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Opportunities of media literacy: Motivation for Science in School Students through the Science Reporters Video Games

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Abstract

Scientific literacy among citizens has become a social need, crucial for countering the rampant spread of misinformation. While the educational potential of video games has been explored, their role in motivating interest in science has yet to be thoroughly investigated. These exploratory aims to address this gap by examining how the Science Reporters video game can serve as a catalyst for igniting scientific motivation among young individuals, thereby promoting meaningful learning experiences. The video game in question is designed around five immersive escape rooms, drawing inspiration from the Sustainable Development Goals and weaving them into the history of science. This exploratory research used a mixed methods approach in which, alongside the experiential development and testing of the video games, 11 questionnaires, in-depth interviews and focus groups with teachers and students. The study concludes, among other aspects, that students who engaged with these science-based video games exhibited improvements in their scientific knowledge. Furthermore, the games effectively bolstered their motivation to pursue scientific interests, with a particularly noteworthy impact observed among female participants. In essence, the Science Reporters video game emerges as a tool for enhancing scientific literacy and nurturing a future generation of enthusiastic scientists. By integrating entertainment and education, it successfully fosters a passion for science, which is essential in our information-driven world.

Keywords: *video games, motivation, science, learning, students..*

Introduction

Science offers solutions to the social, political, health, economic and sustainability challenges of today's society (Owen et al., 2012; Parkinson et al., 2022). A science-literate and science-minded society promotes longer and more enjoyable human lives (UNESCO, 2023).

However, scientific thinking is not learned on a day-to-day basis, but is acquired through social, cultural, and educational interactions that are acquired throughout life (Jirout, 2020; Luce & Callanan, 2020), especially, in the age of Artificial Intelligence (Tejedor, 2023).

In that sense, video games are one of the cultural tools that can enhance player education (Barko & Sadler, 2013; Morozova, 2019), both in formal and informal ways (Dudo et al.,

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2014) across cultures (Samy-Tayie, Tejedor & Pulido, 2023). Several studies show how players can acquire or maintain certain skills (Gupta et al., 2021), increase their cultural (Parkinson et al., 2022), mathematical (Sun et al., 2021), and natural science knowledge (Zhang et al., 2021), among others. Video games that aim to generate cognitive and behavioural change are called Serious Games (McGonigal, 2011).

This study is based on the theoretical systematization and selection of case studies from the project "OMEDIALITERACY. Overview of the challenges and opportunities of media literacy policies in Europe" (reference number 2601203), which addresses one of the main challenges of today's society: disinformation. It is an initiative, funded by the European Media and Information Fund, which has identified existing knowledge on the effects of misinformation in Europe, compared current policies on media literacy and misinformation in member countries and identified good practices to overcome misinformation. The study has conducted a review of scientific literature as well as documentation on disinformation policies in Europe, comparing disinformation policies and identifying good practices. The selection and analysis of case studies has been another area of activity of this project. On this basis, this paper analyzes the Science Reporters project. In the following sections, we will explore in more detail the existing results on the motivation and scientific literacy of schoolchildren through this cultural element. In particular, this research has taken into consideration the reflections of the report entitled "Combatting the Disinformation Crisis: A Systematic Literature Review" (OMedialiteracy, 2023).

The motivation of school students towards science

Over the years, several research studies have investigated students' motivation towards science. Most of these studies have shown that students' positive motivation towards science enhances their academic performance in school (Datu & Yang, 2021; Guler & Unal, 2021) and increases the likelihood of future success (Duckworth et al., 2011).

One of the current objectives of the European educational community is to boost students' motivation for science (European Commission, 2015), as it facilitates academic continuity and improves the quality of life of the population. Anderman and Dawson (2011) showed how dynamic student motivation can be based on achievement goals, social cognitive issues, self-determination, and expectancy-value.

Research indicates that some motivations may arise intrinsically, while others arise from interactions with people in the immediate environment, such as families, schools, and society in general (Tõugu, 2021).

Van Vo and Csapo (2022), who studied students' science motivation across grade levels and the role of inductive reasoning, showed that there was a positive correlation between inductive reasoning and motivation. Furthermore, these scientists found that factors such as age and social interaction about science with family members and educational professionals were good predictors of student motivation in science (Van Vo & Csapo, 2022).

With regards to age, several studies point out that as students get older, they become less motivated by science (Hoffman, 2015). However, Gottfried and colleagues (2001) showed that this lack of motivation depends on subject areas, with mathematics being the most disadvantaged one; nonetheless, a study on participation in academic competitions in mathematics proves that motivation for mathematics can be increased (Rebholz et al., 2022).

Continuing with the above, interrelationships with family and school people around science influence motivation and academic achievement (Tõugu, 2021). Thus, quality interactions in relation to science positively influence motivation and academic achievement (Allen et al., 2021).

Regarding studies on gender differences in motivation, there is no consensus. Some studies point out that there is no difference in the degree of motivation towards science between men and women (Van Vo & Csapo, 2022), other studies show that women are more motivated than their male peers (Schonfelder & Bogner, 2020), and others point out that the stereotypical gender roles of teachers cause girls to have less interest in science. However, the reality is that there are fewer women than men in science careers (Baskaran, 2016).

In order to improve scientific innovation and contribute to more inclusive education and learning, research encourages the need to further enhance students' scientific motivation. To this end, they recommend creative strategies to retain students in science (Allen et al., 2021), the implementation of programmes that increase interpersonal skills and science motivation (Higde & Aktamis, 2022; Mulvey et al., 2022), teachers to be motivated by science actions (Oppermann et al., 2019; Schonfelder and Bogner, 2020), the promotion of inquiry-based education (Covert et al., 2019), and the use of motivating technological elements (Liu, 2021).

In this scenario, newsgames, conceived as educational proposals that amalgamate information and entertainment based on a hypermedia idiosyncrasy (Deterding et al. 2011), have inaugurated a prolific field of study with broad prospects for development (Carrizo & Díaz, 2015). The work of Bogost, Ferrari and Scheweizer (2010), Quesada and Tejedor (2016), Rost, Bernardi and Bergero (2016), Romero-Rodríguez and Torres-Toukoumidis (2018), García Ortega and García Avilés (2018) and Tejedor (2022) has highlighted the importance of analysing the educational potential of these playful contents that connect with the issues and challenges of the media's thematic agenda (Beaudry, 2015). In addition, as Kapp (2013) points out, these technological developments adapt to and exploit many particularities of the current communication scenario, such as problem-solving (Vázquez-Herrero & López-García, 2019).

Video games as a cultural element of scientific literacy and scientific vocations

Video games with science content are shown to be another option for learning science or reinforcing previous science knowledge. Morris and colleagues (2013), in their research "Gaming science", showed that video games have a great potential to be exploited as a benefit for science education. Echoing these benefits are educational actions and programmes that mix video games and science. An example of this is the US initiative Game Design Through Mentoring and Collaboration, which promotes science, technology, engineering, and mathematics content through video games among students at risk of social exclusion. Khalili and colleagues (2011) reported that 16 non-university students and three university students produced two-dimensional video games with themes based on scientific concepts in immunology in just four weeks.

To more extent, Morris and colleagues (2013) point out that these audio-visual products are a cultural tool capable of three key elements to foster scientific literacy: The first element refers to science-based content knowledge, such as information about physical or earth science (Garneli & Chorianopoulos, 2019). The second element refers to process skills, in which the player during the process reflects metacognitively (Lee & Ke, 2019). The last element is related to understanding the nature of science, which is linked to several ideas, including understanding science and self-identifying as someone who knows and uses science. Operation ARA- Acquiring Research Acumen, is an example of a video game designed to enhance scientific reasoning and critical thinking skills. In this game, young people learn scientific reasoning skills by establishing interactive interrelationships with avatars (Halpern et al., 2012). Furthermore, Masters, Oh and Holmes (2016), who studied the development of science content knowledge of participants in online citizen science projects in Zooniverse, found evidence that science-motivated participants increased their knowledge of both the content and processes of science.

Video game mechanics can also support scientific thinking. Morris and his team (2013) noted three types of scaffolding: motivational, cognitive, and metacognitive. First, motivational scaffolds are understood as feedback, rewards, and flow states, which engage learners compared to traditional cultural learning tools. Secondly, cognitive scaffolding refers to simulations and built-in reasoning skills that compensate for the limitations of the individual cognitive system. Third and last, the authors point out that fully developed scientific thinking requires metacognition and video games provide metacognitive scaffolding in the form of constrained learning and identity adoption.

Fraser, Shane-Simpson, and Asbell-Clarke (2014) surveyed 1502 female students to find out what kind of relationships are between identity, science learning and play. The results of the analysis revealed that the relationship between the enjoyment of problem-solving games and identification as a player promotes a greater understanding of science in adolescents. The researchers suggest that to enhance science literacy through video games, these products should focus on social interaction and involve activities and experiences that could be used in the real world rather than problem-solving games. Therefore, science-based video games would benefit perceived self-reliance and favour the acquisition of scientific reasoning in the world, particularly for students predisposed to scientific thinking. Another recommendation to enhance scientific literacy is to integrate games and game elements into science education (Morris et al., 2013).

Despite all the research carried out on the potential of video games to promote scientific knowledge, the research team notes the need to find out whether video games promote interest in science. Therefore, this exploratory research asks whether the Science Reporters video game promotes scientific literacy and motivation for science among young people.

Materials and Methods

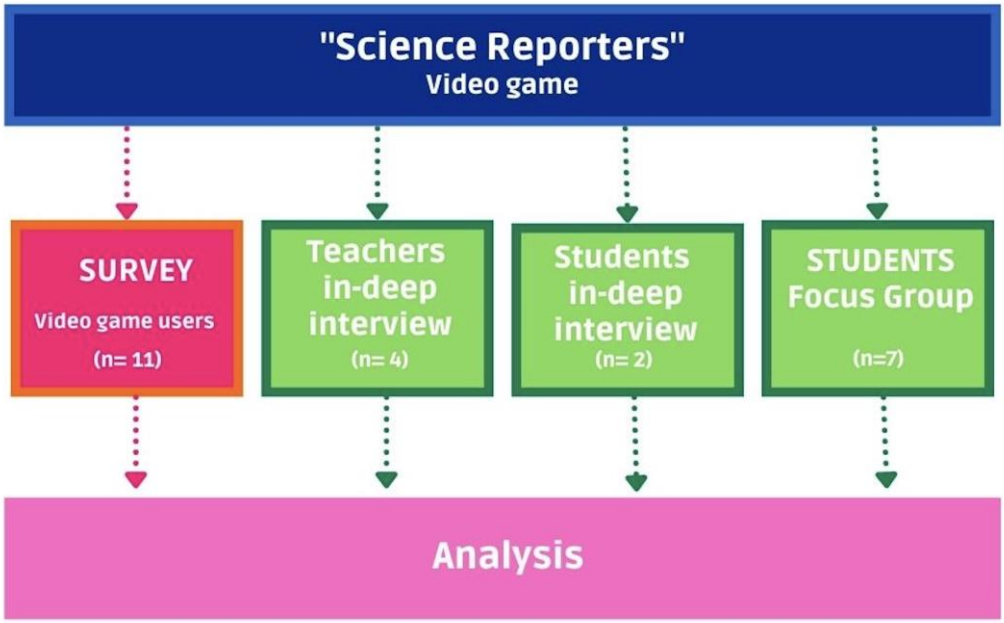
In this research, mixed methods (Denzin, 2010) have been applied, as they include quantitative and qualitative research tools with which a triangulation will be carried out to provide reliability to the exploratory study. The Science Reporters video game was conceived and developed by the research team itself, with the aim of allowing through the game and the transmission of scientific knowledge to motivate players for science and, therefore, to stimulate scientific vocations in young people. The video game is composed of five scape rooms related to natural sciences, female scientific characters, misinformation, scientific activity, and the scientific method. Furthermore, the project aims to encourage critical thinking and scientific vocation in secondary school students through video game based on escape rooms. The initiative seeks training, knowledge, and awareness of science with pedagogical strategies adapted to the profile of young students and their habits of use of the media and, especially, social networks. In this way, students play by solving challenges inspired by the history of science from a gender perspective. The proposal applies the scientific method, giving the user the role of a reporter who investigates, documents, and prepares information. The initiative stands out for its environmental commitment and uses the SDGs, among others, as a common thread (see Figure 1).

Figure 1. Image of the cover of the Science Reporters video game.

XXXX ANONYMOUS FIGURE 1 XXXX

To find out whether young people have been motivated to science; users, teachers, and young people were asked through a questionnaire, in-depth interviews and focus groups. All participants had previously played the video game. Figure 1 shows the data collection process for this research:

Figure 2. Flowchart of the Data Collection and Analysis Process.



Survey Data Collection

Once the videogame was made public, we conducted an online questionnaire with the aim of getting feedback from users on the strengths, weaknesses, and possible ways of improvement for future development of the videogame. For this purpose, a team of two researchers created the questionnaire which was subsequently validated by the research team. The questionnaire is composed of 10 questions where the registered users reported on the usage, their perception of the content, and the benefits obtained by the audio-visual product.

This questionnaire was sent to the 44 users who voluntarily filled it in. Thus, in just one month, July 2022, 11 responses were received.

In-deep Interview Data Collection

At the same time, in-depth interviews were conducted with video game users, both teachers and young people who are studying. The interviews contained three sections made up of 18 questions where they were asked about their perception of the video game, their motivations, the learning acquired and their contributions to improving the product in the future.

The teacher and the adolescents were selected for their involvement with the video game under study. Four in-depth interviews were conducted with teachers aged between 32 and 72 and two adolescents aged between 10 and 15. Table 1 shows the profiles of the interviewees through the in-depth interview.

Table 1. Profiles of the interviewed through the in-deep Interviews.

Pseudonym	Role	Years old	Country
Juan	Teacher and expert on communication	72	Spain
Sofía	Teacher and expert on the impact of technology on children.	50	Spain
Maria	Secondary school teacher and pedagogical preceptor	33	Spain
Carmen	Teacher and expert on the impact of	32	Spain

	technology on society.		
Sonia	Primary student	10	Spain
Elisabeth	Secondary student	15	Peru

Focus Group Data Collection

With regards to the focus groups, two of them were carried out with users of the video game, the first consisting of four 11-year-old teenagers and the second group of three university students aged between 21 and 41. Both groups had the same purpose as the interviews. However, in this case, the interactions between natural groups offered another view of the sensations and learning that the audio-visual product studied provided. Table 2 shows the profiles of the participants in the focus groups.

Table 2. Profiles of the interviewed through the focus groups

Code	Pseudonym	Role	Years old	Country
FG1	Unai	Primary Student	11	Spain
FG1	Mario	Primary Student	11	Spain
FG1	Jon	Primary Student	11	Spain
FG1	Alex	Primary Student	11	Spain
FG2	Laura	University Student	21	Spain
FG2	Paula	University Student	28	Peru
FG2	Ana	University Student	41	Spain

Ethics

The online questionnaires were anonymous and did not contain any personal data. However, a consent form was added at the beginning of the questionnaire for the user to consent participating in the research. In relation to the interviews and focus groups, adults were informed and signed the informed consent form. As for the minors and the parents of the minors, they were previously informed and signed or approved orally the ethical consent. In this way, this research adheres to international ethical standards related to data collection such as the Helsinki standard (World Medical Association, 2013), the data from the in-depth interviews and focus groups were duly coded and pseudonymised.

Analysis

The information obtained through the research tools was treated in two ways. The quantitative data obtained was extracted from the Google Drive form where it was published. While the qualitative data from the in-depth interviews and focus groups were conducted online, and then their contributions were transcribed and analysed in the MAXQDA research software. In this case, the categories have emerged from the theoretical contributions made to the object of study. The analysis of the contributions of the interviewees focused on the following category of motivation for science.

Results

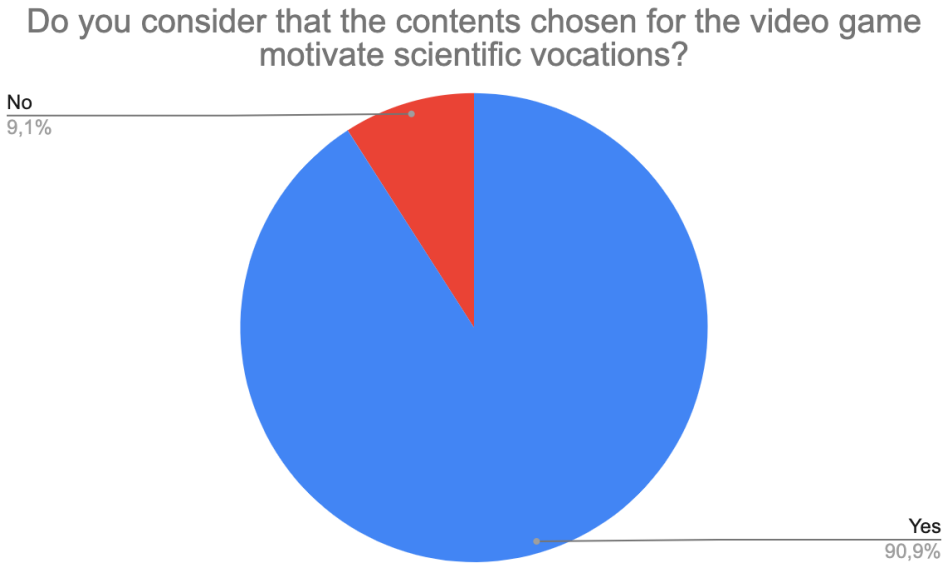
The Science Reporters video game promotes motivation towards science through its playability and scientific content, especially in young people. The results obtained by each of the research tools are shown below:

Survey Results

Of the 11 people who participated in the questionnaire, six were interested in science while three responded that they were somewhat interested. Of them, nine people indicated

that they liked the challenges and puzzles presented in the video game, and only one answered "Maybe". Also, 10 people (90.9%) thought that the content was suitable for working on science motivation, while one person answered "No" (9.1%) (See Figure 3).

Figure 3. People claimed that the content of the video game boosted motivation for science.



People surveyed answered that the strong points of the video game are that it improves learning (nine people, or 81.8%), that women scientists are made visible, that it brings science closer to society, and that the video game introduces educational elements (eight people, or 72.7% for each of the items). These points indicate that they have been important to subsequently motivate them to learn more about scientific topics and improve their knowledge.

In-deep Interviews Results

Teachers and students emphasise that dealing with science through a video game motivates them to learn about scientific topics. The results of the in-deep interviews with both groups are detailed below:

All teachers interviewed emphasise that transferring science to a video game motivates users, especially children. Maria, a secondary school teacher, points out how video game awakens the curiosity of young people. The 33-year-old teacher puts it this way:

The video game is one of the most motivating and incentive tools, and the portal can awaken their curiosity for the subjects they don't know and encourage them to carry out individual searches (Maria, teacher).

Juan, a teacher, and specialist in communication, also highlights the benefits that video games can offer, such as improving communication skills with children and motivating them to learn about science. Juan puts it in the following way: “The video game establishes bridges of dialogue, improving motivation”. (Juan, teacher). According to the teacher, teachers should encourage motivation to learn and promote critical thinking.

As teachers, we have to motivate against laziness to study, against reluctance to learn and we have to cultivate a critical outlook. Motivating the ability to study is one of the great challenges of education today (Juan, teacher).

Maria also stresses that these tools can enhance interest and care for science.

The video game is one of the tools that motivates and encourages them the most and that the portal can awaken their curiosity for the subjects they don't know and encourages them to carry out individual searches (Maria, teacher).

The four teachers highlight the elements that have caused them the most interest and that they believe are the most motivating for the students: the visualisation of women scientists and the escape room on misinformation issues. Even though she is a teacher, Maria confirms that she has learned a lot, especially about women scientists.

I found the escape room about women scientists very interesting because there were things I didn't know and learned. For example, about this actress who invented the WIFI. I had to look it up because I didn't know it (Maria, teacher).

However, they emphasise that it is important for the teacher to be a learning partner with children to further encourage critical thinking about the content that appears in the video game. Carmen, a teacher, and specialist expresses it in the following way: “The teacher is in charge of raising the key questions so that the seed of critical thinking grows” (Carmen, teacher).

Both students interviewed in depth said that the video game motivated them to learn more about scientific topics, especially those related to flora and fauna. They liked the fact that they were given these contents in an interactive way with puzzles and challenges. Elisabeth, a secondary school student, underlines that she is very interested in riddles and challenges and considers video games to be fast and practical.

It was through an escape room, which I love. The fact that there was a time limit, clues and images helped me a lot to understand the situation and to think critically in order to play the game. (Elisabeth, secondary school student).

Moreover, the people interviewed said that they liked and were motivated by the video game because it was fun, entertaining and had educational content. "The video game is very fun, entertaining and I have been able to learn a lot" (Sonia, primary school student). Likewise, one of the two people specifies that educational resources, such as the news or the videos, have helped her assimilate theoretical content related to the environment that she has been seeing in class. He also recognises his interest in science has increased after playing the game. “It has encouraged me to learn and to choose science” (Elisabeth, secondary school student).

Both interviewees emphasise that the role of women in science is made visible in video games. Elisabeth explains that they recently dealt with this topic in the classroom and that playing the game has reinforced the idea that women can also be scientists: “Unfortunately, society has the idea that only men are valid to exercise a scientific profession. We can be future women scientists who contribute to society and win prizes” (Elisabeth, secondary student).

Focus Group Results

The two conducted focus groups highlight that video game is attractive and through which they learn a lot about science. The members of focus group 1 point out that becoming researchers and obtaining quality educational resources such as the news and different videos have helped them to learn more. In addition, they all consider these resources as additional materials for class work. Jon, a secondary school student, shows this need to work on it in class. “If the video game was used with science teachers, students would be more motivated in class, and we would learn the theoretical content more quickly”. (Jon, primary school student).

In this aspect, they emphasise that they would like to play this video game in class, as they point out that it would motivate them more in class and learn the theoretical content

more quickly. Ana, one of the university students, points out that implementing gamification resources like this in the classroom can help children learn more about difficult concepts. Ana, a university student, stresses that gamification can help to improve current learning.

The playful style of the video game gives a lot of value to today's learning. Children have a mentality focused on everything that is gamified. I see it in my very young nephews, and I like the dynamics of video games' (Ana, university student).

Despite the positive things that they stand out about video games, the members of the focus groups remark that their motivation would increase if they could play with other people and interact with other digital content such as social media or virtual reality. "Young people are also attracted to audio resources such as virtual reality" (Paula, university student).

Discussion and Conclusion

The Science Reporters video game increases the scientific motivation of most players investigated. This is a result of the educational intentions reflected in the design and content of the game itself. As Morris and colleagues (Morris et al., 2013) point out, video games with science content can help increase science motivation.

However, this research shows that not all players show interest. This may be because not all people have the predisposition to learn about scientific issues. Anderman and Dawson (2011) pointed out in their study that there are students who are not motivated by science. In order to encourage this group, the researchers believe that the video game analysed should incorporate other services, such as interactions between players. Thereby, scientific interrelationships would also be within the videogame. Secondly, the participation of family members in the video game should be promoted, as Van Vo and Csapo (2022) notice, it is a key element in the development of curiosity. However, it should be noted that video game strengthens the relationship between teachers and students, which is very positive for scientific motivation (Tõugu, 2021).

One of the most valued elements of the video game analysed is the incorporation of women scientists. The visualisation of these professionals has led to increased learning, according to the people interviewed. This is very positive because the fact of learning helps to increase motivation, and the fact that this learning is related to women makes it possible to visualise them and for girls to have scientific references (Baskaran, 2016).

In short, the video game analysed shows positive preliminary results for the scientific motivation of the player, given that the chosen technology is an already motivating element for young people (Fraser et al., 2014) and because it is approached from a pedagogical point of view. However, we believe that the research should continue to deepen the study, given that this research has been limited by the number of people studied, this is due to the youth of the video game. We also think that it would be interesting to study the type of learning scaffolding (Morris et al., 2013) that it generates in players.

Regarding the theoretical contributions of the project "OMEDIALITERACY. Overview of the challenges and opportunities of media literacy policies in Europe" (reference number 2601203), this study has been able to confirm the importance of giving an important role to different organizations and institutions. This aspect, as the selected case shows, is of great importance to improve information assessment skills. From the playful logic of the game, it is possible to work, as the Omedialiteracy project points out, the psychological and behavioral effects of disinformation and develop interventions that address these aspects effectively. In addition, we are committed to other types of formats that connect with diverse audiences in their usage habits and in their dynamics of access

to technology (OMedialiteracy, 2023). Therefore, as a conclusion, this case study highlights the importance of combating misinformation through disruptive formats, but also the importance of promoting the transfer of academic results through more dynamic, eloquent and interactive deliverables.

In conclusion, the paper emphasises the importance of giving video games and gamification processes, in general, a more prominent role within the scientific work carried out in academia. However, this objective will only be possible through interdisciplinary collaboration between researchers and professionals from various fields ranging from computer science to graphic design, media literacy, communication, and education in the broadest sense. In this sense, moreover, the proposed research should be capable of incorporating in the future all the aspects derived from the application of Artificial Intelligence to the ideation, creation, and management of content from automated proposals. On the other hand, and finally, this growing leading role of AI and the new technological developments will demand, as this study points out, progressively more intense work in the promotion of media literacy, on the one hand, and in the acquisition of new competences and skills among the citizenry, on the other hand. Furthermore, at the level of academia and industry, it establishes the need to incorporate this type of aspects in training curricula in order to train future communication professionals with skills and competencies that will enable them to devise and produce gamified proposals in different scenarios and for various themes and user audiences.

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