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Development of Students' Skills through Gamification and Serious Games: An Exploratory Study

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Abstract: Currently, technological development is making its way into education through the increasing integration of new technologies into teaching. In this context, gamification emerges as one of the ways to incorporate the pedagogical process into the digital world, creating the need to encourage both the digital skills of educators and students. The objective of this work is to shed light on the growing use of technology-based teaching methods and encourage their integration into educational practice from the teacher's point of view. This work specifically analyses the European Framework for Digital Competence of Educators, relates the different digital competences defined to a series of localized educational solutions, and proposes a direct relationship between different gamification tools and serious games. Based on the review carried out, this study highlights a profound change in the educational process that involves digitization and the use of new technologies to optimize learning, as well as the training needs of teaching staff and the development of educational solutions that take into account the different digital competences.

Keywords: European Framework DigCompEdu; gamification; serious games; education; learning



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1. Introduction

Before the COVID-19 pandemic, the impact of digital transformation on education and training was much more limited. The pandemic has revealed a series of challenges for education and training systems related to digital skills. These include the digital skills of institutions linked to education and training, the training of teachers, and the general levels of digital skills and competences among citizens. According to a 2018 study by the Organization for Economic Cooperation and Development (OECD), less than 40% of educators across the European Union (EU) consider themselves prepared to use digital technologies in teaching, with significant variations between the different countries within the EU [1]. For their part, more than a third of young people between the ages of 13 and 14 who participated in the 2018 International Computer and Information Literacy Study (ICILS) did not possess the most basic level of digital skills.

In this sense, the pandemic has accelerated the trend towards online and hybrid learning, leading to the discovery of innovative ways for educators and students to organize their teaching and learning activities and interact in a more personalized and flexible way online. These changes require a strong and coordinated effort at the EU level to support education and training systems in meeting these challenges, while presenting a long-term vision for the future of digital education in Europe.

The renewed EU Digital Education Action Plan, in relation to the one presented by the European Commission in 2018 [2], has among its objectives the execution of the Commis-

sion's priority of "a Europe adapted to the digital age" with the support of NextGeneration EU funds. It also supports the Recovery and Resilience Facility, which aims to create a greener, more digital, and more resilient European Union. In this sense, the Digital Education Action Plan is a key factor in achieving the goal of creating a European Education Area by 2025 [3].

This work aims to shed light on and promote the integration of technology into education from the teacher's point of view. After analyzing the European Framework for Digital Competence of Educators (DigCompEdu), it intends to link the defined digital competences in the framework with specific educational solutions and propose the use of available resources in terms of gamification tools and serious games.

2. Related Works

2.1. Background

According to the European Council's (EC) definition from May 2018, digital competence implies the safe, critical, and responsible use of digital technologies for learning, work, and participation in society, as well as the interaction with these technologies. To identify and promote these competencies, the EC has created various frameworks, depending on the intended audience and objectives.

At first, the DigComp was defined as the European Framework of Digital Competences for Citizens, aimed at European citizens in general. It details the essential skills necessary to have appropriate competencies in digital environments [4]. The framework includes 21 competencies, which are divided into five different areas and described in terms of knowledge, skills, and aptitudes. The DigCompEdu framework, as a continuation of the previous one, was defined to respond to the growing need among educators to identify specific digital skills for their profession and to take advantage of technological advances to incorporate new methodologies into the educational process [5]. On the other hand, the OpenEdu framework aims to assist European higher education institutions in decision making regarding open, free, and easy-access education [6]. Lastly, the DigCompOrg framework focuses on educational organizations, such as schools and higher education institutions, among others. Its purpose is to aid in reflecting on the integration progress and effectiveness of digital learning technologies, which should be a part of education as an indication of quality [7].

Currently, there are numerous projects and experiences in which the aforementioned reference frameworks have been utilized. There are studies in which a training program has been designed with the aim of developing digital skills for future teachers. In a study carried out in 2020 [8], after the digital training of 24 teachers-in-training, the work revealed a need for effective implementation of digital competence training programs in which future teachers collaborate on digital issues regardless of their previous experience. Additionally, trainers must structure their courses in a way that future teachers can see them as role models. The EduTrans21 project is in line with this study, offering a transversal approach for developing current skills in teachers through a methodology that primarily relies on digitization. They introduce free and open-source technologies and have developed an online evaluation model [9].

Another example regarding this type of experience is the Pilot Project developed by Microsoft Education, which offered teachers a set of educational tools (Microsoft 365 tools and Minecraft Education Edition) based on the areas of the DigCompEdu framework. After the completion of the project, among other results, 96% of the teachers indicated that they had acquired new skills for the development of their profession and 98% claimed to be able to include gamified methodologies [10]. Similarly, the DigitALAD project offers opportunities for teachers to improve their teaching through the development of digital tools, information, training organizations, and evaluation spaces for their own skills [4]. There are diverse projects in this regard, such as a study carried out in 2019 in Spain, in which researchers applied a teaching improvement cycle in one of the subjects of the Master's degree in Teacher Training, which is mandatory to practice as a teacher in Spain.

This study instructed students on digital skills of the DigCompEdu framework to enable them to apply these skills in their future professional practice. The results show substantial improvements in their digital skills compared to their initial abilities [11].

In this context, gamification is a new methodology that uses rewards, points, levels, and other game elements to enrich the teaching/learning process and motivate students. In this context, the concept of serious gaming is defined as a (digital) “game” used for purposes other than mere entertainment. This type of game allows students to experience situations that are impossible in the real world due to reasons such as security, cost, time, etc., but have a positive impact on the development of players’ different skills [12]. Serious games can be of any genre, use various game technologies, and be developed for cross-platform use (e.g., using different operating systems) [13].

So far, attempts to classify serious game topologies have emerged, although there is no unanimity due to their constant change and the different perspectives with which they are analysed [14]. One attempt at classification is the one carried out by Sawyer and Smith [15]. Their taxonomy, based on the class of game and the function assigned by institutions with educational intentions, is presented as follows: games for health; advertising games; games for training, education, science and research, and production; and games for employment [14]. Michael and Chen offer another classification based on the area at which the game is directed, in which we find military, governmental, educational, corporate, health, political, religious, and artistic games [16]. A third example would be the one proposed by Álvarez and Rampoux [14], where games can be classified into five categories: advergaming, edutainment, edumarket, denunciation games (or diverted games), and simulation games. However, many authors believe that these categories could be simplified into two: advergaming and edutainment, considering the rest as subgenres or derivations [14].

It is important to highlight that there are authors who defend the idea that the concept of gamification should not be confused with the concept of serious games, since, according to their work, there are differences between the two, however diffuse they may seem. The main inequality arises in the use; a serious game is the actual use of the game (which already exists), and gamification, which, like serious games, aims for learning, does not require the use of games [17]. Other authors consider that gamification has a series of tools that allow for teaching and reinforcing knowledge, acquiring new skills, improving communication, teamwork, and problem solving. Gamification tools aim to promote meaningful learning dynamically for students, increasing their motivation and participation [18].

In any case, as a relatively new trend, there are still ambiguities around the concept of gamification. Several authors have attempted to define gamification with the intention of clarifying and defining its characteristics. In 2011, Deterding defined it as the use of game elements in non-game contexts, also referred to as *gameful design*. This study makes a clear distinction between the concept of *gameful design* and *playful design*, describing the latter as a design approach that uses game elements to create playful and enjoyable experiences, rather than focusing on user motivation and engagement [19]. Werbach describes it as a process in which activities are carried out similarly to a game [20]. These authors, along with others, have tried to shed light on the dilemma. Even so, the definitions remain too general and abstract, perhaps due to its short life.

What can be made clear is that gamification has essential components that are respected by everyone who tries to define it, such as its experiential nature, where the player actively participates, and motivation [21]. Another issue is the consensus on the characteristics and elements of these same components, where, once again, authors do not seem to agree.

According to Ibáñez, students believe that education is a commodity that is acquired and consumed. They want their knowledge to be quick, easy, entertaining, practical, group-oriented, and preferably digital [22]. There are studies that reveal, in general figures, the good reception that this type of methodology receives. At present, numerous projects are being developed that are focused on the most diverse markets—from military to governmental, corporate, or healthcare games [11]. An example of this is the DISTRICT

project (Developing Industrial Strategies Through Innovative Cluster and Technologies), Serious Games Cluster and Business Network (SER3 VG), which is part of the Interreg III C Program specifically focused on the business field [11].

It seems evident that society and its needs are changing rapidly, especially in the present day where technologies are a significant part of our lives. In this context, and not surprisingly, education is also undergoing a transformation that requires a different approach than the conventional one; nowadays, there is a need for learning to have a more active character and for students to take on a greater role [22].

2.2. European Framework for the Digital Competence of Educators

The objective of the European Framework for Digital Competence of Educators (Dig-CompEdu) [5] is to describe the digital competences of any teacher throughout the different stages of their professional development, regardless of the subject, stage, or type of teaching they teach. It is a framework of a general nature and structured from a series of functions that all teachers share and that are reflected schematically and summarized in Table 1 [5].

Table 1. Summary of the digital competencies of educators and defined areas by the European Commission [6].

Area	Competence	Definition	
Professional commitment	A1 C1	Organizational communication	Developing and improving organizational communication with students, parents, and third parties through technology and collaboration.
	A1 C2	Professional collaboration	Establishing collaboration with other educators to share knowledge and experiences and innovate pedagogical practices.
	A1 C3	Reflective practice	Reflecting on personal and community digital pedagogical practice, evaluating it, and critically and actively developing it.
	A1 C4	Continuing professional development (CPD)	Using digital sources and resources for their development.
Digital content	A2 C1	Selection of digital resources	Searching, selecting, and programming resources to support and improve teaching and learning.
	A2 C2	Creation and modification of digital resources	Modify and program the use of open license resources. Where permitted, individually and collectively create new resources.
	A2 C3	Protection, management and exchange of digital content	Organize the content for students, parents, and other teachers; protect confidential information; comply with regulations regarding privacy and intellectual property; and be knowledgeable in the use of open educational licenses and resources.
Teaching and learning	A3 C1	Teaching	Utilize devices, digital resources, and new methods to improve teaching, properly managing and coordinating teacher interventions.
	A3 C2	Guidance and support in learning	Improve individual and collective interaction and offer specific guidance and assistance to students through new methods.
	A3 C3	Collaborative learning	To encourage collaboration among students through technology, and to train them for it, in order to improve communication and joint knowledge creation.
	A3 C4	Self-regulated learning	To encourage students to plan, review, and reflect on their self-regulated learning, provide evidence of their progress, share ideas, and create creative solutions.

Table 1. Cont.

Area	Competence	Definition	
Evaluation and feedback	A4 C1	Assessment strategies	To conduct formative and summative assessment, improving assessment formats and perspectives through technology.
	A4 C2	Learning analytics	To generate and critically analyse digital statistics on students' activity, performance, and progress to improve teaching and learning.
	A4 C3	Feedback, scheduling and decision making	To provide feedback, adapt pedagogical strategies, and offer specific reinforcement to students through technology. Use them in decision making.
Student empowerment	A5 C1	Accessibility and inclusion	To ensure access to learning resources and activities for all types of students and needs.
	A5 C2	Personalization	To offer different levels, paces, and objectives to students depending on their individual learning needs.
	A5 C3	Active engagement of students with their own learning	To encourage cross-cutting competencies, complex thinking, and creative expression of students; innovate in learning and real contexts through activities in research or complex problem solving.
Development of students' digital competence	A6 C1	Information and media literacy	To offer activities that cover students' information needs; find information and resources in digital environments; analyse and interpret information, critically evaluating its reliability and credibility and its sources.
	A6 C2	Digital communication and collaboration	To encourage students to use technology effectively and responsibly for communication, collaboration, and civic participation.
	A6 C3	Digital content creation	To carry out activities for modifying and creating digital content. Instruct on copyright, licensing in content, and referencing sources.
	A6 C4	Responsible use	To guarantee the well-being of Students and risk management in the use of technology; safe and responsible use.
	A6 C5	Digital problem solving	To include learning activities and assessment where technical problems are solved, or knowledge is extrapolated to other situations.

As can be seen in Table 1, the specific digital competences for educators are organized into six areas, namely professional commitment, digital content, teaching and learning, assessment and feedback, empowerment, and development of students' digital competence. In addition, each area presents six different stages of development—similar to the Common European Framework of Reference for Languages (CEFR): novice (A1), explorer (A2), integrator (B1), expert (B2), leader (C1), and pioneer (C2) [5]. The purpose of this model of cumulative progression is to help identify, through specific examples of activities related to each competence, the strengths and weaknesses of educators and the specific measures they should take to enhance their competence depending on their stage at any given time.

3. Methodology

Given the heterogeneity and large number of digital resources currently available, in order to carry out our analysis in which we intend to relate a series of solutions to the different digital competences defined in the European Framework DigCompEdu, a systematic and delimited search of different serious games and gamification tools has been carried out. To do this, we used the Google Academic document search engine and based our search on different terms such as “gamification”, “gamification tools”, and “serious games”. The inclusion and exclusion criteria of the different solutions that we located were based on aspects such as their popularity and rating (cases such as Kahoot, Minecraft, or Zoom), due to their repeated appearance in the different related works analysed in this

study, and the source they come from, such as technological experts, for example Google and Microsoft (Interland and Microsoft Teams applications, respectively), as well as their availability at the time of the search. Subsequently, with each of the located solutions, a classification has been made from the point of view of the use that they can provide educators and the potential that each one offers in the process of knowledge transmission.

To carry out the proposed analysis, this work proposes an initial classification into two categories. A first type has been defined, which we have called “serious games”. This includes those games that offer specific training in a predetermined field or theme. Specifically, we have understood serious games as digital solutions (or, in other words, specific and closed “products”) whose purpose is to achieve certain educational objectives that go beyond mere user entertainment. On the other hand, solutions in which educators themselves define the content of the resources have been classified as “gamification tools”. In this sense, the search for and classification of what we have called gamification tools focuses on locating design solutions, more or less technical, of the serious game itself (also known as *gameful design*). In any case, it should be noted that some of the serious games that appear in the classifications can also be considered gamification tools due to their characteristics, as they can be conceived both as a tool for creating games and as already implemented solutions. This is the case, for example, of Minecraft: Education Edition, which can be found in both “gamification tool” and “serious game” formats.

3.1. Serious Games

Based on the study conducted by Area [23], which was based on the types of digital resources and materials, applications, or software with pedagogical intention. Table 2 is presented, which includes a classification of located games and tools, totalling 37. The different types of resources that have been considered are tutorials (T1), interactive exercises (T2), guided problem-solving environments (T3), virtual environments for free exploration (T4), software for the production and dissemination of information (T5), and resources for communication and self-learning (T6). Additionally, information is provided on the theme, usefulness, or scope of application of the game or gamification tool. With regard to adaptability, it is a characteristic that indicates whether the game or gamification tool offers or can offer rewards or punishments that influence the student’s progress, if different paths can be taken with different consequences, or if it is developed by levels that adapt to the player’s responses. The opposite case, that of a non-adaptive solution, is one that would be based on a standard battery of non-varying questions/tests. Other classifications are also shown in the table, such as user ratings of the games, availability, and use (individual/multiplayer). Regarding use, we refer to multiplayer when the learner can use the tool at the same time with different students and/or when the students can form teams or compete against each other, and individual when this is not possible.

Table 2. Classification of serious games located based on the type of educational resource.

	Theme	User Reviews	Avail.	Resource Type	Use	Adapt.	Ref.
Spirits of Spring	Cyberbullying	9 (28 votes)	S	T4	I	NO	[24]
Cisco Packet Tracer	Technology of networks	8.3 (1190 votes)	F	T4	I	NO	[25]
GSD Sim	Global software developer	NA	F	T4	I	YES	[26]
AstroCódigo	Programming	NA	F	T4	I	NO	[27]
Minecraft: Education Edition	Varied theme	7.6 (31,783 votes)	S	T4	I/M	YES	[28]

Table 2. *Cont.*

	Theme	User Reviews	Avail.	Resource Type	Use	Adapt.	Ref.
Tamagocours	Legal framework and legal norm	NA	F	T2	M	YES	[29]
Code Combat	Programming and coding	8.4 (41 votes)	S	T2	I	NO	[30]
Interland	Digital citizenship and security	8.6 (213 votes)	F	T2	I	NO	[31]
Space Shelter	Security	NA	F	T2	I	NO	[32]
Cyberscouts	Cybersecurity	NA	F	T2	I	NO	[33]
Another Lost Phone: Laura's story	Social and sensitive awareness	9 (1741 votes)	S	T3	I	NO	[34]
Somewhere: The Vault Papers	Decision making and problem solving	7.4 (5710 votes)	F	T3	I	YES	[35]
NoStranger	Awareness of the danger and fragility of providing data on networks	8.4 (14,252 votes)	F	T3	I	YES	[36]

Avail.: availability, Adapt.: adaptability, Ref.: references, F: free availability, S: availability under subscription, I: individual use, M: multiplayer use, NA: information not available.

Next, Table 2 presents the list of localized serious games, classified according to the type of educational resource implemented. In order to facilitate access to the located resources, the references included in Table 2 direct the reader to each of the sources where they can be found.

3.2. Gamification Tools

Consistent with the above, in Table 3 the list of localized gamification tools is presented. In this case, the themes have been categorized into three different types depending on the usefulness that educators can derive from them, namely, content creator, behaviour manager, and evaluation tool. In this case, the "Adaptability" column refers to the ability of the educator or developer to create learning products that, while being used, allow the content to be adapted according to the user's responses and/or facilitate the use of prizes, rewards, and punishments that have consequences on the student's development. In order to facilitate access to the located resources, the references included in Table 3 direct the reader to each of the sources where they can be found.

Table 3. Classification of gamification tools located based on the type of educational resource.

Trade Name	Theme	User Reviews	Avail.	Resource Type	Use	Adapt.	Ref.
LearningsApps.Org	Evaluation tool	NA	F	T2	I/M	NO	[37]
WordWall	Evaluation tool	NA	F/S	T2	I/M	NO	[38]
Cerebriti	Evaluation tool	NA	F	T2	I/M	NO	[39]
Educaplay	Evaluation tool	7.4 (67 votes)	F/S	T2	I/M	NO	[40]
TOMI digital	Behaviour manager/evaluation tool/content creator	NA (+50 mil downloads)	F/S	T2/T6/T1	M	NO	[41]
Trivinet	Evaluation tool	8 (36 votes)	F	T2	I/M	NO	[42]

Table 3. Cont.

Trade Name	Theme	User Reviews	Avail.	Resource Type	Use	Adapt.	Ref.
Quizizz	Evaluation tool	9.6 (2194 votes)	F/S	T2	I/M	NO	[43]
Kahoot	Evaluation tool	9.4 (2478 votes)	F	T2	M	NO	[44]
Socrative	Evaluation tool	6.6 (16,527 votes)	F/S	T2/T6	M	NO	[45]
Super Teacher Tools	Evaluation tool	NA	F	T2	I/M	NO	[46]
Mentimeter	Content creator	8.8 (64 votes)	F/S	T5/T1	M	NO	[47]
Pear Deck	Content creator	8.2 (3330 votes)	F/S	T5/T1	M	NO	[48]
Genially	Content creator	9 (76 votes)	F/S	T5/T1	M	NO	[49]
Microsoft Sway	Content creator	7.2 (5 votes)	F/S	T5/T1	M	NO	[50]
Emaze	Content creator	8.8 (12 votes)	F/S	T5/T1	M	NO	[51]
Visme	Content creator	9 (612 votes)	F/S	T5/T1	M	NO	[52]
Brainscape	Content creator	8.8 (255 votes)	F/S	T5/T1	M	NO	[53]
Quizlet	Content creator/evaluation tool	9 (493,103 votes)	F/S	T5/T2	I/M	NO	[54]
Class Dojo	Behaviour manager	9.4 (906 votes)	F	T6	M	YES	[55]
Classcraft	Behaviour manager/evaluation tool	8.4 (22 votes)	F/S	T6/T2	M	YES	[56]
Google Classroom	Behaviour manager/evaluation tool	9.2 (2205 votes)	F	T6/T2	M	NO	[57]
MyClassGame	Behaviour manager	NA	F	T6	M	YES	[58]
Elever	Behaviour manager	NA (+5000 downloads)	F	T6	M	YES	[59]
Minecraft: Education Edition	Behaviour manager/evaluation tool/content creator	7.6 (31,783 votes)	F/S	T4/T2	I/M	YES	[28]

Avail.: availability, Adapt.: adaptability, Ref.: references, F: free availability, S: availability under subscription, I: individual use, M: multiplayer use, NA: information not available.

As can be seen, the number of localized tools is more numerous than the number of serious games. The type of resource assigned to each serious game or gamification tool has been considered the main and most representative type. In those cases where more than one type of resource can be considered in the same game or tool, they have been listed in order of importance.

In relation to Tables 2 and 3, there are a series of instruments that, although they do not have the same objective as the previous tools and games, can be helpful in developing the competencies of the European Framework for Educators and can serve as support for promoting them. These are a series of instruments mainly intended for communication or other related aspects, such as accessibility and inclusion, which are also interesting for teaching purposes. Among them, Zoom Meeting, Google Meet, Microsoft Teams, GoToMeeting, and Cisco WebEx Teams are some of the most commonly used tools for video conferencing communication [60,61]. On the other hand, Google offers communication tools aimed at accessibility and inclusion, such as TalkBack or the Android Accessibility Suite [62].

4. Development of DigCompEdu through Serious Games and Gamification Tools

Generally speaking, the range of games analysed and described in Table 2 can aid in the development of digital competencies of both citizens and educators. In the case of the tools that we have defined as gamification tools, the same does not apply, as these would be exclusively or at least specifically intended for teachers' use.

Given the close relationship between serious games and gamification tools, and the interesting prospects that both have from the perspective of their use in the field of education, Table 4 shows the relationship between the DigCompEdu competencies described in Table 1 and the different examples of games and gamification tools located in this work (see Tables 2 and 3) that could be used to develop these competencies.

Table 4. Relationship between the competencies of DigCompEdu and the games and tools located in this work.

Instrument Names	J/H	A1				A2			A3				A4			A5			A6				
		C1	C2	C3	C4	C1	C2	C3	C1	C2	C3	C4	C1	C2	C3	C1	C2	C3	C1	C2	C3	C4	C5
Spirits of Spring	J			X	X	X		X								X						X	
Cisco Packet Tracer	J			X	X	X		X								X							X
GSD Sim	J			X	X	X		X							X	X							X
AstroCódigo	J			X	X	X		X								X						X	X
Tamagocours	J		X	X	X	X	X	X		X		X	X		X	X	X	X	X	X	X	X	X
Code Combat	J			X	X	X		X								X				X			X
Interland	J			X	X	X		X	X							X			X			X	X
Space Shelter	J			X	X	X		X	X							X			X			X	X
Cyberscouts	J			X	X	X		X	X							X			X			X	X
Another Lost Phone: Laura's story	J			X	X	X		X								X	X	X				X	
Somewhere: The Vault Papers	J			X	X	X		X								X	X	X	X			X	
NoStranger	J			X	X	X		X								X	X	X	X			X	
LearningApps.Org	H	X	X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	X
WordWall	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Cerebriti	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Educaplay	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
TOMI Digital	H	X	X	X	X	X	X	X		X	X	X		X	X			X	X	X	X	X	
Trivinet	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Quizizz	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Kahoot	H			X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Socrative	H	X	X	X	X	X	X	X		X	X	X		X	X			X	X	X	X	X	
Super Teacher Tools	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Mentimeter	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Pear Deck	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Genually	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Microsoft Sway	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Emaze	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Visme	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Brainscape	H		X	X	X	X	X	X		X		X						X	X	X	X	X	
Quizlet	H		X	X	X	X	X	X		X		X	X		X	X			X	X	X	X	
Edmodo	H	X		X	X	X		X	X	X	X	X	X	X		X							
Class Dojo	H	X		X	X	X		X	X	X	X	X	X	X		X	X						
Classcraft	H	X		X	X	X		X	X	X	X	X	X	X		X	X						
Google Classroom	H	X	X	X	X	X	X	X	X	X	X	X	X	X		X							
MyClassGame	H	X		X	X	X		X	X		X	X	X	X		X	X						
Elever	H	X		X	X	X		X	X		X	X	X	X		X	X						
Minecraft: Ed. Edition	J/H	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X
Zoom Meeting	H	X	X	X	X	X		X	X	X								X		X			
Microsoft Teams	H	X	X	X	X	X		X	X	X								X		X			
Google Meet	H	X	X	X	X	X		X	X	X								X		X			
GoToMeeting	H	X	X	X	X	X		X	X	X								X		X			
Cisco WebEx Teams	H	X	X	X	X	X		X	X	X								X		X			
TalkBack	H	X		X	X	X		X									X			X			
Android Accessibility Suite	H	X		X	X	X		X								X			X				

J: serious game, H: gamification tool.

To create Table 4, the assignment of each competency to each game/tool was carried out through an individual review of each case of serious games and gamification tools, paying attention to their themes, characteristics, and objectives, and relating them to the different competencies. As can be seen in Table 4, some competencies such as A1 C4 or A2 C1 can be developed through the use of any of the analysed games or gamification tools,

regardless of their intentionality. This is the case, for example, with competency A1 C4 (continuing professional development), which is described as the use of digital sources and resources for professional development and which, by its nature, can be developed using any of them.

5. Discussion

Technology is causing a revolution in human life, to the point of creating a need to integrate it into any field in which we operate, at all levels, in order to greater efficiency and competitiveness. Given the growing interest in the progressive rise of new technologies, there has been a significant increase in the number of resources invested and in recent years regarding their integration into the educational process. In the field of education, new technologies and resources, their functions, their almost unlimited possibilities, their rapid creation, and the needs of all users and organizations, among others, make it possible for concepts such as gamification and digital competence training to occupy an important place among the challenges of current society. These challenges have been gaining weight and importance progressively in the last decade, but have been particularly influenced by events such as the global COVID-19 pandemic. The pandemic has alerted professionals from all sectors to the need to enhance the use of technology and, specifically in the field of education, the need to introduce a new pedagogical methodology focused on the use of digital resources.

In this context, the European Frameworks on Digital Competences (DigComp, DigCompEdu, DigCompOrg, and OpenEdu), defined by the EC for the first time in 2013, have gained an important place in the plans of anyone who wants to be part of the technological update in education, since they have offered clear and concise guidelines on which aspects should be developed for this purpose. Currently, gamification and serious games are presented as a possible solution for the development of the competences that educators and students must acquire.

Gamification tools provide the possibility of creating as many products (serious games) as the user has ideas. As mentioned, gamification tools, unlike serious games, allow the teacher to develop their competencies and, at the same time, design the game according to their needs. Serious games, on the other hand, allow the teacher to develop students' digital competencies in a more limited and predetermined way. In this sense, this work has sought to emphasize gamification tools due to their special potential from the perspective of developing teaching skills. On the other hand, the topics covered by these resources are very broad, ranging from technical to conceptual aspects, allowing for the development of users' skills. In addition, their use is also diverse, as both individual and collective solutions can be found. Another relevant aspect is availability, as not all of them are free. However, the definitions, characteristics, and types that revolve around gamification, as with serious games, are not clear in the existing literature.

5.1. Digital Resources Analysed

After an analysis of the current landscape, it seems clear that both serious games and gamification tools are some of the most important strategies currently available to digitalize the teaching–learning process. In this sense, in order to facilitate a clear identification of each of the solutions located in this work, taking into account the resources and usefulness that they can provide for the teacher, a classification of the gamification tools and serious games located has been carried out, which can be consulted in Tables 2 and 3. In addition, in this work, a list of serious games and gamification tools is presented and each of them is related to specific digital competencies defined within the European Framework DigCompEdu reflected in Table 4. Altogether, 24 gamification tools and 13 serious games have been located and analysed.

An example of an interesting gamification tool and serious game that has been discussed in this work is Minecraft: Education Edition. In this case, users (teachers, in the case at hand) are allowed to use it as a gamification tool to create a “virtual world” based on

their own rules. At the same time, it offers various worlds that other users have already created and that may be of interest to the person searching for them, covering all kinds of subjects, including the digital competencies of the different frameworks.

As seen in the project carried out with this same resource in the background section, the results are very positive. However, it would be interesting to carry out a case study in which exhaustive, concrete, and experimental data are obtained to carefully analyse its functionality and other relevant aspects such as the benefits, disadvantages, and difficulties that may arise when using this type of resource.

From the 24 gamification tools analysed in our search, Figure 1 shows the percentage of tools assigned to each of the types of educational resources identified and defined in Section 3. As can be seen in Figure 1, the majority of the gamification tools are of three specific types: “Interactive exercises” (T2) with 41.67% of cases, followed by “Software for production and dissemination of information” (T5) with 33.33%, and finally “Resources for communication and self-learning” (T6) with 20.83% of the located tools. There is a minority fourth group, “Virtual environments for free exploration” (T4), which accounts for only 4.17% of the total. In this sense, there is a clear lack of gamification tools related to types that focus on the development of digital skills in guided problem-solving environments and tutorials (types T3 and T1, respectively). Moreover, in our search, no gamification tool was found that primarily and centrally develops the T1 type; however, this does not mean that this type of resource cannot be present secondarily or collaterally in certain gamification tools, as is the case, for example, with the Mentimeter tool.

Gamification tools

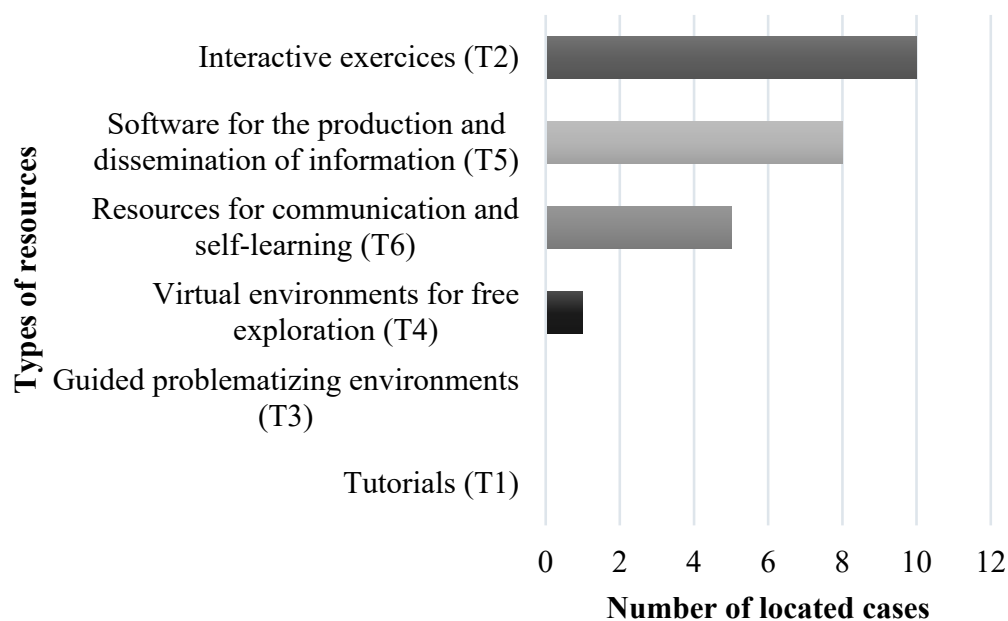


Figure 1. Balance of the gamification tools located based on the type of educational resource.

In Figure 2, the percentage of serious games assigned to each of the identified and defined educational resource types in Section 3 is shown. In this case, it can be seen that two large groups stand out, “Interactive exercises” (T2) and “Virtual environments for free exploration” (T4), whose percentage is 38.46% in both cases. The third group that follows them, “Guided problem-solving environments” (T3), accounts for 23.08% of the total. As in the case of gamification tools, there is a lack of some of the types, specifically types T1, T5, and T6.

Serious Games

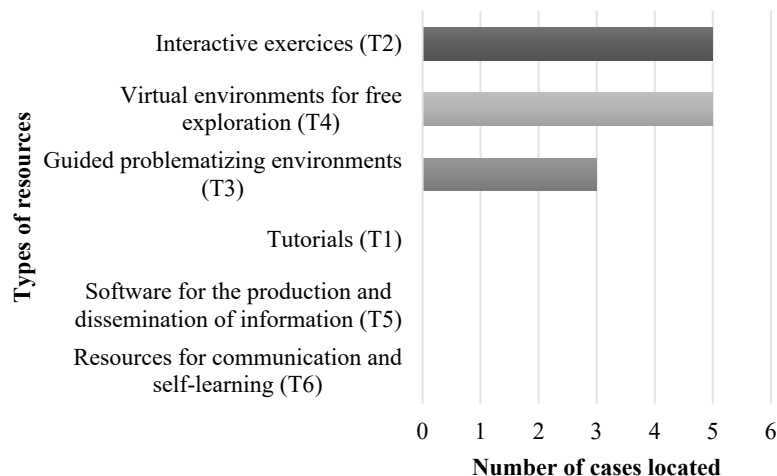


Figure 2. Balance of the serious games located based on the type of educational resource.

Furthermore, gamification as an educational strategy can still be considered to be in development, and this could be one of the reasons why we still do not find a great variety in certain types of gamification tools and serious games.

5.2. Other Relevant Features

Another aspect analyzed in this work is the characteristic defined as ‘Adaptability’ (the ability to automatically adapt the digital educational resource to the user’s level), which some gamification tools may present indirectly, and which serious games **may** demonstrate directly. Figure 3 shows the three main types of educational solutions identified in this work: gamification tools, serious games, and support tools. For each group, the number of localized solutions classified according to their adaptability or non-adaptability is shown. As can be seen, most solutions located in this work do not have this characteristic, specifically, 72.97% of them do not automatically adapt to the level that the user needs. However, this characteristic can provide multiple benefits to teaching, as it allows not only the identification of the level at which the students are, the most frequent errors, and the strengths, but also offers individual and adjusted development and progress. Advancing in the development of adaptive tools and games is presented as a task of special interest in the educational field.

Adaptability

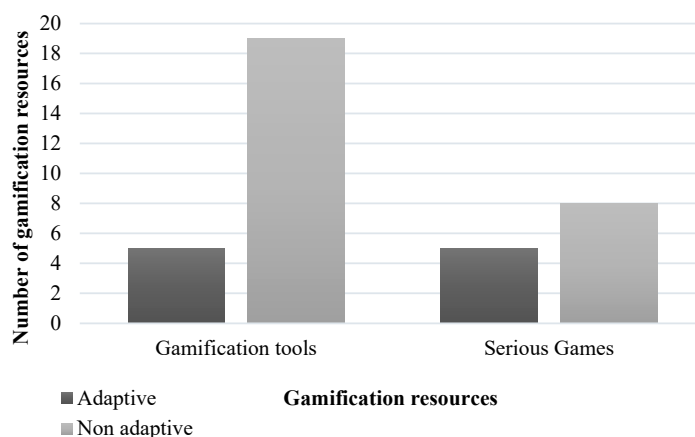


Figure 3. Balance of located gamification resources considering their adaptability capacity.

An interesting dilemma regarding the possibilities presented to education professionals is identifying which option would be more interesting when presented to learners and obtaining certain results from them. A first option could be to use a single game/tool that covers all the pedagogical and educational needs of teaching practice. A second option would be to intersperse and/or complement several of them to achieve the development of a specific competency. In this sense, there does not seem to be a single or clear position. To date, few studies have focused on shedding light on this matter. In any case, considering the current needs and analysed solutions, it could be more interesting for teachers to complement several tools or games, ensuring sustained attention and motivation over time. It would not be advisable to use too many, as this could generate frustration and uncertainty in students who must know the entire repertoire to make efficient use of them. It would be interesting and necessary to conduct a detailed analysis on this matter, given the increasing prevalence of these educational solutions in classrooms.

From the perspective of educational institutions, organizations, and/or education professionals, the efforts invested in gamification resources, and particularly in so-called gamification tools—due to their potential use for teachers—appear as a promising solution for the development of new educational models based on digitization. However, it is clear that for these elements to be effectively incorporated into education, it is necessary for teachers to have adopted and integrated these techniques into their pedagogical practice, and the best option for this is to use these gamification instruments first, to practice and try them out. The advancement of technologies in education does not seem to stagnate, and every day new and diverse paths, strategies, and tools emerge to ensure that both teachers and students acquire not only the digital competencies necessary for modern life, but also specific knowledge based on the use of these tools.

Implications to theory and practice and threats to validity: This article is part of a preliminary study and, as a first approach, it presents certain limitations to theory and practice. Regarding the threats to its validity, we want to clarify that the work focuses on digital resources currently used in pedagogical practice. However, it is important to keep in mind that over time, the characteristics and tools of gamification or serious games may change.

6. Conclusions

In this work, we have carried out a search for a set of gamification and serious game tools and have conducted an analysis to relate them to the different digital competencies defined in the European Framework for Digital Competence for Educators.

After analysing a series of digital solutions that can be integrated into pedagogical practice, taking into account the various aspects and possibilities of them, gamification tools have been identified as resources of particular interest to promote the digital competencies of educators, due to their creativity and innovative capacity from the teaching point of view. Serious games, as a communication channel with students, offer an effective method for the transfer of specific knowledge, both in digital competencies and in any other topics. In this sense, this work proposes a direct relationship between gamification tools and serious games.

Based on the analysis carried out on the different located solutions, the need to create tools and games with a greater diversity of typologies is advocated. Likewise, a relevant and unusual feature in this type of solution is adaptability. Well implemented, it allows both the teacher and the student to obtain better learning results, as well as making the practice of educators more motivating and effective. In any case, to confirm the validity of this type of approach, a thorough study of its characteristics compared to those of non-adaptive and more widespread digital solutions is necessary.

Another aspect to consider regarding the digitization of education is the importance of teachers learning and knowing these tools and games properly to transmit knowledge to students, choosing a path that is rich in terms of the solutions used. Among others, it remains to be seen the extent to which the results obtained from various resources for a particular competence can be more efficient than a single digital solution.

In general terms, the results reflect a profound change in the teaching–learning process that is still under development. The need to continue researching and investing resources in what could be the solution for innovative, efficient, and motivating education is also reflected.

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References

1. Thomson, S.; Hillman, K. The Teaching and Learning International Survey 2018. Australian Report Volume 1: Teachers and School Leaders as Lifelong Learners. OECD Teaching and Learning International Survey (TALIS). 2019. Available online: <https://research.acer.edu.au/talis/6> (accessed on 4 March 2023).
2. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 2018. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:22:FIN> (accessed on 11 January 2023).
3. European Commission. Digital Education Action Plan (2021–2027) European Education Area. 2021. Available online: <https://education.ec.europa.eu/focus-topics/digital-education/action-plan> (accessed on 4 March 2023).
4. Vuorikari, R.; Kluzer, S.; Punie, Y.; European Commission. *Joint Research Centre. DigComp 2.2: The Digital Competence Framework for Citizens—With New Examples of Knowledge, Skills and Attitudes*; Publications Office of the European Union: Luxembourg, 2022. [CrossRef]
5. Redecker, C.; Punie, Y.; Joint Research Centre. *European Framework for the Digital Competence of Educators: DigCompEdu*; Publications Office of the European Union: Luxembourg, 2017; p. 93. [CrossRef]
6. Inamorato, D.S.A.; Punie, Y.; Castaño, M.J. *Opening Up Education: A Support Framework for Higher Education Institutions*; Publications Office of the European Union: Luxembourg, 2016; p. 78. [CrossRef]
7. Kamylyis, P.; Punie, Y.; Devine, J.; Institute for Prospective Technological Studies. *Promoting Effective Digital-Age Learning: A European Framework for Digitally-Competent Educational Organisations*; Publications Office of the European Union: Luxembourg, 2015. [CrossRef]
8. Reisoğlu, İ.; Çebi, A. How can the digital competences of pre-service teachers be developed? Examining a case study through the lens of DigComp and DigCompEdu. *Comput. Educ.* **2020**, *156*, 103940. [CrossRef]
9. Binda, G. Educational Transformation for the 21st Century Needs EPALE. 2022. Available online: <https://epale.ec.europa.eu/en/blog/educational-transformation-21st-century-needs> (accessed on 4 March 2023).
10. Prensa, M. *Minecraft: Education Edition*, Pilar del Desarrollo en Competencias Digitales del Profesorado de Los Colegios FEC—Centro de Noticias. 2021. Available online: <https://news.microsoft.com/es-es/2021/09/01/minecraft-education-edition-pilar-del-desarrollo-en-competencias-digitales-del-profesorado-de-los-colegios-fec/> (accessed on 11 January 2023).
11. Palacios-Rodríguez, A. Mejora de la Competencia Digital del Futuro Profesorado de Educación Secundaria: Enseñanza y Aprendizaje Con TIC. 2019. Available online: <https://doi.org/10.12795/9788447221912.099> (accessed on 9 January 2023).
12. Susi, T.; Johannesson, M. Serious Games—An Overview. 2007. Available online: www.americasarmy.com (accessed on 12 January 2023).
13. Lobo, J.C.; del Sur, M. Juegos Serios: Alternativa Innovadora. *Conoc. Libre Y Educ. (CLED)* **2014**, *2*, 1–18.
14. López, C. The video game as an educational tool. Possibilities and problems about serious games. *Rev. Innovación Educ.* **2016**, *8*, 10.
15. Sawyer, B.; Smith, P. Serious Games Taxonomy. Slides from the Serious Games Summit at the Game Developers Conference. 2008. Available online: <https://thedigitalentertainmentalliance.files.wordpress.com/2011/08/serious-games-taxonomy.pdf> (accessed on 6 March 2023).
16. Breuer, J.; Bente, G. Why so serious? On the relation of serious games and learning. *J. Comput. Game Cult.* **2010**, *4*, 7–24. Available online: <https://hal.archives-ouvertes.fr/hal-00692052> (accessed on 11 January 2023). [CrossRef] [PubMed]
17. Alejaldre, L.; García, A. Gamificar: El uso de los Elementos del Juego en la Enseñanza del Español [Ponencia]. Congreso La Cultura Hispánica: De sus Orígenes al Siglo XXI, Burgos, España, 2015. Available online: <https://dialnet.unirioja.es/servlet/articulo?codigo=8518500> (accessed on 12 January 2023).

18. Sonsoles, I.; García, S. Gamification tools for learning earth sciences. *Edutec Rev. Electrónica Tecnol. Educ.* **2018**, *65*, 29–39. [CrossRef]
19. Deterding, S.; Dixon, D.; Khaled, R.; Nacke, L. From Game Design Elements to Gamefulness: Defining Gamification. 2011. Available online: <http://www.bunchball.com/nitro/> (accessed on 12 January 2023).
20. Werbach, K. (Re) defining gamification: A process approach. In Proceedings of the Persuasive Technology: 9th International Conference PERSUASIVE 2014, Padua, Italy, 21–23 May 2014; pp. 266–272.
21. Lei, S.A. Intrinsic and Extrinsic Motivation: Evaluating Benefits and Drawbacks from College Instructors Perspectives. *J. Instr. Psychol.* **2010**, *37*, 152–160.
22. Gallardo, E.P.; Gértrudix-Barrio, F. Advantages of gamification in the field of formal education in Spain: A bibliographic review in the period 2015–2020. *Contextos Educativos. Rev. Educ.* **2021**, *28*, 203–227. [CrossRef]
23. Area, M. *La Enseñanza y el Aprendizaje con TIC*; Ediciones Morata: Madrid, Spain, 2019.
24. Meta4. Spirits of Spring. 2014. Available online: <https://meta4.games/games/spirits-of-spring/> (accessed on 12 January 2023).
25. Cisco Networking Academy. Cisco Packet Tracer. Available online: <https://www.cisco.com/> (accessed on 12 January 2023).
26. Noll, J.; Butterfield, A.; Farrell, K.; Mason, T.; McGuire, M.; McKinley, R. GSD Sim: A Global Software Development Game. In Proceedings of the International Computer Software and Applications Conference, Shanghai, China, 18 August 2014; pp. 15–20. [CrossRef]
27. Astro Código. Astro Código. Available online: <http://www.astrocodigo.com/> (accessed on 12 January 2023).
28. Microsoft Corporation. Minecraft Education Edition. Available online: <https://education.minecraft.net/es-es> (accessed on 12 January 2023).
29. Omnium Games. Tamagocours: El Tamagotchi Que Certifica Como Docente Digital. Available online: <http://omniumgames.com/tamagocours-el-tamagotchi-que-certifica-como-docente-digital/> (accessed on 12 January 2023).
30. CodeCombat. CodeCombat. Available online: <https://codecombat.com/> (accessed on 12 January 2023).
31. Google. Play Interland-Be Internet Awesome. Available online: https://beinternetawesome.withgoogle.com/es-419_all/interland (accessed on 12 January 2023).
32. Google. Space Shelter: A Game about Learning to Stay Safer Online. Available online: https://spaceshelter.withgoogle.com/intl/es_es/ (accessed on 12 January 2023).
33. INCIBE. Cyberscouts. Available online: <https://cyberscouts.osi.es/> (accessed on 12 January 2023).
34. Villagers, D. Another Lost Phone: Laura’s Story. Available online: <https://anotherlostphone.com/> (accessed on 12 January 2023).
35. Interactive, N. Somewhere—The Vault Papers-APK Download for Android Aptoide. Available online: <https://somewhere.en.aptoide.com/app> (accessed on 12 January 2023).
36. Productions, B.V. NoStranger. Available online: <https://www.blackveinproductions.com/> (accessed on 12 January 2023).
37. LearningApps.org. Available online: <https://learningapps.org/> (accessed on 12 January 2023).
38. Wordwall. Wordwall. Available online: <https://wordwall.net/es> (accessed on 12 January 2023).
39. Cerebriti. Cerebriti. Available online: <https://www.cerebriti.com/> (accessed on 12 January 2023).
40. Educaplay. Educaplay. Available online: <https://es.educaplay.com/> (accessed on 12 January 2023).
41. Lopera, J.M. TOMi.digital. Available online: https://tomi.digital/es?utm_source=google&utm_medium=seo (accessed on 12 January 2023).
42. Ruiz, P. Trivinet. Available online: <https://www.trivinet.com/es/trivial-online/version-web> (accessed on 12 January 2023).
43. Quizizz. Quizizz. Available online: <https://quizizz.com/join> (accessed on 12 January 2023).
44. Kahoot. Kahoot! Available online: <https://kahoot.it/> (accessed on 12 January 2023).
45. Maimon, A.; Berte, B.; West, M. Socrative. Available online: <https://www.socrative.com/> (accessed on 12 January 2023).
46. SuperTeacherTools. Available online: <https://www.superteachertools.us/> (accessed on 12 January 2023).
47. Mentimeter. Mentimeter. Available online: <https://www.mentimeter.com/es-ES> (accessed on 12 January 2023).
48. Eynon-Lynch, M.; Eynon-Lynch, R.; Showalter, A.; Sweeney, D. PearDeck. Available online: <https://www.peardeck.com/> (accessed on 12 January 2023).
49. Rubio, J.; García, L.; Roldán, C. Genially. Available online: <https://app.genial.ly/dashboard?from=login=true> (accessed on 12 January 2023).
50. Microsoft. Microsoft Sway. Available online: <https://sway.office.com/my> (accessed on 12 January 2023).
51. Emaze. Emaze. Available online: <https://www.emaze.com/es/> (accessed on 12 January 2023).
52. Taei, P. Visme. Available online: <https://www.visme.co/es/> (accessed on 12 January 2023).
53. Cohen, A. Brainscape: The Best Flashcards App Make Flashcards Online. Available online: <https://www.brainscape.com/> (accessed on 12 January 2023).
54. Sutherland, A. Quizlet. Available online: <https://quizlet.com/es> (accessed on 12 January 2023).
55. ClassDojo. ClassDojo. Available online: <https://www.classdojo.com/es-es/> (accessed on 12 January 2023).
56. Young, S. Classcraft. Available online: <https://www.classcraft.com/es-es/> (accessed on 12 January 2023).
57. Google. Classroom. Available online: <https://classroom.google.com/u/0/> (accessed on 12 January 2023).
58. MyClassGame. @MyClassGame. Available online: <https://www.myclassgame.es/> (accessed on 12 January 2023).
59. Elever Investment Adviser Private Limited. Available online: <https://elever.ch/> (accessed on 12 January 2023).

60. Singh, R.; Awasthi, S.E. Preprint. Updated Comparative Analysis on Video Conferencing Platforms-Zoom, Google Meet, Microsoft Teams, WebEx Teams and GoToMeetings. 2020. Available online: <https://www.easychair.org/publications/preprint/download/Fq7T> (accessed on 1 March 2023).
61. Macmillan, K.; Mangla, T.; Saxon, J.; Feamster, N. Measuring the performance and network utilization of popular video conferencing applications. In Proceedings of the ACM Sigcomm Internet Measurement Conference IMC, New York, NY, USA, 2–4 November 2021; pp. 229–244. [CrossRef]
62. Google. Android Accessibility Overview-Android Accessibility Help. 2023. Available online: <https://support.google.com/accessibility/android/answer/6006564?hl=en> (accessed on 1 March 2023).

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