Impact of the Use of the Video Game SimCity on the Development of Critical Thinking in Students: A Quantitative Experimental Approach

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***Abstract*—The objective of the research is to determine to what extent the use of the SimCity video game allows the development of critical thinking in the teaching-learning processes of students. The methodology applied consisted of a research with a quantitative approach of experimental type, working with a sample of 25 students selected through a simple random sampling of a population of 100 students, 10 sessions were developed using the SimCity video game, a pretest and posttest of skills and abilities required to develop critical thinking of Watson Glaser were applied, whose dimensions measured were: Inferences, assumptions, deductive reasoning, logical interpretation and evaluation of arguments. The results show that with adequate stimulation through the use of the SimCity video game, critical thinking can have a moderate but effective development in the students, from the comparison of the data obtained in the pretest and posttest a significant progress in terms of scores is observed; likewise, the effectiveness of the use of the SimCity video game is reflected to a greater extent in inferences and evaluations of arguments, since during the posttest evaluations greater progress was observed in comparison to other skills; while the interpretation of information obtained less progress in comparison to the other skills, the use of skills such as deductive reasoning, inferences and evaluation of arguments were moderately developed. In conclusion, the use of the SimCity video game allows the development of skills and abilities to develop critical thinking according to various factors, such as the way in which it is incorporated into the curriculum, the orientation and guidance of teachers, and the way in which reflection and analysis is carried out after the game experience.**

Keywords*—SimCity; video games; critical thinking; critical learning

I. Introduction

In many educational institutions, the teaching approach focuses on memorization and repetition of information rather than critical analysis of it. This can hinder the development of critical thinking in students as they are not given the opportunity to question and critically evaluate information. In this context, we propose the following research question: To what extent does the use of the video game SimCity foster the development of critical thinking in students?

SimCity is a game designed for educational and critical decision-making purposes. The study [1] mentions that these games, besides being created by a dedicated team of game developers, also involve psychologists, doctors, and other professionals who assist in creating a more serious and realistic environment. Thus, SimCity is a serious simulation game where decisions depend on the player. According to [2], a video game can be a simulation game, which, unlike a simulator, tends to have open gameplay based on strategy and role-playing, as opposed to a rigid action and adventure gameplay of a simulator. SimCity is a video game software created by Electronic Arts and released in 2003. The game is designed for single player, but there is an option to create multiple cities that can be played by different people at different times within the same software. It is a system simulation game where players assume the role of a mayor and deal with issues such as crime, budget deficits, and traffic to create and develop cities [3]. Additionally, [2] mentions that as a simulator, one must think as if everything were real and consider all the factors present since the player holds the power. The simulation game SimCity offers the opportunity to orchestrate the construction and development of a city. The tremendous success of SimCity demonstrates the surprisingly convincing power of a particular type of human-computer interaction. According to [3], in combination, it can be understood that it is a popular game that allows for interaction between people and machines. The success of the game in education is due to the artificial environment with rules where there are no limits of size or time [4]. Since the game presents a large amount of data that players must be aware of, such as air pollution levels. SimCity 4 allows its players to shape and build a settlement where the player acts as the mayor [5]. SimCity allows players to determine the evolution of a city, which depends on the player's decisions. Thus, SimCity has an interface with a small control panel that provides information about the city's development and any problems it may have, whether they are economic, social, etc.

The SimCity game guide mentions that decision-making is the main aspect, as players, in the role of mayor, must define zones for houses, factories, and others while also meeting basic needs in order to maintain a stable city. At the beginning, it is recommended to follow a small tutorial to understand the game's themes [6]. The city is not just a toy that SimCity claims to be, and SimCity plays with urban planning in a way that misleads students in their understanding of how a city works and how it could be planned [3]. SimCity is considered a serious game [7]. They mention: Games have the unique ability to provide participants, especially learners, with the opportunity to acquire skills through activities embedded within the game itself. This is due to the playful and interactive nature of games, which allows players to experience situations and challenges actively and participatively. Unlike

gamification, where game elements are incorporated into contexts that are not necessarily playful, games themselves are inherently playful by design. In other words, when it is mentioned that games allow for the acquisition of skills through game-based activities, it refers to how players learn and enhance their abilities as they interact with the game. These activities can involve solving puzzles, making strategic decisions, overcoming obstacles, and achieving goals within the game. Through these actions, players are exposed to challenges that require the application of specific skills, thus contributing to the acquisition of skills.

According to [8], thinking is defined as the ability to process information and build knowledge through the combination of mental representations, operations, and attitudes. It classifies thinking into three types:

- Automatic Thinking: Sometimes we act without much thought, we think automatically; that is, we respond immediately to various stimuli in the environment with previously learned responses.
- Systematic Thinking: Other times, we stop to think, we think systematically; we use all the intellectual resources at our disposal (concepts, skills, and attitudes) to create new responses to situations.
- Critical Thinking: Finally, in very extraordinary occasions, we reflect on our own thinking process; we carry out what philosophers call self-awareness and psychologists call metacognition. This involves examining and critically evaluating our own thoughts, beliefs, and assumptions, as well as the arguments and evidence supporting our conclusions. Critical thinking aims to objectively analyze, question, and rigorously evaluate information before reaching conclusions or making decisions.

Furthermore, it is mentioned that the stage of formal operations, also known as the fourth stage, is the highest point at which a person can make decisions through broader logic [9]. Thus, it can be understood that learning theory is related to critical thinking since in its fourth stage, conclusions are sought through more exhaustive reasoning.

Critical Thinking is configured as a philosophical type of thinking that is concerned with cultivating and improving each individual's reasoning abilities [10]. In other words, it is the capacity that a person possesses to have a critical judgment in a given situation. Critical thinking is a mode of thinking about any topic, content, or problem in which the thinker improves the quality of their thinking by grasping the inherent structures of the act of thinking and subjecting them to intellectual standards [11]. In other words, critical thinking is a cognitive skill that involves analyzing information objectively and systematically, carefully evaluating it, and making informed decisions based on available evidence. Critical thinking involves the ability to analyze, synthesize, and evaluate information from different sources, including books, articles, websites, media, and personal experience.

The Multidimensionality of Critical Thinking has been categorized by [12] as a mode of thinking that corresponds to the current conditions of the development of productive and technological forces, their complexity, and the changes underlying the multidimensionality of systems. Thus, it is understood that critical thinking seeks to relate all possible aspects of a topic to understand their influence on it. Critical thinking constitutes a complex system of dimensions that allows for the analysis of one's own thinking and that of others at a more specific level, which, when subjected to the analysis of the different dimensions, as stated by [13].

- Logic: Involves analysis through logical reasoning.
- Substantive: Evaluates truth and falsehood.
- Contextual: Recognizes the social and historical context.
- Dialogical: Examines thoughts in relation to the perspectives of others.
- Pragmatic: Recognizes the purpose or intention behind a thought.

It has been researched that SimCity can be applied in the development of administrative skills in undergraduate and graduate students [14]. This indicates that SimCity has application in the educational field. Additionally, Piaget's learning theory reflects the fourth stage when playing a strategy video game, as the player will use logic to make decisions [15]. Thus, SimCity, being a strategy game where decisions must be made through structured logic, allows for the development of critical thinking. Unlike many games, SimCity encourages deep thinking due to its characteristics. Of course, no matter how much computer game designers grant to players, any simulation will be based on a set of basic assumptions. SimCity has been criticized from both the left and the right for its economic model [3]. Therefore, individuals who play SimCity must apply their knowledge based on the dimensions of critical thinking. In strategy games, it is mentioned that logical thinking and problem-solving are primarily developed [16]. Thus, it can be understood that SimCity as a game allows for the development of logic as another dimension of critical thinking, but as a simulator, other aspects must also be considered. Furthermore, [17] mentions that the game allows for decision-making based on the environmental conditions displayed during the construction and development of the city. Therefore, to make decisions, the contextual and dialogical dimensions are important because one has to think based on what is proposed during the game and then make decisions.

On the other hand, the use of algorithms is common in video games. The research [18] mentions how video games nowadays use predictable algorithms, but with the use of artificial intelligence, this varies, although they become more comprehensible and logical. Thus, the pragmatic dimension will also be developed as, during the game, one will have to anticipate and think about the future critically and question the decisions made.

Therefore, critical thinking is essential in decision-making to make them with determination. The author in [19] mentions that video games improve reasoning and critical thinking abilities, leading to making accurate decisions.

According to the research conducted by [20], there is an effect of the game SimCity on the development of spatial intelligence among students at Angkasa Secondary School in Bandung. Secondly, the application of the SimCity game in geography learning helps students make decisions to overcome spatial problems. This is evidenced by the increase in the average score in the post-test of the experimental class after using SimCity as an instructional medium. Thirdly, the application of the SimCity game in geography learning requires structured learning scenario planning and proper time allocation. Consequently, the learning steps must be carefully followed without skipping any steps. Fourthly, SimCity game can be an alternative learning medium, although it has some disadvantages compared to conventional methods.

Likewise, the research conducted by [21] demonstrated that even a technically complex and fast-paced medium like a computer video game, SimCity, can be used in an instructional scenario for an extended period with limited effort, although the challenge of the game's aging must be actively addressed. Furthermore, in the described instructional scenario, SimCity is perceived as a motivating and accepted learning diversification: the learning activity can be considered playful. This finding, moreover, has not been widely presented in the literature.

II. Research Methodology

The applied methodology follows a quantitative experimental approach.

A. Objective

To determine to what extent the use of the video game SimCity in teaching-learning processes allows the development of skills and abilities to promote critical thinking in regular basic education students.

B. Hypothesis

The use of the video game SimCity in teaching-learning processes enables regular basic education students to develop skills and abilities to promote critical thinking.

C. Variables

- Independent: Use of the video game SimCity
- Dependent: Development of critical thinking
- Controlled: The number of students and the playtime of SimCity

D. Population and Sample

A simple random sampling has been applied to select 25 students for the control group and 25 students for the experimental group. The total population consisted of 100 third-grade students from regular secondary education. Informed consent was obtained from the parents or guardians of all students.

E. Methodological Design

The research is experimental in nature. According to [22], unlike theoretical research, it requires direct interaction with the members and components of the group being studied, in this case, individuals. To determine the effectiveness of the video game SimCity in the development of critical thinking, the Watson Glaser Critical Thinking Appraisal test [23] will be administered. This test is internationally standardized.

F. Aspects Measured by the Watson Glaser Test

- Capacity for critical thinking.
- General understanding of the importance of providing evidence and support when formulating conclusions.
- Ability to differentiate between inferences, assumptions, and generalizations through the application of logic.
- The ability to combine these skills in decision-making.

Table I shows that both Group A and Group B participated in the study and were administered the Watson Glaser Critical Thinking Appraisal test in both the pretest and posttest. Additionally, a total of 10 sessions of 30 minutes each were conducted as part of the study. The total duration of the study was 12 hours.

TABLE I. Procedure Followed in the Research

Group	Pretest	Sessions	Postest	Duration
Group A and B	The Watson Glaser Critical Thinking Appraisal test will be administered to both samples	10 sessions of 30 minutes each will be conducted	The Watson Glaser Critical Thinking Appraisal test will be administered to both samples	12 hours

G. Application of the Watson Glaser Test to Both Samples

The Table II displays the distribution of questions and scores across different dimensions of critical thinking.

TABLE II. Structure of the Watson Glaser Test

Dimensions	Number of questions	Score
Inferences	15	15
Assumptions	16	16
Deductive Reasoning	9	9
Logical Interpretation	12	12
Evaluation of Arguments	15	15
Total	67	67

H. Sessions for the use of the Video Game SimCity

1) Introduction to the game SimCity

- In a session of 25 to 30 minutes, the students will be explained about the game SimCity and how it is played.
- The entire introduction will be played for the students to understand the game dynamics.

2) Duration of the 10-hour game

- Session 1: A small stable population will be initiated.
- Session 2: Connections with neighboring towns will be developed.

- Session 3: Investments will be made in education, health, and security.
- Session 4: A railroad or highway will be constructed.
- Session 5: Construction will take place in the other neighboring cities.
- Session 6: New transportation methods will be built based on the city.
- Session 7: A balance will be sought in six aspects: traffic, health, education, environment, security, and land value.
- Session 8: Demographic growth will be initiated by expanding more areas.
- Session 9: Community problems will be addressed and solved.
- Session 10: More recreational sites and leisure areas will be created if there is stability.

The sessions are for reference purposes, as the students have the final decision on what they choose to do.

3) Objectives of the game in SimCity:

- Achieve a population of at least 50,000 inhabitants.
- Avoid having a deficit.
- Maintain a positive score of over 60% in the six aspects (traffic, health, education, environment, security, land value).

III. Results

Table III shows the total scores of the pretest and posttest of Watson Glaser applied to the 25 students.

TABLE III. Comparison of Watson Glaser Test Scores

Student	Pretest	Postest
01	35	52
02	33	50
03	37	51
04	32	51
05	36	50
06	36	52
07	31	49
08	33	52
09	37	52
10	37	48
11	36	54
12	36	49
13	37	50
14	36	50
15	30	46
16	34	54
17	36	54
18	30	51
19	33	52
20	34	48
21	32	48
22	32	49
23	35	48
24	32	50
25	32	48

Table IV shows the results by dimensions of the pretest Watson Glaser.

TABLE IV. Results By Dimensions of the Watson Glaser Pretest

Students	Inferences	Assumptions	Deductive Reasoning	Interpretation of Information	Evaluation of Arguments	Total
01	8	8	6	6	7	35
02	6	10	5	6	6	33
03	7	8	6	7	9	37
04	5	12	6	6	8	37
05	7	9	4	6	10	36
06	7	8	5	6	10	36
07	6	7	5	6	7	31
08	7	7	4	7	8	33
09	6	8	4	8	11	37
10	6	9	5	8	9	37
11	5	9	6	8	8	36
12	7	9	5	7	8	36
13	8	10	5	7	7	37
14	8	9	5	7	7	36
15	5	7	6	5	7	30
16	8	9	6	5	6	34
17	6	11	5	7	7	36
18	6	6	5	7	6	34
19	8	7	6	6	6	33
20	6	9	5	6	8	34
21	7	8	4	6	7	32
22	5	8	6	5	8	32
23	8	11	3	7	6	35
24	6	9	3	6	8	32
25	8	5	4	6	9	32
Total	15	16	9	12	15	67

TABLE V. Results by Dimensions of Watson Glaser Postest

Students	Inferences	Assumptions	Deductive Reasoning	Interpretation of Information	Evaluation of Arguments	Total
01	12	12	7	9	12	52
02	11	11	7	9	12	50
03	11	13	7	9	11	51
04	10	14	8	8	11	51
05	11	12	6	8	13	50
06	12	12	7	8	13	52
07	13	11	6	8	11	49
08	13	11	7	9	12	52
09	11	10	7	11	13	52
10	9	10	7	9	13	48
11	12	13	8	11	10	54
12	9	11	8	9	12	49
13	13	12	6	9	10	50
14	12	11	6	9	12	50
15	9	9	8	8	12	46
16	15	12	8	8	11	54
17	15	13	8	8	10	54
18	12	11	7	10	11	51
19	10	13	8	10	11	52
20	11	10	6	8	13	48
21	9	12	7	8	12	48
22	9	11	7	11	11	49
23	9	11	7	8	13	48
24	11	12	6	8	13	50
25	12	9	6	10	11	48
Total	15	16	9	12	15	67

Table V presents the results of the posttest Watson Glaser assessment, indicating a comprehensive overview of students' critical thinking skills across different dimensions. The provided scores suggest a notable improvement in various critical thinking dimensions following the implementation of the SimCity game. It is evident that the use of SimCity has positively impacted students' critical thinking abilities. Specifically, the dimensions of Inferences, Assumptions, Interpretation of Information, and Evaluation of Arguments display improved scores, underscoring the game's influence on enhancing these critical thinking aspects. Moreover, the overall total score demonstrates a collective improvement, reinforcing the notion that the game has contributed significantly to the students' overall critical thinking skills.

TABLE VI. PAIRED T-TEST

Statistics	Variable 1	Variable 2
Mean	34.28	50.32
Variance	5.376666667	4.47666667
Observations	25	25
Pearson correlation coefficient	0.363155411	-
Hypothesized difference of means	0	-
Degrees of freedom	24	-
t statistic	-31.97783414	-
P(T<=) one-tail	1.7226E-21	-
Critical value of t (one-tail)	1.71088208	-
P(T<=) two-tail	3.4452E-21	-
Critical value of t (two-tail)	2.063898562	-

Table VI displays the paired samples t-test, which shows a significant difference between both variables. this indicates that the impact of the simcity video game application influences the development of critical thinking. It can be concluded that variable 2 has a significantly higher mean than variable 1. This conclusion is based on the extremely low p-values, the comparison of the t-statistic with critical values, and the direction of the observed difference

I. Data Analysis

An analysis of the data collected is presented and analyzed in the following graphs.

According to Fig. 1, the development of the inference ability varied among each student, due to the multiple strategies that can be approached in the game. It is evident that the development in the inference ability of each student was positive, as all of them obtained a higher score compared to the pretest, surpassing their previous score by an average of five points. For a successful experience in SimCity, it is necessary to infer that, thanks to this ability, we can determine or identify certain information that is not explicitly stated in the source [24]. Thus, to achieve the proposed objectives in SimCity, some students approached the inference aspect better, for example, constructing multiple small and stable cities to fulfill the goals without encountering problems. Overall, the inference ability was developed through the game's challenges, which were tackled with varied solutions proposed by the players.

In Fig. 2, a lesser progress is observed in the development of the assumption ability, a factor related to how students approached problems based on clues and how effective their solutions were. Considering something as true or real based on the clues available [25]. This understanding allows us to infer those problems such as the need for more schools, shopping centers, or other facilities placed in the necessary quantity and the right location were actions taken by the students to fulfill the proposed objectives. In conclusion, the assumption ability had a more complex development, as the numerous options provided by SimCity can lead to making many errors.

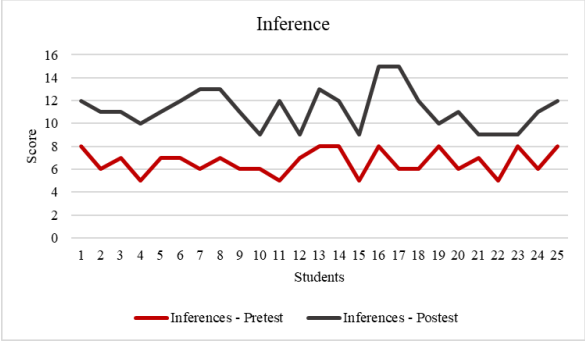

Fig. 1. Scores of the inference ability.

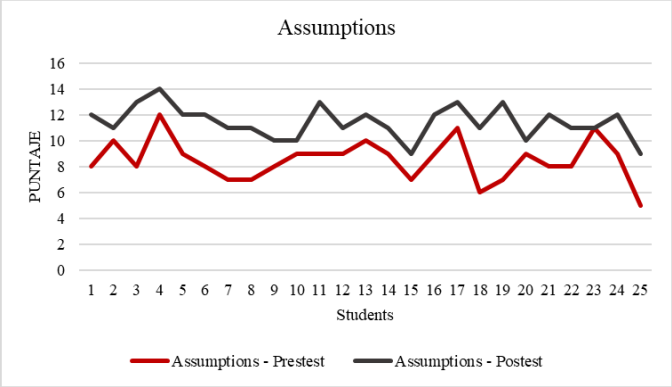

Fig. 2. Scores of the assumption ability.

According to Fig. 3, regarding deductive reasoning, a positive impact is observed as all students obtained better scores, improving by an average of 2 points compared to the pretest. Furthermore, with a maximum score of 9, significant development can be identified, with six students achieving a score of 8. In relation to SimCity, this ability is of utmost importance because when there are problems with city organization or services, the game communicates through messages that inform the player about possible strikes or riots, which leads students to make decisions and infer conclusions about the potential outcomes if the problems are not resolved. This reasoning allows organizing premises into syllogisms that provide decisive proof for the validity of a conclusion; it is often said to deduce from an unexplained situation [26]. For example, if there are environmental problems, the premises can be the notifications and the low percentages in city aspects such as health and the environment. Overall, SimCity enables the exercise of deductive reasoning through its notification system and the overall panel displaying the city's aspects.

According to Fig. 4, in terms of information interpretation, the progress was similar to deductive reasoning, with an average increase of 2.48 points from the previous score. This ability is related to the concepts provided at the beginning of the game application since the interpretation of the given tutorial information, which aimed to provide foundations on how a city can grow sustainably, also offered solutions to common problems. The small difference in scores obtained by the students demonstrates a similar interpretation of the tutorial. However, SimCity is not a game of narratives or closed decision-making; it is an open-ended game. Therefore, the interpretation of information varied in each case, as the developing city differentiated itself from others. The information provided to the students through notifications was diverse, and thus, its interpretation also varied.

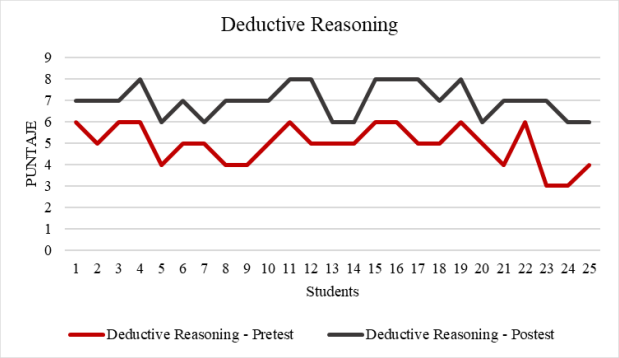

Fig. 3. Scores of the deductive reasoning ability.

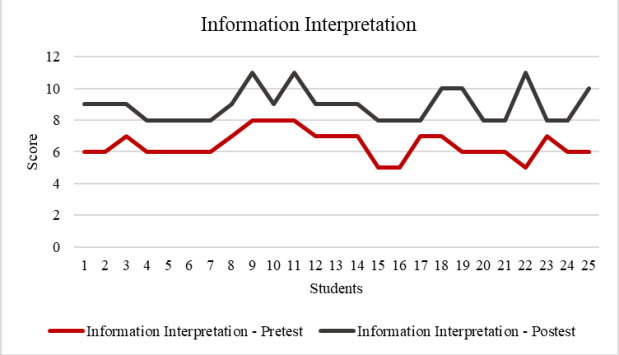

Fig. 4. Scores of the information interpretation ability.

Fig. 5 shows an average development of 4 points compared to the pretest, which indicates that despite not being a game solely focused on answering questions based on information, SimCity has demonstrated that errors allow for significant student learning. An argument is a reasoning that justifies something, and in the case of SimCity, when a decision deviates from the intended path, it can be considered as something negative, leading to the evaluation of the student's decisions. This process prompts students to evaluate their own arguments and make decisions based on them. This attribute is present in each student during the game, as problems frequently arise in the process of building a stable city. Therefore, students often seek solutions, and if they make an incorrect decision, they realize it through the economic deficits they encounter, creating the need to evaluate their decisions and find the best solution, which students achieved and is evidenced by the improvement in their scores.

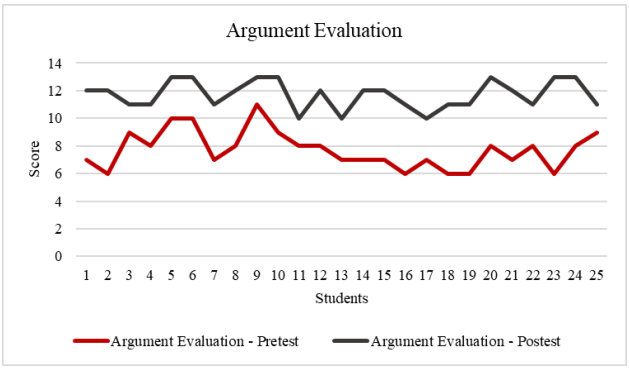

Fig. 5. Scores of the argument evaluation ability.

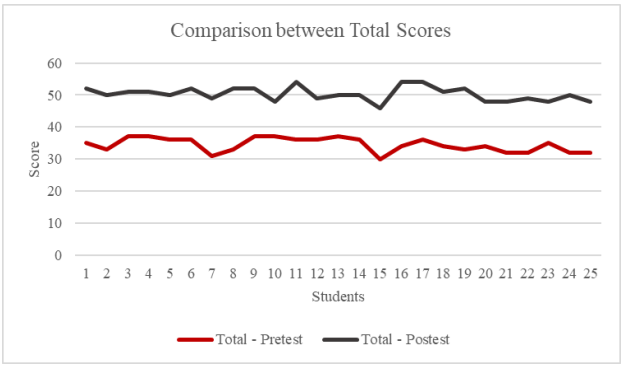

Fig. 6. Comparison of the total scores between the pretest and posttest.

According to Fig. 6, it is evident that critical thinking has developed in the students, as all of them showed improved scores. These results infer that the SimCity video game had a positive impact on the development of critical thinking in students.

IV. Discussion

The results of this study are in line with previous research highlighting the positive impact of the game SimCity on the development of specific cognitive skills. According to the work done by [20], a significant effect of the SimCity game on the enhancement of students' spatial intelligence is established. This finding is important as it supports the notion that video games can contribute to the development of specific cognitive skills, in this case, spatial intelligence, which is crucial for effectively understanding and navigating spatial environments.

Furthermore, the results obtained in this research align with the findings of [21], who also emphasized the perception of SimCity as a motivating and enriching tool in the educational scenario. The motivating diversification of learning adds to the evidence that video games, in this case, SimCity, can generate greater student engagement and participation in the teaching-learning process, potentially improving information retention and the understanding of complex concepts.

Regarding our findings, it was found that the use of the SimCity video game in teaching-learning processes has a positive impact on the development of critical thinking skills in students of regular basic education, although it is partial. This

suggests that while the game contributes to the overall development of critical thinking, some dimensions of critical thinking may not be comprehensively addressed. The dimensions of critical thinking are varied and may require specific approaches for complete development.

In particular, the logical dimension showed the greatest development through the use of the SimCity video game, and this dimension exhibited a close relationship with the results obtained in the Watson Glaser test. This correlation highlights the importance of logical thinking in problem-solving and the evaluation of arguments, two central aspects of critical thinking. However, it is observed that other dimensions of critical thinking could benefit from complementary pedagogical approaches to achieve comprehensive development.

According to [27], engaging in the SimCity video game activity has provided a framework for developing meaningful educational situations that facilitate the contextualization and application of scientific conceptual content acquired by students. Additionally, according to [28], the development of critical thinking attitudes can be determined through various aspects of the gaming experience. One of these aspects involves analyzing the underlying model in the video game and comparing it with reality, while the other aspect involves exploring the values and counter-values presented. In this way, students have applied their acquired knowledge to compare simulation and reality, noting significant differences. Some of the weaknesses criticized for potential educational use can thus be transformed into opportunities for developing skills and attitudes.

For example, it is criticized that the model programmed in the simulation never reaches reality [29], [30]. The development of problem-solving skills through the SimCity video game series has already been confirmed in studies by [31] and [32]. In this case, the steps that students take to solve problems of varying difficulty, ranging from easy to medium and complex, have been analyzed to determine the process followed, in addition to the final result. The conclusion is that through the simulation video game, students can employ very different strategies to reach the same final solution, thus fostering creativity and accommodating the diversity of students [33]. As indicated by [34] and [35], an added value for improving the teaching-learning process of Geography is provided by the need to manage a simple layered geographic information system, which can serve as an introduction to GIS (geographic information systems). Furthermore, according to [36], [37] the development of problem-solving skills is one of the main consequences of becoming a mayor to manage and build a city with SimCity. The research conducted in contrast to the reviewed background allows us to glimpse that it is possible to use this type of video game to develop critical thinking skills in students, as demonstrated by the results.

V. Conclusions

These collective results underscore the effectiveness of the SimCity game in fostering critical thinking skills among students. The improvements across dimensions and the significant shift in mean scores support the premise that video games, when strategically integrated into educational contexts, can indeed contribute to the development of targeted cognitive abilities. This study adds valuable insights to the growing body of research on the educational potential of video games and suggests that their incorporation into pedagogical approaches warrants further exploration and consideration.

The use of the SimCity video game in teaching and learning processes allows for the partial development of critical thinking skills in regular basic education students since the focus is not on each dimension of critical thinking as such, given their diversity. Similarly, the logical dimension was the most developed through the SimCity video game, being the one most related to the Watson Glaser test.

It is inferred that with adequate stimulation through the SimCity video game, critical thinking can have a moderate and effective development in regular basic education students, as significant progress in scores was observed based on the data obtained from the post-test, which were validated with the hypothesis through the Student's t-test.

Likewise, the effectiveness of SimCity is more reflected in inferences and argument evaluations, as greater progress was observed during the post-test evaluations compared to other abilities, even resulting in ideal scores for two students in the inference capacity.

On the other hand, the progress in information interpretation was lower compared to other abilities, as it had a lower but achieved progress. This is because the video game initially only presents a tutorial, which provides a broad scale understanding of the theme, resulting in minimal information to interpret. Meanwhile, the use of skills such as deductive reasoning, inferences, and argument evaluation is more necessary for the development of critical thinking, as only the best decisions ensure the achievement of the proposed objectives.

Recommendations

Regarding the SimCity video game, it should be played in a supervised environment to achieve better results, as this ensures the proper use of the video game since, despite not being an online game, uncontrolled use can lead to addictive behavior. Additionally, it is recommended for future research to apply the test to a control group that does not play SimCity to enable a comparison with an experimental group.

The research was conducted with a relatively small sample of students, which could limit the generalization of the results to larger populations.

Research Limitations

Limited Duration: The study was carried out over a specific period of time, which might not fully reflect the long-term effects of implementing SimCity on students' critical thinking.

Specific Context: The results could be influenced by the specific conditions and characteristics of the educational institution where the study was conducted, making it challenging to extrapolate the findings to other settings.

Focus on a Single Tool: The research centered on the SimCity game as the sole intervention tool. Including other

tools or pedagogical approaches could have provided a more comprehensive understanding of how critical thinking skills are developed.

Impact of External Factors: Uncontrolled external factors, such as individual student motivation or influences beyond the educational environment, could have influenced the outcomes.

Measurement of Other Variables: The research specifically focused on critical thinking and did not consider the measurement of other skills or competencies that could have been influenced by the game.

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