STUDIA UBB GEOGRAPHIA, LXVII, 1-2, 2022 (p. 93-121)
(RECOMMENDED CITATION)
DOI:10.24193/subbgeogr.2022.07

ASSESSMENT OF GEOGRAPHY TEACHING-LEARNING PROCESS THROUGH GAME, IN PRE-UNIVERSITY EDUCATION

Florentina TOMA[1], Daniel Constantin DIACONU[2], Gabriel Vasile DASCĂLU[1], Alexandru NEDELEA[3], Daniel PEPTENATU[4], Radu-Daniel PINTILII[4], Marin MARIAN[4]

ABSTRACT. – Assessment of Geography Teaching-Learning Process Through Game, in Pre-University Education. A general problem recognized in the educational process is the need to identify the manner in which the teacher, as the factor with the greatest influence on learning, increases the students' school performance. The creation of a tool in the form of an interactive website, using types of languages to improve an easy understanding of learning, the formation of specific competences and the students' enhanced motivation for study are the objectives of this study. This study evaluates the teaching-learning system through its own created game, using certain types of computer languages: HTML, CSS and JavaScript, from the perspective of measuring the impact of the effect on tests in the formative assessment sequence of students, compared to other teaching-learning methods. The experiment, observations, performance analysis and qualitative Google Forms questionnaires, suggested a high degree of student engagement and how game technology can facilitate teaching. As the results have shown that there is a strong difference between experimental and control groups, it indicates that educational play has had a positive impact on learning and increasing students' interest, confirming the advantages of learning through play. The teaching-learning model can be extended to use at national and international level.

Keywords: *teaching-learning through game; Geography; Google Forms; HTML computer language; CSS and JavaScript.*

1 *University of Bucharest, Simion Mehedinți "Nature and Sustainable Development" Doctoral School, Bucharest, Romania, e-mails: florentina.ghersin@drd.unibuc.ro, gabriel.dascalu@drd.unibuc.ro*
2 *University of Bucharest, Faculty of Geography, Department of Meteorology and Hydrology, Bucharest, Romania, e-mail: daniel.diaconu@unibuc.ro*
3 *University of Bucharest, Faculty of Geography, Department of Geomorfology, Bucharest, Romania, e-mail: alexnedelea10@yahoo.com*
4 *University of Bucharest, Faculty of Geography, Bucharest, Romania, e-mails: peptenatu@yahoo.fr, pinty_ro@yahoo.com, marian.marin@geo.unibuc.ro*

1. INTRODUCTION

Learning through play and the use of information and communication technologies (ICT) in the educational process are topics of interest to many studies.

There has been a number of research papers over the past six years addressing the use of ICT tools for learning, as well as their effects for students. Most studies show the advantages of using these applications and less their disadvantages. Glover's paper (2020) stands out in this regard, arguing that the tool “Google Forms helps stimulate conversations around basic concepts to improve learning and equip students with the technology and collaboration tools to prepare them for future professional contexts.” Andrew (2019) investigated “student attitudes toward various language learning tasks in Google apps and explored the benefits of using Google apps as a collaboration tool”. About the use of Google Forms as a blended docent learning initiative, Murphy's study (2018, p. 4) and Rejón-Guardia et al. (2019) stand out, in that the app allows “the student to be an active agent in the learning process”, just like other Google applications. Liu and Lan (2016) “suggest that many Web apps (e.g. Google Docs) play a key role in improving student motivation and engagement.”

In terms of the type of assessment, in most of previous research, Kahoot! Platform is predominant, since it has demonstrated a positive influence on students, creating a conducive environment for study (Iwamoto et al., 2017; Taylor and Reynolds, 2018; Wang and Tahir, 2020; Thomas et al., 2021).

Some studies also look at “the use of digital technology as indicated to be suitable for measuring and accepting e-learning tools” (Cheung and Vogel 2013; del Barrio García et al., 2015).

Learning through play has been tested and analyzed by several researchers, but lacking the in-depth quantitative and qualitative data for the realization of a general model of teaching-learning and objective assessment on an online platform, to be used in all three models of teaching-learning-assessment. Game-based learning motivates and engages in such a way that the learning process takes place without being aware of this fact and can be beneficial for the motivation and dynamics of the class (Sharples, 2002; Gee, 2003). It is also necessary to discover an appropriate methodological assessment plan, related to online and traditional teaching and learning practices, such as evidenced by the “online game science argumentation program (OGSA) for experiments – performance of learning and argumentation of the sciences, but time-consuming” (Lin, 2018).

Various research papers present various game models, highlighting the direction of improving the learning effect: “the learning and play performance of students in an educational game based on exercises with mixed methods” and “video games (Virtual Age, based on sound and design) facilitate students' learning and understanding of biological evolution, their behavior influenced by score" (Cheng et al., 2015; Lin et al., 2019). A case study looks at "establishing an interactive virtual learning platform that connects all students together - blended learning - improving the learning performance of students' vocabulary through the use of synchronous and asynchronous games and activities" (Karaaslan et al., 2018).

Other research examined "students' learning outcomes through mixed methods and their learning experiences through playing a Serious Educational Game, as they learn more content" (Cheng and Annetta, 2012). Also in this regard, "new teaching methods are being designed that encourage students to be active participants in their own learning, based on the game (GBL) – the use of mobile phone applications to improve learning" (Elsherbiny and Al Maamari, 2020).

Other studies have provided a number of educational teaching and learning models experienced by university education. Thus, "interactive learning environments such as digital games (DGBL) were used to attract students' interest, based on the analysis of drawings, questionnaires, pre-test and post-test results, impact and interest" (Perini et al., 2017).

Another example is provided by Annetta et al. (2009), who researched the effectiveness of a multiplayer educational gaming application (Dr. Friction Multiplayer Educational Gaming) created by the teacher, using mixed methods and collecting results at pre-test and post-test.

Other studies have been identified the positive impact of learning through play: the work of Zaharias et al. (2017) "results in serious games being effective learning tools, demonstrating the positive impact on learning of the 2D and 3D educational game on Geography".

There are various concerns about the use of JavaScript. These refer to "creating dynamic and interactive websites to support the teaching-learning process of web programming with JavaScript and Java Server Pages, an assessment tool" (Jaimez-Gonzalez, 2019). Also, the JavaScript program is considered "an easy means of bringing interactivity and checking the answers to the educational, fast-to-learn, attractive web pages, highlighting the educational use and tests in the future of distance learning" (Krumm and Thum, 1998).

Regarding "increasing the performance of students after improving the teaching-learning-assessment methods, a specialized paper that studies "visible learning", a guide for teachers (Hattie J., 2012), stands out. A useful method for calculating the results of assessments on certain time intervals and on certain samples, is "calculating the size of the effect (d and r)" (Hedges and Olkin, 1985; Cohen, 1988; Lipsey and Wilson, 2001; Schagen and Hodgen, 2009; Rosenthal et al., 2000). These results of the size of the positive effect are consistent with previous results in the literature (for example Hattie, 2009).

At the opposite end, we find studies on the lack of motivation of students that can lead to reduced learning outcomes and an unpleasant atmosphere in the classroom (Liu et al., 2012), and boredom on the computer to a problematic behavior (Baker et al., 2010). Educational research has shown that students actively involved in the learning activity will learn more than passive students (Butler, 1992).

Although there have been many research studies on learning through play, few have referred to pre-university education, and the subject of geography. We thus consider this study appropriate, in order to highlight the importance that information and communication technology (ICT) has acquired in teaching, learning and evaluating geography, especially with the advent of the COVID-19 pandemic (Toma et al., 2021). This aspect is considered necessary as a means of motivation for students and teachers.

A study from Ireland provides substantial evidence of the negative psychosocial impact of SAH ("home schooling") perceived by parents and students and of the fact that students learned less during SAH (Flynn et al., 2021).

The usefulness of teaching situational geography stories in virtual reality and the value of using this teaching method can induce positive and negative emotions, as demonstrated in China (Yang et al., 2022).

The research performed aims to evaluate (quantitatively and qualitatively) the method of teaching-learning through play, with the method of Power Point presentation. At the same time, steps were taken to determine the students' opinions about the advantages and disadvantages of the implemented game and to use it in the future.

The aim is to identify optimal teaching methods in the current context of technological development.

2. MATERIALS AND METHODS

2.1. Research objectives

The hypothesis proposed to the study research is that a game developed through the JavaScript programming language and included in the teaching-learning sequence of geography would increase the volume of information and specific skills assimilated by students.

The overall objective of the research is to comparatively assess the teaching-learning-assessment of students through play, compared to another method of teaching-learning and the students' perspective through a questionnaire of their reflection about the implemented method.

This identifies the advantages, disadvantages and usability of the game. This objective took into account 4 specific objectives.

The first objective was to measure the level of previously acquired knowledge and specific skills through a formative assessment standardized with the Kahoot! interactive exercise by measuring the size of the effect on formative tests on the Kahoot! learning platform.

The second objective was to measure the level of acquired knowledge and specific competencies through a formative assessment standardized with the Interactive Kahoot! exercise during the game developed through JavaScript/Google Forms implemented teaching-learning tool by measuring the size of the effect on the formative tests.

The third objective was to measure the level of knowledge that students acquired after applying the implemented teaching-learning game by measuring the size of the effect on the tests on the Kahoot! learning platform.

The fourth objective was to learn the students' opinion about using the game tool in JavaScript as a teaching-learning technique by applying a feedback questionnaire in the Google Forms application.

2.2. The context of the research and the sample

The research was carried out within the pre-university education in the subject of geography, during 12 topics about the Hydrosphere, from four levels of study, representing the 5th, 6th, 9th and 10th grades, totaling a number of 373 students. For the experimental groups, Google Forms and the game developed with JavaScript as a teaching-learning method was used as a teaching-learning tool associated with the PowerPoint presentation (231 students) and for the control groups (142 students) only the PowerPoint presentation. The Google Forms questionnaire on students' perception of the two teaching-learning models was applied only to experimental groups.

The groups of students in the sample are intellectually homogeneous, but heterogeneous in high school specialization (mathematics, social sciences and philology profiles), have a predominantly visual learning style, studying Geography one hour a week from the common trunk.

A selection criterion was used to choose the classes that will participate in the learning experiment with the two comparative methods: two ISCED levels 2 and 3 in the classes with the lowest previous average (9th grade H, 10th D and 6th grade B) and two ISCED levels (international standard classification of education) 2 and 3 in the classes with the previous higher average (10th E and 9th C) and with approximately equal averages in classes 5th A and 5th B, but with insignificant differences in the score of the average between the classes of the two (experimental and control) groups before the experiment is conducted, from a minimum of two points for the 6th graders, to a maximum of 0.56 points in the 10th grades. This situation makes it possible to support the fact that the dispersion of the two samples is homogeneous, as a prerequisite for the future experiment to be carried out optimally.

Regarding the variable "high school/middle school level profile", an equal number of students was selected for the two groups, 145 students for the "sciences" profile and 58 for the "humanities" profile, and an equal number of 28 students for the level of the 5th and 6th grades. Their attribution is symmetrical within the two groups, with a larger number of students in the experimental group to compare their own JavaScript web game created and the Google Forms tool associated with the PowerPoint presentation.

The reason for recruiting and selecting participants is to identify the degree of influence of the teaching-learning sequence through its own JavaScript-created game and the Google Forms tool simultaneously with the presentation in Microsoft PowerPoint in learning geography, starting from:

* The measurement of the level of knowledge previously acquired by the students;

* The implementation in the routing sequence of the teaching-learning of the method with their own JavaScript created game and the Google Forms tool associated with the presentation in Microsoft PowerPoint;

* The measurement of the level of knowledge acquired and the specific competences through a formative assessment;

* The measurement of the level of knowledge acquired by the students after the application of the implemented method of teaching;

* The students' opinion on the use of the Google Forms/JavaScript game tool associated with the presentation in Microsoft PowerPoint as tools of the teaching-learning method.

The sample size represents all the 373 students belonging to the classes that have the same teacher of Geography in the same educational unit, involving middle school and high school.

2.3. The tool used and the validation

The study used the following research methods and tools: analysis (collecting data on the conduct of teaching-learning-assessment within the classes), in order to assess the specific competences, performance and progress of students; the quantitative statistical method for calculating the magnitude of the effect for school acquisitions of expected progress; the survey method based on the questionnaire, using the Likert ordinal scale; the method of observing students' behaviour; the analysis of the products of students' activities; the experiment; the method of researching school documents; the test method and the comparative method. For the interpretation of data, we used statistical methods.

The tool used in teaching-learning students is the use of their own created game in JavaScript / Google Forms associated with the PowerPoint presentation. To evaluate the students' results, we used the formative test on the Kahoot! platform for the feedback sequence. The validation model used is the grid for interpreting the value of the effect size, according to Cohen (1988).

2.4. Model and procedure of research

a. The procedure for the experiment:

Cohen (1988) calculated the effect size in two ways: for the same level with the two evaluation moments – the previous one (pre-test) and during the implemented teaching-learning method with their own web created game in JavaScript and with the Google Forms tool associated with the Microsoft PowerPoint presentation (post-test), for experimental and control groups. The second way is for the same level as two other evaluation moments – during the implemented teaching-learning method with the JavaScript web game and the Google Forms tool and PowerPoint presentation.

The methodology used (within the experiment) to measure the results of the students in the three stages was achieved by testing the hypothesis of the magnitude of the studied effect, based on the quantitative statistical method of calculating the size of the effect for school acquisitions of the expected progress of the students per class during the research period, by using the SPSS program – *Statistical Package for the Social Sciences* (for the experimental and control classes, for the 5th and 9th grades) and Jasp and Jamovi (only for 6th grades and 10th grades, because the SPPS program did not calculate, as there was a single test to compare between the two groups).

So, the methodology used to test the assumption of the magnitude of the effect studied is the quantitative statistical method of calculating the magnitude of the effect on school procurement of the expected student progress by class during the research period using the Jasp program. Standard class deviation was calculated at all evaluations and effect size in tests (equation 1), in two ways: for the same class as the two assessment moments – one previously, and the other one during the implemented teaching-learning method using our game in JavaScript / the Google Forms instruments (equation 1, situation 1 and 2) and for the period of implementation of the teaching and learning method with our game in JavaScript / the Google formats tool, the second phase of research for different classes (equation 1, situation 3).

The effect size (d) is:

$$d = \frac{M\ (test\ 1) - M(test\ 2)}{(AS\ test\ 1 + AS\ test\ 2)/2} \qquad (1)$$

Where:

Situation 1 (the same class):

M (test 1) is the mean of the posttest (for the whole class); M (test 2) is the mean pretest (for the whole class); AS test 1 is the standard deviation of the posttest (for the whole class); AS test 2 is the standard deviation of the pretest for the whole class.

Situation 2 (the same class):

M (test 1) is the posttest mean, during the use of the implemented method (for the whole class); M (test 2) is the mean pretest previous (for the whole class); AS is standard mean deviation of the same class for the two moments of the assessment.

Situation 3 (different classes):

M (test 1) is the mean test for class with our game in JavaScript/the Google Forms tool (for the whole class); M (test 2) is the mean test for a class without Google Forms tool (the whole class); AS test 1 is the standard deviation class with Forms; AS test 2 is the standard deviation class without our game in JavaScript/ Google Forms tool.

In the post-research stage, we analysed the results of each class, thus comparing the teaching-learning method with our game in JavaScript/ the Google Forms tool, with the presentation PowerPoint method over the five weeks in the 9th and 5th grades and for one week in the 6th and 10th grades.

A further five week Kahoot! standardized game-type assessment in the 5th, 6th, 9th and 10th grades was also carried out to compare the progress or backsliding of students after the method implemented with our game in JavaScript/the Google Forms teaching-learning tool ceased to apply. The effect size has also been calculated for the next stage (equation 1, situation 4).

Situation 4 (the same class):

M (test 1) is the mean posttest during the usage of the implemented method (for the whole class); M (test 2) is the pretest, previous to method implementation (for the whole class); AS is the standard deviation of the whole class for the two moments of the assessment.

Students who used our game in JavaScript/the Google Forms tool method, received at the end a questionnaire stating its advantages and disadvantages and to what extent they agree to the re-use of this teaching-learning method during future classes.

Other working methods were the teaching-learning method and the survey based on the Google Forms questionnaire, the JavaScript web game and the graphical method of the results obtained with students by classes in the Microsoft Excel program.

Also, the experiment was carried out for a total of 373 students in middle school (5th and 6th grades) and high school (ninth and tenth grades).

The results are presented according to the specific objectives of the research, namely the performance achieved by the students compared between the three teaching-learning methods and the students' perception of teaching and learning based on their own web game created in JavaScript and the Google Forms tool/associated with the presentation in Microsoft PowerPoint.

b. The procedure for creating your own JavaScript web game

Making online games involved integrating requirements into web pages using certain types of computer languages: Hyper Text Markup Language (HTML), Cascading Style Sheets (CSS) and JavaScript.

HTML is a markup language that forms the structural basis of web pages. Through it we created and ordered the components of web pages. The other computer languages mentioned completed the project by stylizing and animating their component elements.

CSS is a computer tool necessary for editing HTML documents. It allows the implementation of the visual aspect characteristics of the component elements in a web page. In this case, CSS has provided an important help in stylizing and arranging objects in games for a visual effect as pleasant and attractive as possible. Without CSS, creating HTML pages is very difficult, the results on their design are often unsatisfactory.

For a good interaction it was necessary to use a programming language used in handling web pages, JavaScript. Through its specific codes, we were able to build and complete the applications we wanted. JavaScript allows animating, modifying, moving elements created in HTML, as well as changing CSS codes to change the appearance of graphic elements according to user action (Fig. 1).

```
<script>
var nrQ=0;
var nrTotal=18; //total questions
var corect=0; //total correct answers
var incorect=0; //total incorrect answers
var raspuns=4; //answers option (0,1,2 or 3)
var nrC=0;
var timp=30; //the number of minutes provided

var titlu=" LECȚIA 1-Hidrosfera" ; //lesson title
var capitol="<b>GEOSFERELE TERREI: HIDROSFERA</b>"; //chapter title
var tipLectie="Lecție dobândire de noi cunoștințe (de descoperire pe cale inductivă/deductivă) ";  //lesson type
var atitudini="<i>Respectarea unor reguli ....</i>";//responsible attitudes / connection to real life
```

Fig. 1. The first variables created to manage information in game development.
Source: the authors

Questions, answers, specific competences, performance standards and operational objectives were grouped together as separate matrices, the link between them being the order in which they were positioned. For example, the first question in the series of questions corresponds to the variants of the answer from the first element in the sequence of answers, the first element in the sequence of objectives, the first element in the string of performance standards and the first element in the skill sequence.

Syntax example:

const questions =[“Exercise 1”,0, “the location of the image file to be displayed”, “Image source:”];
const answers=[“answer1”,”answer2”,”answer3”,”answer4”];

In the given example, the first exercise is elemental in questions [0][0], and the correct saying is questioned [0][1], marked with 0, that is, the first variant of answer. If it was past 1, it meant that the correct answer was the second option. With the help of JavaScript, we were able to link the elements in these data strings to display the necessary information.

If the sixth exercise appears in the game, i.e. questions [5][0], the response variants displayed will be those from the answers [5], the performance standards displayed will be those from the standards [5], the specific competencies from the competencies [5], and the operational objectives from the objectives [5]. Of course, these names can be changed, but for a more correct understanding of the structure of the game, we used the names “questions”, “answers”, “competencies”, “standards”, “objectives”.

After completing the games, they were uploaded to an online server, from where they were accessed. It is necessary to purchase a web hosting package (hosting) and an internet domain for the operation of this website (www.hidrosfera-jocuri.com). The created devices will be accessible for the students, requiring only an internet connection.

The own created game model can also be used internationally, by setting in Google Chrome the translation of a desired foreign language (Fig. 2).

2.5. Data analysis

The study was divided into four stages of research. In the first stage, the results of previous formative assessments were analyzed by comparing the average obtained by level (classes) from seven and eight contents (pre-test results).

In the second stage, the results of the formative assessments were analyzed by comparing the score obtained per class to the one (grades 6th and 10th) and five (5th and 9th grades) contents about the Hydrosphere, during the comparison of the three teaching-learning methods.

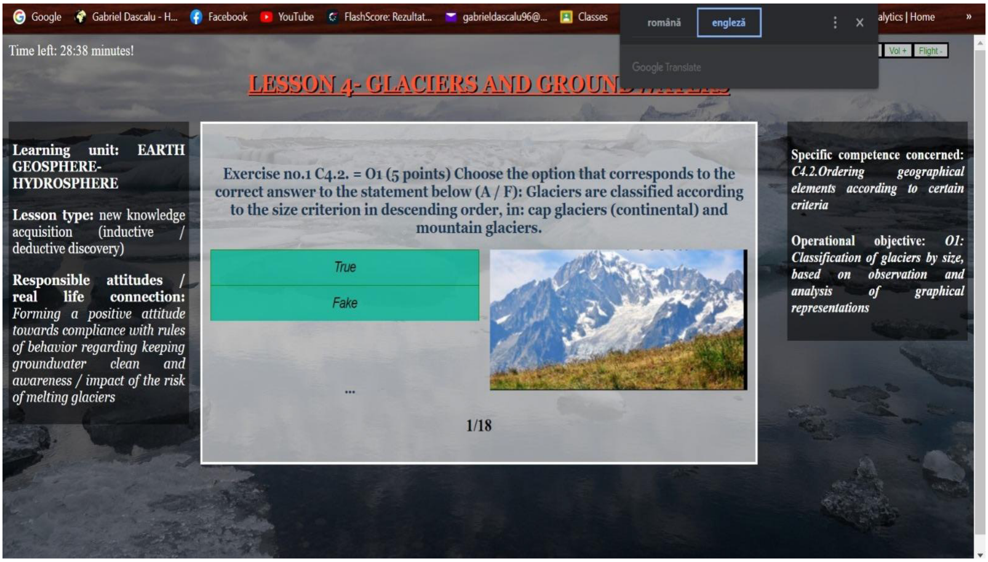


Fig. 2. Own created game model in Java Script in English by setting in Google Chrome the translation into a desired foreign language.
Source: the authors

For all 12 lessons, the number of questions in the game made was 18, with a working time limit of 30 minutes, with play buttons, pause and volume. The 18 items are of objective type, in which one is correct and the rest are fun, plausible, of the dual choice type: True / False and with multiple choices from 3 or 4 variants of answer. On the first background is the title of the lesson, the learning unit, the type of lesson and the responsible attitudes/connection with real life to be formed to the students. Then, on each image of the existing 18, a learning activity (exercise) with the number of the specific competence and the number of the proposed operational objective, the title of the lesson, the learning unit, the type of lesson, the play, pause and volume buttons, the specific competence targeted and the proposed operational objective is each put in place. The students choose the correct answer and will be shown whether the answer is right or wrong and the number of the question they are in. Students cannot move on to the next learning activity if they do not tick an answer. The last picture will show the resolution time, score and wrong detailed answers on specific skills and operational objectives. The students will keep this last image as a screenshot and post it on Google Classroom in the theme category. The score obtained by the students is on average per class a score of over 90 points, which confirms the attention throughout the teaching-learning conduct sequence.

At all 3 stages presented, at the assessment sequence at the end of each class, all students received a Kahoot!! game with nine standardised questions on the specific competences and formulated according to the operational objectives of the lesson and a feedback question on the lesson taught by the teacher. As teaching-learning methods, the PowerPoint presentation associated with the Google Forms tool for 2 experimental classes (57 students), the PowerPoint presentation associated with the own created game in JavaScript programming language for 6 experimental classes (174 students) and only the PowerPoint presentation for the control groups (142 students) were used.

The data with the test results stored in Excel was converted to the ODS program and entered into the Jamovi program. The methodology used (within the experiment) to measure the students' results from the 3 stages was achieved by testing the hypothesis of the magnitude of the studied effect, based on the quantitative statistical method of calculating the size of the effect for school acquisitions of the expected progress of the students per class during the research period, by using the Jamovi program. The average difference was calculated in this program, SD, SE, p, at all assessments (Table 1) and the effect size of the tests (Cohen effect size), in two ways. The first way was for the same level with the two moments of assessment – the previous one (pre-test) and during the implemented method of teaching-learning with the JavaScript game and the Google Forms tool and PowerPoint presentation (post-test). The second way was for the same level with two other assessment moments – during the implemented teaching-learning method with the JavaScript game and the Google Forms tool and PowerPoint presentation (pre-test) and later – only with teaching-learning based on PowerPoint presentation (post-test).

In the fourth stage, the Google Forms questionnaire applied to students from the experimental groups was analyzed. It included 6 items, of which 2 questions were with an open answer, 1 question contained the Likert scale and 3 questions on demography.

The methodology used in testing the hypothesis of the size of the studied effect is the quantitative statistical method of calculating it for school acquisitions of the expected progress of the students per class, during the research period of the three teaching-learning models.

3. RESULTS

The results are presented according to the four specific objectives of the research, namely the performance achieved by students compared between the three teaching-learning models and the students' perception of teaching-learning based on JavaScript and the Google Forms tool.

In the second sub-stage, in the 5th and 9th grades, a minimum value of the average is noticed in the first lesson from an average of 7.65 (in the 5th grade) to 8.38/8.26 in the 9th grades, these progressing to the maximum values of the average of 9.05 at the lesson 5 in the 5th grade and 9.64 in the 9th grades. In the 6th grades, the average was 9.04 and in the two classes of the 10th grade (with JavaScript game associated with the PowerPoint presentation) there was an average of 8.66 and 8.22 respectively (with Google Forms tool associated with PowerPoint presentation).

According to the data obtained, none of the students obtained a score below 5 in the experimental groups. At the same time, it can be seen how, as the score progresses towards the maximum possible result, the control group tends to register decreasing values. In the 9-10 points category, the experimental group recorded values of 63.57%, more than half of the students, while the control group registered only 39.82% (table 1).

Table 1. The score obtained by the students in the experimental and control groups

	3 points	4 points	5 points	6 points	7 points	8 points	9 points	10 points
Percent students (%) Experimental group	0	0	0.59	4.72	9.84	21.25	35.43	28.14
Percent students (%) Control group	1.45	1.74	7.26	11.91	15.4	22.38	26.74	13.08

Source: the authors

Thus, the average obtained by the experimental group was 8.77 points, and that of the control group was 7.73 points, with a difference of 1.04 points between them.

The figures below show the evolution by classes and by experimental groups and control groups viewed comparatively.

Fig. 3 shows the pretest-posttest evolution of the experimental groups.

Fig. 3. Bar chart made in SPSS program – Results of the Kahoot! formative tests at pretest and during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (posttest) related to the contents about the Hydrosphere (class level experimental group).
Source: the authors

In Fig. 4, the evolution of the experimental and control groups and by class may be noticed during the implementation of the methods (5th grades in Fig. 5, 6th grades in Fig. 6, 9th grades in Fig. 7 and 10th grades in Fig. 8).

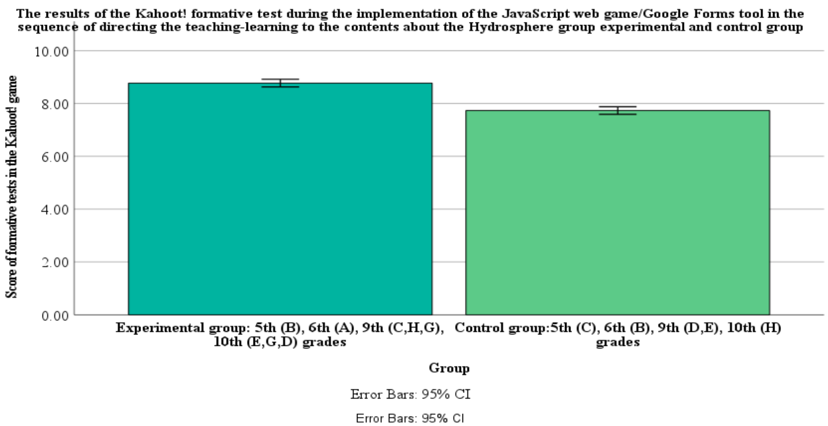


Fig. 4. Bar *chart* made in SPSS program – Results of Kahoot! formative tests before (pretest) and during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (posttest) related to the contents about the Hydrosphere (experimental group and control group, by class level).
Source: the authors

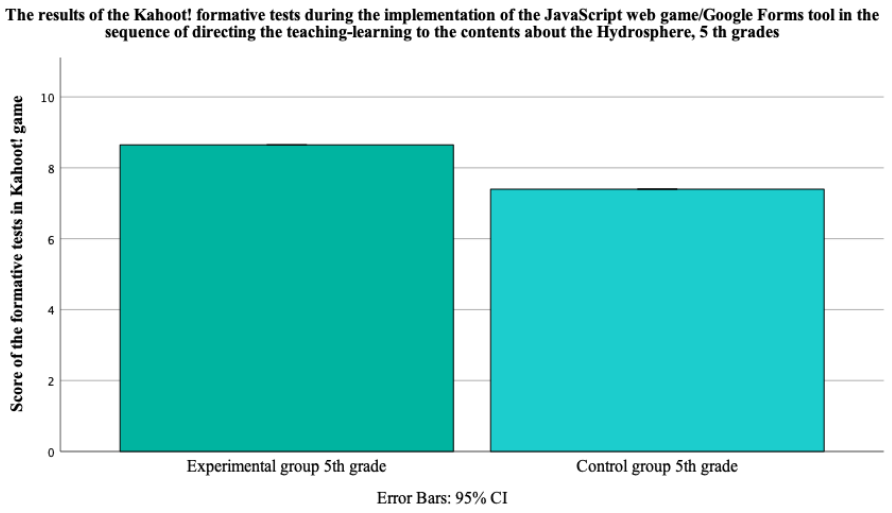


Fig. 5. Bar chart made in SPSS program – Results of Kahoot! formative tests before (pretest) and during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (posttest) related to the contents about the Hydrosphere (experimental group and control group, 5th grades).
Source: the authors

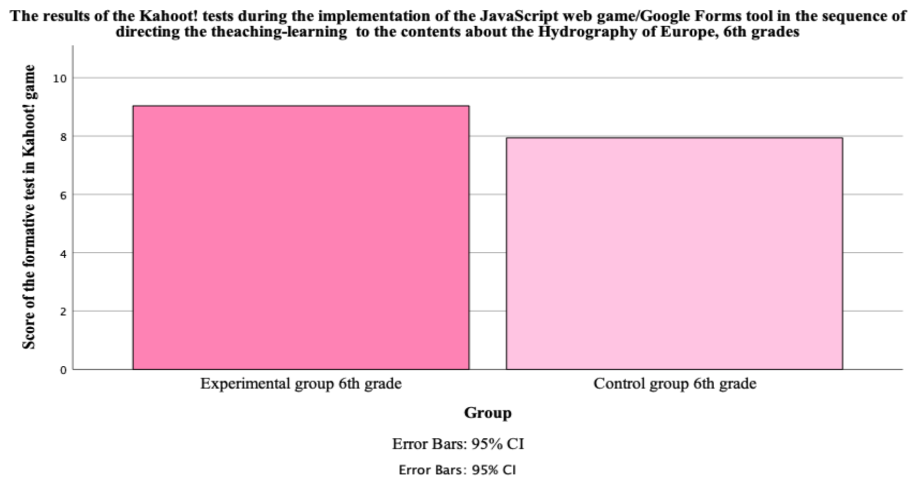


Fig. 6. Bar chart made in SPSS program – Results of Kahoot! formative tests before (pretest) and during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (posttest) related to the contents about the Hydrography of Europe (experimental group and control group, 6th grades).
Source: the authors

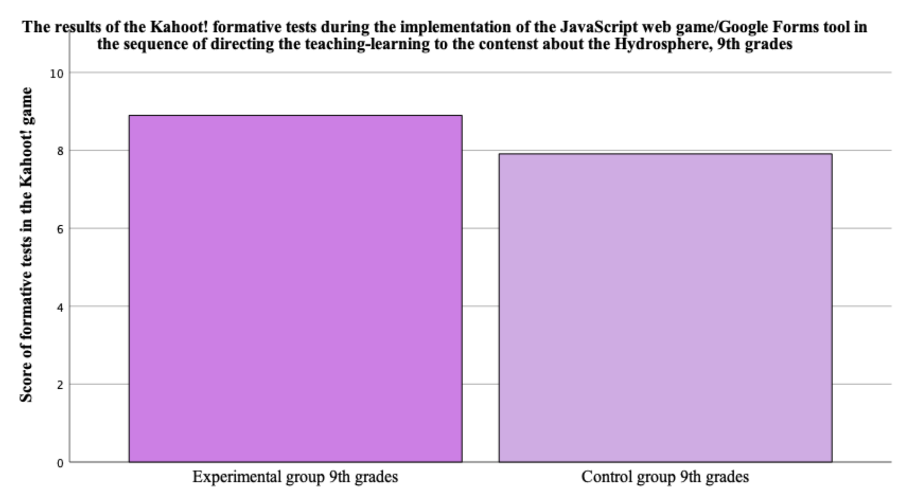


Fig. 7. Bar chart made in SPSS program – Results of Kahoot! formative tests before (pretest) and during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (posttest) related to the contents about the Hydrosphere (experimental group and control group, 9th grades).
Source: the authors

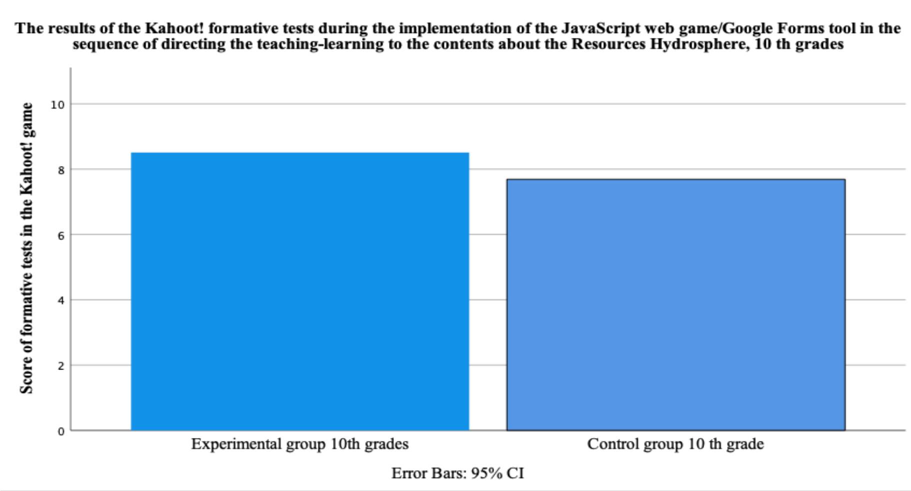


Fig. 8. Bar chart made in SPSS program – Results of Kahoot! formative tests before (pretest) and during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (posttest) related to the contents about the Resources of Hydrosphere (experimental group and control group, 10th grades).
Source: the authors

The value of the effect size obtained by class (***d***, Cohen) was obtained by calculating it from the experimental groups together with the control groups.

Thus, in the experimental classes, the size of the Cohen effect is very large, at 3.97 (manually calculated, according to Hattie formula) or 3.99 (calculated in Jamovi program) and p has values < 001 during the implementation of the teaching-learning of the method with the own created web game in JavaScript / Google Forms tool associated with the presentation in Microsoft PowerPoint, during the period of five lessons, compared to the subsequent period, when the value decreases.

At the same time, in the control groups, calculated in the Jamovi program, the size of the Cohen effect has an average value of 0.577 (calculated in the Jamovi program) and p has values of 0.332 during the implementation of the teaching-learning of the method using the JavaScript game, but not in these classes, for the period of five lessons, compared to the subsequent period when the value decreases.

A validation model of the variable used regarding the level of knowledge acquired and of the specific competences during the method implemented with the web game-type tool created by JavaScript / Google Forms tool and the presentation in Microsoft PowerPoint in the teaching-learning routing sequence, is another magnitude index of the effect: omega-squared (ω2), in equation 2 as follows:

$$\omega 2 = \frac{t^2-1}{t^2+n1+n2-1} = \frac{8.77^2-1}{8.77^2+(175+56)+142-1} = \frac{75.91}{448.91} = 0.169 \qquad (2)$$

In this case, *t* is the test average obtained by the experimental groups, *n1* is the number of students in the experimental group and *n2* is the number of students in the control group.

After calculating the index, its resulting value was 0.169. According to Cohen's recommendation, given that 0.17 is greater than 0.14, it indicates a strong association between the use of the own created web game in JavaScript / Google Forms tool and the amount of information assimilated by students. In this situation, the hypothesis can be confirmed with certainty, according to which, if in the process of teaching and learning geography, the web game tools created personally in JavaScript / Google Forms associated with the presentation of Microsoft PowerPoint are introduced, then the volume of information and specific skills assimilated by students increases.

All the results of the assessments, measured by the Cohen index (class average) reflect a higher level of knowledge for all experimental classes during the application of the teaching-learning method based on the JavaScript web game and Google Forms tool, which are the subject of this research.

In the third stage, the results of the formative evaluations were analyzed by comparing the average obtained by level (classes) from five contents (pretest results, during the implementation of the three training methods) with the results obtained later (posttest, after applying the methods).

The results of the pretest (considered during the implementation of the three training methods) and posttest (considered the subsequent average) for the experimental groups and for the control groups are shown in Fig. 9 and Fig. 10.

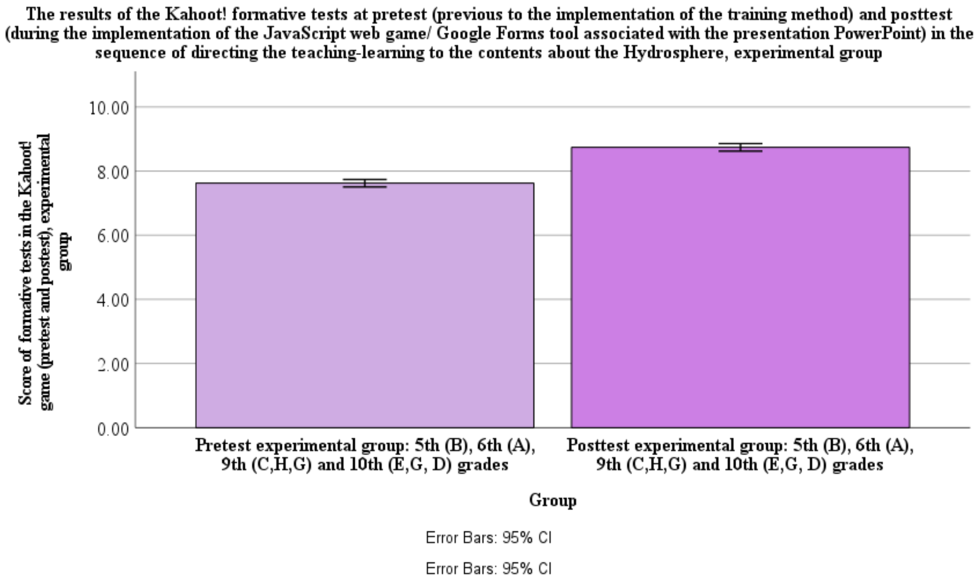
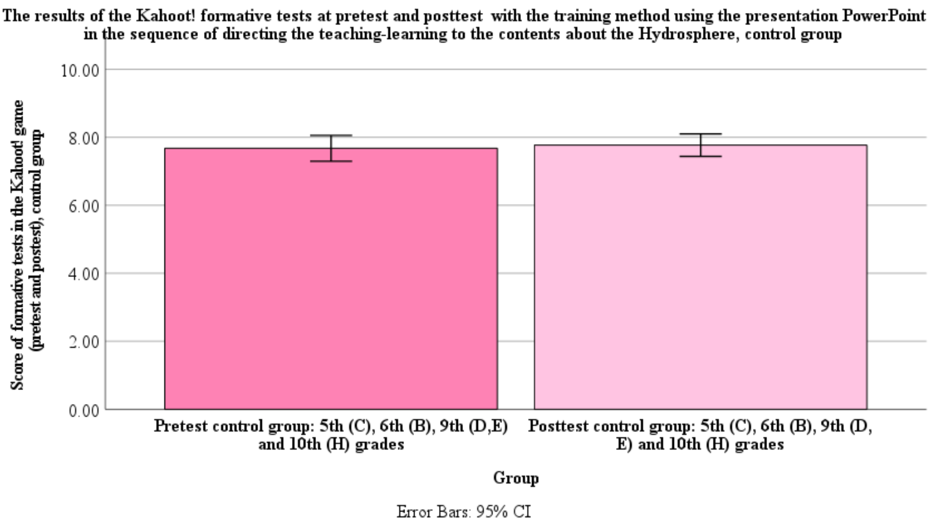


Fig. 9. Bar chart made in SPSS program – Results of Kahoot! formative tests during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (pretest) and after the implementation of the methods (posttest) related to the contents about the Hydrosphere (experimental group, by class level).
Source: the authors

All assessment results, as measured by the Cohen index (class average), reflect a higher level of knowledge for all experimental classes during the application of the teaching-learning method based on the JavaScript game and the Google Forms tool, which are the subject of the research *(Table 2).* The p-values of experimental groups during the implementation of the teaching-learning method with JavaScript tool and Google Forms is < 0.01.



Error Bars: 95% CI

Fig. 10. Bar chart made in SPSS program – Results of Kahoot! formative tests during the implementation of the method with the JavaScript web tool and Microsoft PowerPoint presentation (pretest) and after the implementation of the methods (posttest) related to the contents about the Hydrosphere (control group, by class level).
Source: the authors

Table 2. The results obtained at the Kahoot! formative test related to contents about the Hydrosphere

Group of students	**Pre-test (period of implementation of teaching-learning through play compared to the previous period)**				
	Mean	**Mean difference**	**Std. Deviation/ AS**	**p**	**Effect size: Cohen's d**
Experimental groups with teaching-learning method with JavaScript game and Google Forms tool, associated with the PowerPoint presentation	8.77	1.04	0.239	< .001	3.99
Control groups with teaching-learning method with PowerPoint presentation	7.73	-1.04	0.249	0.332	0.577

Source: the authors

The pre-test average (five assessment tests), the average obtained during the JavaScript game and Google Forms tool implementation associated with PowerPoint presentation in the sequence of conducting learning-teaching related to Hydrosphere content (one/five assessment tests), and the post-test average (five assessment tests) are in Table 3.

Regarding the questionnaire applied to students to learn their opinion on the use of the game-type tool developed, a feedback questionnaire developed in Google Forms was also used. 204 students responded to this, of which male 51% and female 49%. When asked if they would still reuse the game type developed and the Google Forms tool as a form of teaching-learning, 81.6% of students checked the total agreement and 18.4 answered with partial agreement.

Table 3. Pre-test average (at five assessment tests). Average during JavaScript game and Google Forms tool implementation associated with PowerPoint presentation in the sequence of conducting learning-teaching related to Hydrosphere content (at one/five assessment tests). Post-test average (at five assessment tests)

Classes	**Pre-test average (five assessment tests)**	**Average during JavaScript game and Google Forms tool implementation associated with PowerPoint presentation in the sequence of conducting learning-teaching related to Hydrosphere content (one/five/ assessment tests)**	**Post-test average (five assessment tests)**
5th grade B (teaching method with JavaScript game and PowerPoint presentation)- experimental group	7.40	**8.5**	7.50
5th grade C (teaching method with PowerPoint presentation) - control group	*7.37*	*7.40*	7.57
6th grade A (teaching method with JavaScript game and PowerPoint presentation) - experimental group	8.09	**9.04**	7.54
6th grade B (teaching method with PowerPoint presentation) - control group	*8.07*	*7.94*	**7.71**
9th grade C (teaching method with JavaScript game and PowerPoint presentation) - experimental group	7.88	**9.06**	7.96
9th grade H (teaching method with JavaScript game and PowerPoint presentation) - experimental group	7.57	**9.03**	7.92

Classes	**Pre-test average (five assessment tests)**	**Average during JavaScript game and Google Forms tool implementation associated with PowerPoint presentation in the sequence of conducting learning-teaching related to Hydrosphere content (one/five/ assessment tests)**	**Post-test average (five assessment tests)**
9th grade D (teaching method with PowerPoint presentation) - control group	*7.73*	***8.10***	7.94
9th grade E (teaching method with PowerPoint presentation) - control group	*7.37*	***7.73***	7.76
10th grade E (teaching method with JavaScript game and PowerPoint presentation) - experimental group	8.15	**8.81**	8.17
10th grade D (teaching method with Google Forms tool and PowerPoint presentation) - control group	*7.59*	*8.22*	7.22
10th grade H (teaching method with PowerPoint presentation) - control group	*7.85*	***7.69***	7.56
5th grade B (teaching method with JavaScript game and PowerPoint presentation)- experimental group	7.40	**8.5**	7.50
5th grade C (teaching method with PowerPoint presentation) - control group	*7.37*	*7.40*	7.57
6th grade A (teaching method with JavaScript game and PowerPoint presentation) - experimental group	8.09	**9.04**	7.54
6th grade B (teaching method with PowerPoint presentation) - control group	*8.07*	*7.94*	**7.71**
9th grade C (teaching method with JavaScript game and PowerPoint presentation) - experimental group	7.88	**9.06**	7.96
9th grade H (teaching method with JavaScript game and PowerPoint presentation) - experimental group	7.57	**9.03**	7.92
9th grade D (teaching method with PowerPoint presentation) - control group	*7.73*	***8.10***	7.94
9th grade E (teaching method with PowerPoint presentation) - control group	*7.37*	***7.73***	7.76
10th grade E (teaching method with JavaScript game and PowerPoint presentation) - experimental group	8.15	**8.81**	8.17
10th grade D (teaching method with Google Forms tool and PowerPoint presentation) - control group	*7.59*	*8.22*	7.22
10th grade H (teaching method with PowerPoint presentation) - control group	*7.85*	***7.69***	7.56

Classes	**Pre-test average (five assessment tests)**	**Average during JavaScript game and Google Forms tool implementation associated with PowerPoint presentation in the sequence of conducting learning-teaching related to Hydrosphere content (one/five/ assessment tests)**	**Post-test average (five assessment tests)**
5th grade B (teaching method with JavaScript game and PowerPoint presentation)- experimental group	7.40	**8.5**	7.50
5th grade C (teaching method with PowerPoint presentation) - control group	*7.37*	*7.40*	7.57
6th grade A (teaching method with JavaScript game and PowerPoint presentation) - experimental group	8.09	**9.04**	7.54
6th grade B (teaching method with PowerPoint presentation) - control group	*8.07*	*7.94*	**7.71**
9th grade C (teaching method with JavaScript game and PowerPoint presentation) - experimental group	7.88	**9.06**	7.96
9th grade H (teaching method with JavaScript game and PowerPoint presentation) - experimental group	7.57	**9.03**	7.92
9th grade D (teaching method with PowerPoint presentation) - control group	*7.73*	***8.10***	7.94
9th grade E (teaching method with PowerPoint presentation) - control group	*7.37*	***7.73***	7.76
10th grade E (teaching method with JavaScript game and PowerPoint presentation) - experimental group	8.15	**8.81**	8.17
10th grade D (teaching method with Google Forms tool and PowerPoint presentation) - control group	*7.59*	*8.22*	7.22
10th grade H (teaching method with PowerPoint presentation) - control group	*7.85*	***7.69***	7.56

Source: the authors

4. DISCUSSIONS

In the proposed research we investigated the method of teaching-learning through play, based on the acquired scores compared to the formative assessment of the students. Based on the interpretation of their results, we consider that the purpose of this study is to identify the most appropriate teaching-learning solutions for the future and to ensure specific competencies in the curriculum.

Creating a game that maintains the interest and attention of students during the teaching-learning sequence, which develops their specific skills and ensures school progress is necessary.

The results showed that students who benefited from their own play created by means of JavaScript and the Google Forms teaching-learning tool achieved better results with significant values, highlighting the students' school progress.

There were research papers that examined the effects of the game in the long term, focusing more on knowledge and less on the attitudes of students (Mondozzi and Harper, 2001).

The results obtained by the experimental groups reflect the fact that the positive influence factor is represented by the method of teaching-learning through play and the realization of the learning activities proposed for all students. The negative factor for the control groups is the lack of attention of some students during the class, with only a part of the students being asked for answers, thus highlighting the lower results.

We also identified other causes of lower results in both groups of students: lack of necessary technical equipment (video projector, permanent internet connection, etc.), the speed of students to tick the answers to the formative assessment of Kahoot! game type, the response time to questions, the different degrees of difficulty for the contents of the lessons studied.

The results obtained in this study have demonstrated the criteria for success, in terms of teaching-learning by using one's own game created by means of JavaScript language and the Google Forms tool, regarding the permanent assessment on the Kahoot! learning platform, which provides active participation among all students in a class and improves the quality of the instructive-educational process.

No disadvantages have been identified concerning this method used in the research we have carried out.

The best for the teaching-learning process is the performance of learning activities with all the students of the class, by using active-participatory methods and modern IT training means. The assessment must be permanent (formative) and agreed by the students, in the form of an interactive game. Thus, the quality of teaching depends on the tools provided in the school, on the students, on the professional training, on the needs of teachers and students, as we find in other studies (Almaia Ana et al., 2020; Gewin, 2020).

Also, the results obtained showed first of all that the choice of teaching-learning strategies and appropriate assessment tools by the teaching staff, develops a deep understanding of the information by the students, as evidenced by other scientific papers (Ruan et al., 2021).

The proposed methodological addition contributes to the completion of the practical approaches of the assessment tools and of the effective teaching-learning methods.

The study also has some limitations that need to be considered, but which could indicate potential future lines of research. One of the main limitations is the size and origin of the sample, therefore generalizations based on these results should be treated with caution.

Another limitation of the study may be the low content in curriculum while using the teaching-learning method with the Google Forms tool (one chapter for grades 5th and 9th and one lesson for grades 6th and 10th).

5. CONCLUSIONS

The answer to the study's research question *if a game developed through the JavaScript programming language is included in the sequence of geography teaching and learning, would it increase the volume of information and specific skills assimilated by students?* is positive. There is thus evidence of the progress of the proposed theory by means of the results obtained, through which the performed research affects the use of educational information systems.

The results obtained proved that teaching-learning based on this game improved the learning process of the students. The effectiveness of the method based on information technology may be underestimated by those who do not have it. At the same time, participatory methods of learning through discovery and assessment through play develop a responsible and motivational attitude towards learning, cognitive intelligence skills for students and improve the specific competences of students.

The study examined that Google Forms tool, Kahoot! learning platform, PowerPoint presentation, the own-created game developed with JavaScript have a positive effect on learning and assessment. In particular, these digital technologies energize the students, and for the teacher they represent motivating tools of the teaching activity. Also, the use of digital technology is suitable for measuring and accepting e-learning tools, as other research has shown (Joo et al., 2014).

The study demonstrates that the results obtained by students in the tests are significantly better for those who have used the two teaching-learning tools and can be recommended for ICT analysis in school education, as they allow the student to be an active agent in the learning process, along with other Google applications (Rejón-Guardia et al., 2019).

Compared to current research, one have learned that the development of the specific competences in the school curriculum for all students through their active participation and the optimal school progress of the students is mainly given by the degree of involvement of the students in the entire instructive-educational process, by the training and stimulation of all the students of a class during courses. We address the need to analyze the results of the permanent assessment, as teachers can properly implement the teaching strategies, in order to ensure the success of the students' learning.

The method does not induce a departure from the learning objectives of the content specific to the curriculum and does not require special digital skills.

The results obtained are in line with other research papers that show that games have positive influences on students' knowledge, learning and acquiring skills (Barab et al., 2005).

Investigating how gamification in learning environments can affect physical, cognitive, emotional, and social well-being is present in many international studies (Melo C. et al, 2020).

Possible future lines of research may be the application of the proposed teaching-learning method (the game created in JavaScript) in the context of students throughout several stages of the curricula, or in different geographical areas in order to achieve results which can be easier to generalise.

Author contributions

Conceptualization F.T.; Data curation F.T.; Formal analysis F.T. and D.C.D.; Funding acquisition -; Investigation F.T.; Methodology F.T., D.G. and D.C.D.; Project administration-; Resources F.T., D.G. and D.C.D.; Software F.T., D.G. and D.C.D.; Supervision F.T. and D.C.D.; Validation F.T., D.G., D.C.D., A.N., D.P., R.D.P. and M.M.; Visualization F.T., D.G. and D.C.D.; Roles/Writing - original draft F.T.; Writing - review & editing F.T. and D.C.D.. All authors have read and agreed to the published version of the article.

REFERENCES

1. Almaia Ana, A., Minghat, A.D., Purnawarman, P., Saripudin, S., Muktiarni, M., Dwiyanti, V. and Mustakim, S.S. (2020), *Students' Perceptions of the Twists and Turns of E-learning in the Midst of the Covid 19 Outbreak*, Romanian Magazine for Multidimensional Education, 12 (1), Suppl. 2, 15-26, doi: /10.18662/rrem/12.1sup2/242.
2. Almaiah, M.A., Al-Khasawneh, A. and Althunibat, A. (2020), *Exploring the Critical Challenges and Factors Influencing the E-Learning System Usage during COVID-19 Pandemic*, Education and Information Technologies, 25 (6), 5261-5280, doi: *10.1007/s10639-020-10219-y.*
3. Andrew, M. (2019), *Collaborating Online with Four Different Google Apps: Benefits to Learning and Usefulness for Future Work*, Journal of Asia TEFL, 16 (4), 1268-1288, doi: 10.18823/asiatefl.2019.16.4.13.1268.
4. Annetta, L., Mangrum, J., Holmes, S., Collazo, K., and Cheng, M.T. (2009), *Bridging Realty to Virtual Reality: Investigating gender effect and student engagement on learning through video game play in an elementary school classroom*, International Journal of Science Education, 31 (80), 1091-1113, doi: 10.1080/09500690801968656.
5. Baker, R.S.J.D., D'Mello, S.K., Rodrigo, M.M.T., and Graesser, A.C. (2010), *Better to be frustrated than bored: The incidence, persistence, and impact of learners' cognitive–affective states during interactions with three different computer-based learning environments*, *International Journal of Human-Computer Studies, 68* (4), 223–241, doi: 10.1016/j.ijhcs.2009.12.003.
6. Barab, S., Thomas, M., Dodge, T., Carteaux, R., and Tuzun, H. (2005), *Making learning fun: Quest Atlantis, a game without guns*, Educational Technology Research and Development, 53, 86-107, doi: 10.1007/BF02504859.
7. Borza, M. and Park, J.O. (2020), *Facing the University Environment with Covid-19 Pandemic: A Comparative Analysis between Romania and South Korea*, Romanian Magazine for Multidimensional Education, 12 (1), 34-38, doi: /10.18662/rrem/12.1sup2/244.
8. Butler, J.A. (1992), *Use of teaching methods within the lecture format*, Medical Teacher, 14 (1), 11–25, doi: 0.3109/01421599209044010.
9. Cheng, M.T. and Annetta, L. (2012), *Students' learning outcomes and learning experiences through playing a Serious Educational Game*, Journal of Biological Education, 46 (4), 203-213, doi: 0.1080/00219266.2012.688848.
10. Cheung, R. and Vogel, D. (2013), *Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning*, Computers and Education, 63, 160–175, doi: 10.1016/j.compedu.2012.12.003.
11. Cheng, M.T., Lin, Y.W. and She, H.C. (2015), *Learning through playing Virtual Age: Exploring the interactions among student concept learning, gaming performance, in-*

game behaviors, and the use of in-game characters, Computers and Education, 86, 18-29. doi: 10.1016/j.compedu.2015.03.007.
12. Cohen, J. (1988), *Statistical power analysis for the behavioral sciences* (2nd ed.), Routledge, New York, 567 p, eBook, doi:10.4324/9780203771587.
13. del Barrio-García, S., Arquero, J. L., and Romero-Frías, E. (2015), *Personal learning environments acceptance model: The role of need for cognition, e-learning satisfaction and students' perceptions*, Journal of Educational Technology and Society, 18 (3), 129–141, https://www.jstor.org/stable/pdf/jeductechsoci.18.3.129.pdf.
14. Dolezal, D., Posekany, A., Motschnig, R., Kirchweger, T., and Pucher, R. (2018), *Impact of game-based student response systems on factors of learning in a person-centered flipped classroom on C programming*, EdMedia+ Innovate Learning, 1143–1153, Association for the Advancement of Computing in Education (AACE), https://www.learntechlib.org/p/184323/.
15. Elsherbiny, M.M.K., and Maamari, R.H. (2020), *Game-based learning through mobile phone apps: effectively enhancing learning for social work students*, Social Work Education, 40 (3), 315-332, doi: 10.1080/02615479.2020.1737665.
16. Flynn, N., Keane, E., Davitt, E., Mccauley, V., Heinz, M. and Mac Ruairc, G. (2021), 'Schooling at Home' in Ireland during COVID-19': Parents' and Students' Perspectives on Overall Impact, Continuity of Interest, and Impact on Learning, Irish Educational Studies, 40 (2), 217-226. doi: 10.1080/03323315.2021.1916558.
17. Gee, J.P. (2003), *What video games have to teach us about learning and literacy*, Computers in Entertainment, 1 (1), 20. doi: 10.1145/950566.950595.
18. Gewin, V. (2020), *Into the Digital Classroom. Five Tips for Moving Teaching Online as COVID-19 Takes Hold*, Nature, 580 (7802), 295-296, doi: 10.1038/d41586-020-00896-7.
19. Glover, M.J. (2020), *Google Forms can stimulate conversations in discussion-based seminars? An activity theory perspective*, South African Journal of Higher Education, 34 (1), 99-115, doi: 10.20853/34-1-2814.
20. Hattie, J.A.C. (2009), *Visible learning – a synthesis of over 800 meta-analyses relating to achievement*, Routledge, New York, E-Book, https://www.routledge.com/Visible-Learning-A-Synthesis-of-Over-800-Meta-Analyses-Relating-to-Achievement/Hattie/p/book/9780415476188
21. Hattie, J.A.C. (2012), *Visible learning for teachers – Maximizing impact on learning*, Routledge, New York, E-Book, doi: 10.4324/9780203181522, https://www.routledge.com/Visible-Learning-for-Teachers-Maximizing-Impact-on-Learning/Hattie/p/book/9780415690157
22. Hedges, L.V. and Olkin I. (1985), *Statistical methods for meta-analysis*, Academic Press, Orlando, e-Book: https://files.eric.ed.gov/fulltext/ED227133.pdf.
23. Iwamoto, D.H., Hargis, J., Taitano, E.J., and Vuong, K. (2017), *Analyzing the efficacy of the testing effect using Kahoot! TM on student performance*, Turkish Online Journal of Distance Education, 18 (2), 80–93, doi: 10.17718/tojde.306561.
24. Jaimez-Gonzalez, C.R. (2019), *Assessment of online teaching resources to support the teaching-learning process of web programming with JavaScript and Java Server Pages*, Dilemas contemporáneos – Educación, Política y Valores, VI (3), 54,

https://search.proquest.com/openview/65be78cecbd60b30ac59796924af6bba/1?pq-origsite=gscholar&cbl=4400984.

25. Joo, Y.J., Lee, H.W. and Ham, Y. (2014), *Integrating user interface and personal innovativeness into the TAM for mobile learning in Cyber University*, Journal of Computing in Higher Education, 26 (2), 143–158, https://link.springer.com/content/pdf/10.1007/s12528-014-9081-2.pdf.
26. Karaaslan, H., Kilic, N., Guven-Yalcin, G., and Gullu, A. (2018), *Students' reflections on vocabulary learning through synchronous and asynchronous games and activities*, Turkish Online Journal of Distance Education, 19 (2), 53-70, doi: 10.17718/tojde.444640.
27. Krumm, S. and Thum, I. (1998), *Distance learning on the Web supported by JavaScript: A critical appraisal with examples from clay mineralogy and knowledge-based tests*, Computers & Geosciences, 24 (7), 641-647, doi:10.1016/S0098-3004(98)00041-7.
28. Lin, Y.R. (2018), *The influences of contextualized media on students' science attitudes, knowledge, and argumentation learning through online game-based activities*, Journal of Computer Assisted Learning, 34 (6), 884-898, doi:10.1111/jcal.12297.
29. Lin, Y.C., Hsieh, Y.H., Hou H.T., and Wang S.M., (2019), *Exploring students' learning and gaming performance as well as attention through a drill-based gaming experience for environmental education*, Journal of Computers in Education, 6 (3), 315-334, doi: 10.1007/s40692, https://doi/org/019-00130-y.
30. Lipsey, M. and Wilson, D.B. (2001), *Practical meta-analysis, Applied Social Research Methods Series (vol.49)*, Sage, Thousand Oaks, e-Book, http://rogeriofvieira.com/wp-content/uploads/2016/05/Wilson.pdf.
31. Liu, O.L., Bridgeman, B. and Adler, R.M. (2012), *Measuring learning outcomes in higher education: Motivation matters*, *Educational Researcher, 41* (9), 352–362, doi:10.3102/0013189X12459679.
32. Liu, S.H.J. and Lan, Y.J. (2016), *Social Constructivist Approach to Web-Based EFL Learning: Collaboration, Motivation, and Perception on the Use of Google Docs*, Educational Technology & Society, 19 (1),171-186, doi: /stable/jeductechsoci.19.1.171.
33. Melo, C., Madariaga, L., Nussbaum, M., Heller, R., Bennett, S., Chin-Chung, T., and van Braak, J. (2020), *Editorial: Educational technology and addictions*, Computers & Education, 145 (103730), doi:10.1016/j.compedu.2019.103730.
34. Mondozzi, M.A. and Harper, M.A. (2001), *In search of effective education in burn and fire prevention*, Journal of Burn Care & Rehabilitation, 22 (4), 277-281, doi: 10.1097/00004630-200107000-00006.
35. Murphy, M.P.A. (2018), *"Blending" Docent Learning: Using Google Forms Quizzes to Increase Efficiency in Interpreter Education at Fort Henry*, Journal of Museum Education, 43 (1), 47-54, doi:0.1080/10598650.
36. Perini, S., Margoudi, M., Oliveira, M.F. and Taisch, M. (2017), *Increasing middle school students' awareness and interest in manufacturing through digital game-based learning (DGBL)*, Computer Applications in Engineering Education, 25 (5), 785-799, doi:10.1002/cae.21836.

37. Rejón-Guardia, F., Polo-Peña, A. I. and Maraver-Tarifa, G. (2019), *The acceptance of a personal learning environment based on Google apps: the role of subjective norms and social image*, Journal of Computing in Higher Education, 32 (2), 203-233, doi:10.1007/s12528-019-09206-1.
38. Ruan, L., Long, Y., Zhang, L. and Lv, G. A. (2021), *A Platform and Its Applied Modes for Geography Fieldwork in Higher Education Based on Location Services*, *ISPRS International Journal of Geo-Information, 10 (4),* 225, doi:10.3390/ijgi10040225.
39. Rosenthal, R., Rosnow, R.L. and Rubin D.B. (2000), *Contrasts and Effect Sizes in Behavioral Research: A Correlational Approach*, Cambridge University Press, e-Book, https://www.google.com/books?hl=ro&lr=&id=ByxHEePhwHIC&oi=fnd&pg=PR9&dq=Rosenthal,+R.,+Rosnow,+R.L.,+%26++Rubin,+D.B.(2000).+Contrasts+and+Effect+Sizes+in+Behavioral+Research:+A+Correlational+Approach.+ISBN-13:+978-0521659802.+&ots=gvQVf_nIlW&sig=WszSybCZEAbfcZvAo2_hBzVahuw.
40. Schagen L. and Hodgen E., (2009), *How much difference does it make? Notes on understanding, using, and calculating effect sizes for schools*, Research Report, www.educationcounts.govt.nz/publications/schooling/36097/36098.
41. Sharples, M. (2020), *The design of personal mobile technologies for lifelong learning*, Computers & Education, 34 (3–4), 177–193, doi: 10.1016/S0360-1315(99)00044-5.
42. Taylor, B. and Reynolds, E. (2018), *Building vocabulary skills and classroom engagement with Kahoot!*, in 26th Korea TESOL International Conference, 89, Seoul, Korea. https://koreatesol.org/sites/default/files/pdf_publications/KOTESOL.2018--Extended.Summaries.pdf#page=89.
43. Toma, F., Diaconu, D.C. and Popescu, C.M. (2021), *The Use of the Kahoot!! Learning Platform as a Type of Formative Assessment in the Context of Pre-University Education during the COVID-19 Pandemic Period*, Education Science, 11 (10), 649, doi:/10.3390/educsci11100649.
44. Wang, A.I. and Tahir, R. (2020), *The effect of using Kahoot!! for learning – A literature review*, Computers & Education, 149, 103818. doi: /10.1016/j.compedu.2020.103818.
45. Yang, S., Zhaoxue, W., Ming, L., Jing, Y., and Yunchao, G. (2022), *An Empirical Study of Geography Learning on Students' Emotions and Motivation in Immersive Virtual Reality*, Sec. Educational Psychology. doi:10.3389/feduc.2022.831619.
46. Zaharias, P., Chatzeparaskevaidou, I. and Karaoli, F. (2017), *Learning Geography Through Serious Games: The Effects of 2-Dimensional and 3-Dimensional Games on Learning Effectiveness, Motivation to Learn and User Experience*, International Journal of Gaming and Computer-Mediated Simulations, 9 (1), 28-44, doi:10.4018/IJGCMS.2017010102.