) shown in Table 9, both in girls and boys, the number of outstanding stands out with 69% and 55%, respectively.

Table 9

Ratings by gender

Qualification	Girls		Boys		Total	
Outstanding (9-10)	n=29	69%	n=23	55%	51	61%
Remarkable (7-8)	n=10	24%	n=13	31%	24	29%
Enough (5-6)	n=3	7%	n=6	14%	9	11%
Insufficient (<5)	n=0	0%	n=0	0%	0	0%
Totals	n=42	100%	n=42	100%	n=84	100%

With regard to the average grades of "2º de ESO" by tool used to evaluate, Table 10 shows how these are 8.77 in the register of gold rings, 8.50 in sapphire rings, 9.17 in the emerald rings and 5.78 in the diary.

Table 10

Average qualifications of "2º de ESO" by evaluation tool out of 10 points

Tool	Gold rings	Sapphire rings	Emerald rings	Diary
Average	8.77 (± 1.50)	8.50 (± 1.39)	9.17 (± 1.22)	5.78 (± 4.97)

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The above tools and their average data are reflected in Table 11 according to gender, and although the clearest difference is seen in the diary where the girls obtain an average score of 6.19 and the boys 5.24, they are not found significant differences in these data.

Table 11

Average qualifications of "2º of ESO" by evaluation tool and gender

Gold		Sapphire		Emerald		Diary		Total	
Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
8.88	8.66	9.04	9.31	8.53	8.47	6.19	5.24	8.55	8.46
(±1.59)	(±1.39)	(±1.34)	(±1.04)	(±1.09)	(±1.63)	(±4.86)	(±4.99)	(±1.13)	(±1.24)

Note: No significant differences ($p < 0.05$)

And finally, the most significant results of the anonymous questionnaire to assess the degree of student satisfaction were presented in Table 12. This table shows the most frequent answers given in the questionnaires, as well as the average score that the students gave to experience, this being 8.95.

Table 12

Results of the anonymous ad hoc questionnaire

Question	Most frequent answers	Citacions
What did you like the most?	Roller hockey / tournament	22
	Get the emeralds / competitive activities	13
	Learn to skate	11
What did you like least?	Nothing / I liked everything	13
	Heat / temperatura	12
	Difficulty of the challenge of moving with a skate	8
What would you improve?	Nothing	24
	Another time of year / early hours / change schedule	15

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	More games	8
Phrase or word that summarizes the unit	Fun / I liked it a lot	24
	Positive description (very cool, spectacular, the bomb, super pretty, the best activity, very pretty, the unit that I liked the most)	15
	Entertaining	8
Value the experience	Average value from 0 to 10: 8.95	

Discussion

Despite the fact that the secondary education stage is the one with the most published gamification experiences with 52.2% (Escarvajal and Martín-Acosta, 2019; Arufe-Giraldez et al., 2022a), we have not found any gamified experience with the world of Sonic, nor gamified experiences of rollerblading content.

The idea of carrying out the gamification of an inline skate unit through the world of Sonic has had good results with the population of young people included in this study. This has been reflected in the level of skating achieved by the students, in the academic results and in the assessment that they made of the experience. Different studies on gamification in Physical Education have resulted in increased motivation and/or involvement of students in Physical Education classes (Monguillot et al., 2015; Navarro et al., 2017; Quintero, Jiménez and Area, 2018; Arufe, 2019; Pérez et al., 2019; Rodríguez Parra et al., 2019; Magaña, Manrique, Manso, Ramos and Fraile, 2020; Seguras-Robles, Fuentes-Cabrera, Parra-González and López-Belmonte, 2020; Flores-Aguilar et al., 2021; Real, Sánchez and Padilla, 2021; Acebes-Sánchez, Ros, 2022; Ortega and Chacón-Borrego, 2022) and the results of this study can be attributed to these variables.

Considering the previous and subsequent mastery of the skates, shown in Tables 6 and 7, great benefits could be seen since all the students improve their level or maintain their high level. Specifically, 55 students improve their skating level after applying the unit (12 go from low to medium, 32 from low to high and 11 from medium to high), being at the end of the

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unit 72 students out of 84 who presented a high level of skating compared to the 29 that were initially; without forgetting that at the end of the unit no student, of the participants in the study, presented a low level compared to the 44 that were initially.

Regarding the academic results indicated in Tables 8 and 9, the average grade is 8.47, with a total of 51 students (61%) who get an outstanding in the unit and nine students (11%) who obtain a grade of sufficient, there being no students with less than five points in the unit. These data may be related to the methodology implemented in the unit; studies such as those carried out by Monguillot et al. (2015), Rodríguez Parra et al. (2019) and Arufe-Giráldez, Sanmiguel-Rodríguez, Ramos-Álvarez and Navarro-Platón (2022b) showed improvements in academic performance in their results. However, after a systematic review carried out by Arufe-Giráldez et al. (2022a) on the effects of gamification in Physical Education (of 17 empirical investigations), only one study confirmed improvements in academic performance, although most studies confirmed improvements in motivation and commitment to exercise.

In relation to the above, if we observe Tables 10 and 11 in which the average qualifications by evaluation tool are specified, it can be seen how a high score was obtained in the achievement of the gold, sapphire and emerald rings; which implied an improvement in the level of execution with the skates, the adoption of preventive and safety measures with the skates, respect for others and care for the material, as well as good performance in team work, that is, which far exceeded the didactic objectives 1, 2, 3 and 4 and evaluation criteria 1, 9 and 7.

On the other hand, the class diary is the one that greatly lowers the average grades, since many did not turn in the diary or the presentation was not adequate; this last instrument related to recreation and enjoyment during practice and therefore with objective 5 and criterion 8. However, paying attention to the results of Table 12, it could be said that the students had fun and that therefore, this objective was also exceeded.

Regarding the evaluation of the experience (extracted from the results of Table 12), it received an average score of 8.95, which shows that it has been a gamification that has fit perfectly with the unit and the students. One of the most liked aspects of the unit was the

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achievement of gems through competitive activities between groups. "Competitive" activities but for the development of gamification it was a cooperative activity among all taking into account that the objective was to recover the emeralds that Doctor Robotnik had. Among the aspects that they liked the least, indicate that the most cited response was "nothing" or "I liked everything", reflecting the satisfaction of the young people in the unit; followed by "heat" or "temperature". And it is that of the eight hours of the four courses, three were from 12:30 to 13:30 and four from 13:30 to 14:30. The reason for this timing was that the skates were obtained in February thanks to a project presented that provided a grant for their purchase.

Continuing with what they liked least, it is curious how, without having dealt with it especially in class, the students indicated that the sliding challenge with a skate was one of the aspects that they liked the least; probably because many did not get all the gold rings due to this challenge, which consisted of sliding 10 meters with the help of the previous race and the impulse of a foot wearing a sports shoe.

Thus, on future occasions we could work more on this part with a more gradual progression or even adapt the challenge.

With regard to the improvements proposed by the students, the most logical was to change this content to another time of the year or to do it at other times of less heat, since there was no covered space available for skating. And finally, in relation to Table 12, it was nice to see how the word "fun" or "I liked it a lot" was the most cited as a summary of the unit, also keeping other descriptions such as "this unit has been the bomb" or "It was the best activity I've ever done in my life."

For Pérez et al. (2019) gamification is a tool that can be used to provoke positive feelings and emotions towards learning, hence the comments made by students at the end of the unit.

At a methodological level, although the central axis was gamification, a Service-learning was also carried out, although as we have already said, the students studied here were only the recipients of the service. Studies such as those carried out by Navarro et al. (2017) that hybridizes gamification with PBL, CBL, Cooperative Learning and Service-learning,

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Flores and Prat (2018) that does it with Cooperative Learning, Quintero et al. (2018) with the transmedia narrative (as an educational trend) and Cooperative Learning, Seguras-Robles et al. (2020) with the flipped classroom or Sánchez-Silva and Lamonedá (2021) that hybridizes it with the Integral Model of Active Transition towards Autonomy and the HBPE, are examples that have good results when hybridizing gamification with other pedagogical models or active methodologies.

Other gamified proposals carried out resulted in the promotion of cooperative work (Monguillot et al., 2015; Quintero et al., 2018; Pérez et al., 2019; Rodríguez Parra et al., 2019), greater autonomy (Rodríguez Parra et al., 2019; Seguras-Robles et al., 2020), the promotion of education in values (Arufe, 2019; Acebes-Sánchez and Ros, 2022), the prevention of violent behavior (Arufe, 2019) and even the decreased absenteeism (Navarro et al., 2017) or decreased anxiety (Rodríguez Martín, Flores Aguilar and Fernández Río, 2022).

Although in this study it has not been specifically evaluated, we think that gamification in this inline skating unit could favor cooperative work and autonomy, in addition to promoting education in values in students; something that would have been more complex to achieve with this apparently individual activity and with great technical requirements through direct instruction and traditional methodologies.

Arufe-Giraldez et al. (2022a) reveal the existence of a low number of controlled and randomized trials regarding the use of gamification in Physical Education, therefore, they suggest continuing to investigate the possible positive effects that the implementation of gamified pedagogical proposals in Physical Education can have, whether using gamification in isolation or hybridizing it with other active methodologies. Pérez-Pueyo and Hortigüela-Alcalá (2020, 581) corroborate the foregoing, indicating that most of the literature focuses on proposals and experiences, but not research, so that its short history prevents us from knowing what will happen afterwards.

Conclusions

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Based on the results of this innovative experience, it can be concluded that this gamified unit is an ideal and motivating proposal to work on the content of inline skates with adolescent students. This has turned out to be a good solution to improve the level of skating while students have fun pretending to be in a video game in real life.

As a limitation to the study, indicate that the evaluation of the high school students who took the Service-learning was strictly academic, leaving aside variables such as their motivation or their assessment of the experience, which would be useful to take it into account in future interventions.

To conclude, although not all centers have skates, this gamification can be adapted to a unit of scooters, skateboards, bicycles and so on.

We consider that they are essential means for the physical-motor development of our young people, a good option for active leisure at any age and that childhood and adolescence are ideal ages for their learning. It is hoped that this unit will serve as an idea for other teachers and inspire and encourage them to innovate and gamify in Physical Education.

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