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Impact of Virtual Environments on Learning Binary Inorganic Compounds

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Abstract

A well-prepared abstract enables the reader to identify the basic content of a document quickly and accurately, to determine its relevance to their interests, and thus to decide whether to read the document in its entirety. The Abstract should be informative and completely self-explanatory, provide a clear statement of the problem, the proposed approach, or solution, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length. The abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited. The keyword list provides the opportunity to add keywords, used by the indexing and abstracting services, in addition to those already present in the title. Judicious use of keywords may increase the ease with which interested parties can locate our article.

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1 Introduction

The problem of learning Chemistry in the Ecuadorian educational system is and has always been one of the greatest challenges for teachers; The factors that affect the problem are multiple and hence its complexity arises. The most comfortable attitude for the teacher of this subject is to reproduce the style with which he was trained and, in this way, fulfill the basic tasks of this activity. Therefore, virtual environments within the teaching-learning process are basically work tools through which image, video, audio and communication formats are used with the purpose of motivating learning.

Currently, the management developed by the teacher is essential to optimize the educational process, so it is essential to make available alternatives that facilitate the teaching-learning process. In this sense, the proposed research revolves around the topic of virtual environments and the impact they have on the learning of binary inorganic compounds in the Chemistry subject as a valid alternative to motivate the student.

Through virtual environments, various pedagogical and scientific areas can be developed that promote the development of logic in the various areas of health sciences. These virtual environments can be supported by platforms that can accurately describe the various contents of academic programs, through the use of simulation. On the other hand, it is worth considering criteria such as Chonillo-Sislema (2024), who points out that the teaching of Chemistry requires a pedagogy that transcends the simple memorization of formulas and data. Given this panorama, the teaching-learning of this subject is not an easy process, so the teacher must explore creative, innovative and interactive didactic alternatives (p.87).

The dynamics of the teaching-learning process of Chemistry through virtual environments become more important every day. However, traditional pedagogical strategies are still valid in many educational institutions, where for various reasons virtual environments are not implemented, leaving aside the importance they have in current education. On the other hand, the purpose of the research was to find a solution to the low performance and disinterest that exists among students regarding learning Chemistry. Taking this problem into account, the aim is to evaluate the "VirtualQuimi" Project by incorporating virtual environments for learning binary inorganic compounds, where virtual environments constitute educational strategies that motivate and facilitate learning.

The objective of the research was to determine the impact of virtual environments as a pedagogical strategy to motivate the learning of binary inorganic compounds at the BGU level of the "San Isidro" Educational Unit. The hypotheses raised were: Ho = There are no significant differences between the control and experimental group regarding the impact of virtual environments on the learning of binary inorganic compounds and Ha = There are significant differences between the control and experimental group regarding the impact of the environments. virtual in learning binary inorganic compounds. At the same time, answers are sought to fundamental questions such as: What type of methodological strategies to propose in the teaching-learning process of Chemistry? How to link virtual environments in the meaningful learning of this subject?

Based on the aforementioned, it is considered that the research related to the impact of virtual environments on the learning of binary inorganic compounds at the BGU level of the "San Isidro" Educational Unit emphasizes that, fundamentally, the center of the activity teaching is knowing how their students develop their activity in a more productive way for them. Within the research, it is also considered that the teacher must plan and implement strategies so that his students build their own knowledge.

2 Materials and Methods

The research adopted a quantitative approach. The methodology used was related to the inductive method, through which the information collected is organized and analyzed, with the purpose of drawing conclusions starting from the particular scope of the problem raised until reaching the general one. As well as the deductive method contributed to highlighting the current situation of the teaching-learning process of binary inorganic compounds. On the other hand, the level of correlational research and the type of experimental research were determined.

Data collection was carried out through knowledge tests on the students (control and experimental group). Where, in the first scenario, a demonstration class was developed for the control group, using only the Chemistry textbook provided by the Ministry of Education, and where the teaching material was the photographs that appeared in it. In a second scenario, a demonstration class was implemented for the experimental group, incorporating tools from virtual environments such as the "Virtual Quimi Project" project, whose fundamental purpose is to introduce virtual environments oriented to learning binary inorganic compounds.

The population was made up of teachers and students from the "San Isidro" Educational Unit of the San Isidro parish, province of Manabí. On the other hand, the sample It was made up of two groups of 15 third-year BGU students, each (Control and Experimental Group).

3 Results and Discussions

Virtual environments

The problem of learning subjects such as Chemistry in the Ecuadorian educational system is and has always been one of the greatest challenges for teachers; The factors that affect the problem are multiple and hence its complexity arises. The most comfortable attitude for the teacher of this subject is to reproduce the style with which he was trained and in this way fulfill the basic tasks of this activity. Therefore, virtual environments within the teaching-learning process are fundamentally work tools through which image, video, audio and communication formats are used with the purpose of motivating learning.

Virtual environments are work tools designed to fulfill specific tasks in various areas, such as education. In the area of education, these environments allow teachers better communication with their students, and students better understanding and motivation for learning. On the other hand, within the field of education, there are computer applications dedicated to simulation or games through which the student can participate more actively in the teaching-learning process.

The desired effectiveness in virtual environments requires a reflective practice of teaching, a motivated and committed student body, where needs for belonging, connection, competition, achievement and also fun are fostered, a student body willing to acquire skills such as self-regulation, discipline, collaborative work, decision making; That is, the center of planning is the development of individual or interactive group activities (Baque & Marcillo, 2020).

Basic education must be in line with the development of advances in science and technology to take advantage of the various benefits that virtual environments provide in the educational field, in accordance with the requirements of the students of this generation who are natives of the digital age. . Therefore, the implementation of teaching strategies with technological tools that facilitate various multimedia and hypertext formats is required for the management of autonomous learning and collaborative work in learning from each other.

Virtual learning environments depend largely on the organization, development and use of audiovisual resources, which allow for strengthening knowledge, and communication skills, improving oral expression skills, and stimulating critical and reflective thinking, as well as skills. cognitive, which have their origin in the development of socio-emotional skills (Rodríguez et al., 2023).

The sharing of knowledge through virtual environments highlights the cultural component of the cognitive process, because it is conditioned by the dynamic interaction of the subjects who propose learning, a process in which each of them is enriched by the experience. shared, thus demonstrating that the production of knowledge is a product of interaction and the use of virtual tools (Berrocal & Ruiz, 2023).

Virtual environments at the educational level are spaces hosted on the Internet, which in turn hosts computer applications of all types, depending on the nature of said site. Thus, for example: In the field of Chemistry teaching, these environments could host recreational computer applications that facilitate understanding. On the other hand, the creation of these educational platforms has contributed to the systematization of knowledge, that is, they enable the creation of virtual meetings and information spaces between teachers and students.

Nomenclature of binary inorganic compounds

Chemical nomenclature, in addition to being the language of Chemistry, allows us to achieve a better understanding of basic chemical concepts; for example, the amount of substance, with which the combination relationships between the atoms that make up the substances are explained; the chemical equation, which explains how substances combine to form others and, most importantly, in what proportion they do so, and also allows generating classifications of substances depending on the type of atoms that form them.

Chemical nomenclature requires adequate knowledge of different elements, such as: the symbols of all the elements that exist in nature, their physical characteristics, atomic number, etc. In this regard, Delgado Fernandez (2021), indicates that chemistry as a science studies the composition, structure and properties of matter, as well as the changes they experience during chemical reactions and their relationship with energy (p. 14). In order to learn to form chemical compounds, detailed knowledge of the elements that make them up is required, but additionally, didactic strategies that motivate and draw the attention of students are required. From the point of view of Vera de la Garza & Padilla (2020), nomenclature is one of the most important areas of Chemistry when you are in the process of understanding and speaking in chemical terms (p. 1).

Nomenclature is the language that characterizes Chemistry and that allows chemists to communicate with each other, even if they do not speak the same mother tongue. Therefore, for a student in the area of Chemistry, it is vitally important to learn, understand and correctly apply symbols, terminology, units and nomenclature (Vera de la Garza & Padilla, 2020). However, the difficulties that students present during learning this subject arise during the application of traditional teaching strategies. The lack of understanding of protocols related to chemical notation are the topics that most affect when writing formulas for inorganic binary compounds.

The dynamics of the teaching-learning process of Chemistry become more important every day. However, traditional pedagogical strategies are still valid in many educational institutions, where for various reasons they are not updated, leaving aside the importance they have in current education. Current educational systems are based on the incorporation of innovative pedagogical strategies related to virtual environments, at the same time that they are concerned with motivating the learning of areas of knowledge that, by their nature, represent a certain difficulty for learning. Maila-Álvarez et al. (2020), point out that the incorporation of play in the educational field energizes the teaching-learning process (p. 60).

The importance of chemical nomenclature in general, and especially of binary inorganic compounds, must be considered. It should be noted that, due to its nature, this subject is one of the most complex in terms of the teaching-learning process, at the same time it is considered among the least popular among students. Therefore, Chemistry teachers are required to incorporate pedagogical elements that contribute to the improvement of the teaching of this subject. Activities derived from the use of virtual environments are not a substitute for other teaching methods but should be used as a source of motivation and support tool to optimize the teaching-learning process.

When analyzing the information obtained with the implementation of a pre and post-test regarding the Impact of virtual environments on the learning of binary inorganic compounds in third-year students of BGU Educational Unit "San Isidro" (Control and experimental group).

The purpose of this exercise (Table 1) was to show that there are significant differences between the control and experimental groups regarding the impact of virtual environments on the learning of binary inorganic compounds, as well as to determine if the use of this has a significant impact. or another way in student learning. Verify that virtual environments motivate the active participation of students in the classroom (Dewi et al., 2020; Caputo et al., 2024; Goodman, 1958; Jaradat & Imlawi, 2021). For this, an exercise was planned through which the VirtualQuimi Project project was used to teach binary inorganic compounds. The purpose of the exercise was to generate information that made it possible to demonstrate the impact that the use of virtual environments for learning inorganic chemistry had on students.

Table 1
Control group vs Experimental group

Experimental Group			Control group		
Students	Pre-test score	Post-test score	Students	Pre-test score	Post-test score
EX1	4	5	CO1	3	3
EX2	2	4	CO2	5	4
EX3	4	4	CO3	2	5
EX4	3	4	CO4	3	3
EX5	4	4	CO5	3	5
EX6	5	6	CO6	4	3
EX7	3	5	CO7	4	6
EX8	2	3	CO8	2	2
EX9	4	4	CO9	3	4
EX10	6	7	CO10	5	4
EX11	3	5	CO11	6	5
EX12	3	5	CO12	2	3

EX13	6	7	CO13	4	4
EX14	2	4	CO14	4	4
EX15	3	4	CO15	5	3
Media	3.62	4.46	Media	3.81	3.86

Source: Knowledge test control and experimental groups

The information collected based on the implementation of the pre-test shows that when calculating the mean of the control group a value of 3.86 was obtained, in turn, when calculating the mean of the experimental group a value of 4.46 was obtained. Therefore, it is concluded that there was no significant difference between both groups when evaluating their knowledge. On the other hand, when analyzing the results obtained at the post-test level, the data show an average of 3.86 for the control group and 4.46 for the experimental group, that is, there is no significant difference. Regarding the calculation of group statistics. At the control group level, a mean of 3.86 was calculated, showing a standard deviation of 1.509 and a mean standard error of 0.302. On the other hand, the calculation showed that, for the experimental group, a mean of 4.46, a standard deviation of 1.576, and a mean standard error of 0.384 were calculated, as shown in Table 2.

Table 2
Analysis of differences

Group statistics					
Post test evaluations	Treatments	N	Media	Standard deviation	Media del error standard
	Control	15	3.86	1.509	0.302
	Experimental	15	4.46	1.576	0.384

Source: Knowledge test, control, and experimental groups

The table 3 shows the results obtained in the control vs experimental group.

Table 3
Differences (control vs experimental)

Independent Samples Test							
Evaluations	Levene's test of equal variance		t test for equality of means				
	F	Significance	t	gl	Sig (bilateral)	Significant difference	Standard error difference
Equal variances are assumed	1.345	0.262	2.19	34	0.030	0.789	0.354
Equal variances are not assumed			2.19	34.15	0.031	0.801	0.354

Source: Knowledge test, control and experimental groups

In the calculation related to the parameters with the independent sample t-test, the main values do not show a significant difference in the parameters established for the evaluation, they mark a value of 0.030 at the Significance level (two-sided). In the aspects related to the significant differences, 0.789 was recorded and the standard error difference was recorded 0.354. On the other hand, the results of Levene's equality of variance test had a significance of 0.262. Taking into consideration the factors that contribute to indicating whether the difference between the two means of the groups (Control and experimental), can be considered significant when the larger level of alpha requires less difference between the means ($p < .05$). Consequently, there are no significant differences between the post-test evaluations between the control and experimental groups (Table 3). The result of the Student's T test p value =

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0.030; It means that the affirmative hypothesis is rejected, and the null hypothesis is accepted. Consequently, based on the results obtained, it is evident that there is no significant difference in the impact of virtual environments on the learning of binary inorganic compounds (Wilson, 1999; Nichols et al., 2000; Kim et al., 2014; Takatalo et al., 2008).

Discussion

The research was based on demonstrating the impact of virtual environments on the learning of binary inorganic compounds in third-year BGU students from the "San Isidro" Educational Unit. At the same time, test the hypothesis related to the existence of significant differences between the control and experimental groups regarding the impact of virtual environments on the learning of binary inorganic compounds. The results obtained provide information to teachers who seek to improve the quality of teaching the subject Chemistry and to students who seek meaningful learning.

The incorporation of virtual environments such as the "Virtual Quimi Project" project, whose fundamental purpose was to introduce virtual environments oriented to learning binary inorganic compounds, suggests a permanent update of knowledge related to technology. However, many teachers have not had the opportunity to train, have not had the opportunity to work in virtual environments, or do not know how to establish a teaching structure by correlating their subject knowledge with digital tools.

The dizzying educational transformation imposes a new form of teacher/student/technology relationship, where virtual learning simulators take center stage in all areas of knowledge. In this regard, Andrade-Sánchez (2022), points out that the simulator in the educational field is a teaching and learning scenario based on real cases for educational purposes since simulation is understood as the process of designing and developing a computerized model of a system (p. twenty-one). According to Sulvarán (2023), one of the tools preferred by teachers and students when learning Chemistry corresponds to simulators because they allow us to understand what happens in many of the interactions of the different proposed elements (p. 15).

In this sense, when analyzing the results obtained with the implementation of a pre-and post-test to evaluate the impact of virtual environments on the learning of binary inorganic compounds in third-year BGU students (15 control group and 15 experimental groups), The results obtained based on the independent samples test: Levene for equality of variance and t-test for equality of means, allow us to accept the null hypothesis. To = No There are significant differences between the control and experimental groups regarding the impact of virtual environments on the learning of binary inorganic compounds.

In this context, the importance of virtual environments in learning binary inorganic compounds is highlighted. According to the results obtained based on the research carried out by López & Vegas (2021), it is indicated that the main training needs for learning this subject is the learning of chemical nomenclature and the strategies used by teachers (p. 561). Therefore, the need to include cell phones in the educational field must be considered and thereby give way to the development and implementation of methodologies based on the use of these environments. On the other hand, the results obtained allow us to conclude that the design of activities related to the "VirtualQuimi Project" project were particularly feasible for teaching this subject to third-year BGU students from the "San Isidro" Educational Unit.

The results of the analysis of differences between the control and experimental group recorded the following readings where at the statistical level of the control group a mean of 3.86 was calculated, showing a standard deviation of 1.509 and a mean standard error of 0.302. On the other hand, the calculation showed that, for the experimental group, a mean of 4.46 was calculated, yielding a standard deviation of 1.576 and a mean standard error of 0.384. In the parameters related to the independent sample t-test, where the main values do not show a significant difference in the parameters established for the evaluation, marking a value of 0.262 at the level of equal and non-equal variances. Therefore, the null hypothesis is rejected, Ho = There are no significant differences between the control and experimental groups regarding the impact of virtual environments on the learning of binary inorganic compounds (Thaler, 1998; Hoigné et al., 1985; Wang et al., 2006; Cariati et al., 2006; Rivas et al., 2020).

4 Conclusion

The research on the impact of virtual environments on the learning of binary inorganic compounds in third-year students of BGU Educational Unit "San Isidro", allowed us to verify through the implementation of a post-test that when calculating the average of the control group, a value of 3.86, in turn, when calculating the mean of the experimental group a value of 4.46 is evident. This means that, contrary to the expected results, no significant difference was found.

The research confirms that there are no significant differences between the control and experimental groups regarding the impact that the "VirtualQuimi" project had on the learning of binary inorganic compounds in third-year students of BGU "San Isidro" Educational Unit. However, the research is not conclusive since the group of students was small and the planned activities were not socialized with sufficient time. When analyzing the impact of virtual environments on the learning of binary inorganic compounds in third-year students of BGU Unidad Educativa "San Isidro", exposure to different virtual environments such as the "VirtualQuimi" project, positively impacts learning, but depending on whether the student is motivated, otherwise significant learning does not occur.

When testing the hypothesis raised in this research, the information obtained demonstrated, through the application of the Student's T test, that the p-value = 0.030; which means that the affirmative hypothesis is rejected and the null hypothesis is accepted. Consequently, a significant difference is not evident when determining the effectiveness of virtual environments in the learning of binary inorganic compounds in BGU students of the "San Isidro" Educational Unit.

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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