

EFFECTIVE USE OF CHEMICAL GAMES: A PANACEA TO DIFFICULTIES IN LEARNING CHEMISTRY CONCEPTS IN SECONDARY SCHOOLS

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Abstract

Abstract nature of chemistry concepts may have contributed to difficulties in learning chemistry concepts among secondary school students. This study explores how the use of chemical games can convey understanding of chemical concepts to secondary school students. The study therefore focused on the effect of teaching chemistry concepts with the use of games on the achievement of secondary school students. A sample of 40 students was randomly selected from a population of 78 chemistry students of Federal College of Education (Technical) Omoku, Rivers State, Nigeria. The sample was grouped into 'A' (experimental) and 'B' (control). Solutions were proffered as to the levels of achievements of students taught with chemical game (group A) and those taught without chemical game (group B). Data collected from the tests administered were analyzed by the use of arithmetic mean and t- test of significant difference between two independent group means at 5% level of significance with 38 degree of freedom and critical table value of 2.021. Results revealed that group A (experimental) performed relatively higher than group B (control) and there was a significant difference between the two groups. Results were discussed while suggestions and recommendations for future research were made.

Keywords: *Chemistry, Chemical game, Periodic table, Abstract.*

1.0 INTRODUCTION

The role of science in the development of a nation is never in a dispute. The need to improve students' academic perceptions or understanding of scientific knowledge has been a great concern to science educators. Chemistry is one of the core science subjects embedded in secondary school curriculum.

Chemistry education has been identified to be one of the major bedrocks for the transformation of our national economy hence, must be accorded adequate attention (Lawrence 2011). Ababio (2000) defines chemistry as a branch of pure science, which deals with the composition, properties and uses of matter. These properties of substances and the changes they undergo are abstract in nature. The abstract nature of chemistry might have contributed greatly to difficulties in many chemistry topics

Chemistry draws upon a wide range of abstract concepts, which are embedded in a large body of theoretical knowledge. It is often discussed and taught largely in terms of non-observable theoretical entities – such as molecules, electrons and orbitals which probably seem as familiar and real to a chemistry teacher, yet, comprise a realm as alien and strange to many students (Tabar 2019). However, the abstract nature of chemistry could be brought to reality by making chemistry learning activity based, which can enable students have mastery of the subject. Chemistry instructions should be result oriented and student centered (Edemwoyin otu, 2011).

In the light of the above, chemistry requires the use of motivating methodologies in its learning, especially at the secondary school level.

In recent time, it is common to see students show more interest in devices such as computers, mobile phones and videos. It therefore becomes pertinent that these young people should be motivated with what they seem to have much passion for. This involves a paradigm shift from the traditional teaching methods such as lectures into games which seem to attract their interest (fu et al. 2009).

In this study, we tried to focus on the effect of complementing teaching of chemistry with educational game on the academic achievement of secondary school chemistry students of Demonstration Secondary School, Federal college of Education (Technical) Omoku, River's state of Nigeria.

This game is chemistry oriented and as such, it is tagged 'Chemical Game' by the researchers. It is developed based on the study of the first twenty 20 elements on the periodic table.

1. Purpose of Study.

The purpose of this study was to find out,

- i. the levels of performances of senior secondary school (SSS) II chemistry students of Demonstration Secondary School, Federal College of Education (Technical) Omoku, taught with provision of chemical game and those taught without provision of chemical game.
- ii. whether the two groups differ significantly in their achievements.

2. Research Questions

The researchers sought solutions to the following questions based on the purpose of the study.

- i. What are the levels of achievement of students taught with chemical game and those taught without chemical game?
- ii. To what extent will the performances of chemistry students taught with chemical game differ from those taught without chemical game.

3. Hypothesis

The second research question could be translated to a Null Hypothesis as follows, there is no statistically significant difference in achievement between students taught with a chemical game and these taught without a chemical game.

5.0: Literature

5.1: Periodic table and its place in the teaching and learning of chemistry.

According to Oke (2016), an in-depth understanding of the periodic table reveals the following properties about elements.

- i. The periods into which elements belong, seven of which are available and are numbered in Arabic numerals.
- ii. The groups into which elements belong. There are eight of these and are numbered in Roman numerals.
- iii. The ionization energies, or potentials of elements, electron affinities, atomic radii, electron negativities, all vary in properties along and across the table.
- iv. The atomic masses, symbols, electronic configuration etc.
- v. The groups' names as well as block of elements and their properties

He therefore asserts that an in-depth knowledge of the periodic table will in no doubt help in teaching and learning of chemistry since all the above properties when analyzed, cut across nearly all the topics in chemistry as a subject.

However, to some students, the table appears vague due to its relatively non-relationship with real life situations.

To this group of students, learning about elements and the periodic table can be dry and boring, hence, the need for interactive methods such as games that can bring about outside classroom activities and fun for better understanding of the subject matter.

5.2: Relevance of Games to Teaching and Learning

In the middle of 1950's, game-based learning originated from the game research and from the 1980's, scholars started the research and practice of integrating games into instructions, and with the population of electronic games and the transformation of education concepts, people gradually accepted games as learning tools (Seabon et al. 2015).

In recent time, students have shown much interest in devices such as computers, mobile phones and videos. It therefore becomes imperative that these young people should be motivated with that in which they seem to have much interest. This involves transforming some traditional teaching methods such as lectures into game-based learning that seem to attract their interest (fu et al. 2009).

Educational games are often used as teaching and learning tools, with studies showing that game-based learning is widely accepted among children and teenagers. The experience of enjoyment typically associated with playing games provides for a deeper learning experience and allows the individual to connect various concepts, skills and knowledge as well as sparking creativity (Ab Jalil et al. 2020).

Many of the concepts that are important in the context of games, such as motivation, have aspects relating to different theoretical foundations – cognitive, affective, motivational and socio cultural (Jan et al 2015, Plass et al. 2015). They argue that for games to achieve their potential for learning, all these perspectives have to be taken into account with specific emphasis depending upon the intension and design of the game.

5.3: Advantages of Complementing the Teaching of Chemistry with Game

- i. Since it is a game, the learning environment is more relaxed where normal classroom management regulations are not enforced.
- ii. Games bring about fun, interactive and challenging learning environment while enabling learners to experience and apply knowledge (Chen et al 2018)
- iii. There are game mechanics such as competition, scoring and ranking that motivate learners to win, gain a sense of accomplishment and satisfaction which makes learners highly motivated to learn (Jagust et al 2018, Uche et al 2021)
- iv. It involves critical thinking, problem solving interaction and collaboration with peers. Thereby creating room for players to adapt to any real-world situation (Victor et al 2017, Nadolnyl et al. 2020, Elina et al. 2022)

5.4: Disadvantages

- i. Some of the disadvantages of game-based learning are related to the time component involved. It is difficult for teachers to anticipate how much time students may need to accomplish all the levels of a game and thus regard the educational game-related task

- as completed. Establishing a deadline for students to end the game may result in discouragement and low self-esteem for the student who would not be able to complete the task in the given time (Venera et al. 2014, Odbayer, 2023)
- ii. Use of digital game by students may become quite challenging when teachers or instructors cannot control such environment. Students can have access to other platforms which may be harmful.
 - iii. Use of computers and other electronic devices can cause health hazards such as eye strain and other physical problems (Victor et al. 2017).

6.0: METHODOLOGY:

6.1: Study Population

The study population consists of all the 74 senior secondary II students of Demonstration Secondary School, Federal College of Education (Technical) Omoku, River's state of Nigeria who offer chemistry for the senior secondary school certificate examination. This population was chosen because it consists of students who can understand and play games designed with chemistry concepts.

6.2: Study Sample:

Two groups of 20 students each were selected from the population (groups A and B) as study samples. Group 'A' was the experimental group while group 'B' was the control group

This implies that 40 students were selected from the population to make up the study sample.

6.3: Method of Data Analysis:

Group 'A' (experimental group) was taught for 3 weeks with chemical game while group 'B' (control group) was taught for the same period without chemical game. At the end of the three weeks the same tests were administered to the two groups. The scores of the two groups of students constituted data for the study.

Data were analyzed using arithmetic mean and t-test of significant difference between two independent group means. The means were used to determine levels of achievement of both groups in the chemistry tests administered to the groups. Their achievements were tested for significant difference between two independent group means with the use of t-test.

The arithmetic means were used to determine the levels of academic achievement between chemistry students taught with chemical game and those taught without chemical game. T-test was used to detect whether or not there was significant difference between the two Groups of chemistry students in performance.

7.0: Results:

The mean scores of students taught with game and those taught without game were calculated. These are shown in table 1 below.

Table 1

Groups	N	Ts	\bar{x}
A (experimental)	20	1,260	63
B (control)	20	1,034	51.7

Where:

N= number of students in each group

Ts= total score of each group

\bar{x} = arithmetic mean of the group

From the above table, the mean score of those taught with chemical game and those taught without games are 63 and 51.7 respectively. These mean scores indicate that those taught with chemical game put up an average (high) performance while those taught without chemical game put up an average (moderate) performance.

It was hypothesized that there was no significance in achievement between students taught with chemical game and those taught without chemical game. To test the stated hypothesis, the standard deviations of the two groups were computed and a t-test conducted with the groups. The t-test was conducted at 5% level of significance with 38 degree of freedom and a critical table value of 2021. The result of the t-test is shown in table II below.

Table II

Groups	N	Ts	\bar{x}	Sd	t-value
A (experimental)	20	1,260	63	12	
B (control)	20	1,034	51.7	5.67	3.804

Where:

N= number of students in each group

Ts= total score of each group

\bar{x} = arithmetic mean of the group

SD= standard deviation scores of each group

T- value= calculated t-value.

The table above shows that the calculated t- value of 3.804 was greater than the critical value of 2.021. this implies that there is statistically significant difference in achievement between chemistry students taught with chemical game and those taught without chemical game. The stated null hypothesis was therefore rejected.

8.0: Discussion Of Findings

Basically, this work studied the effect of complementing classroom teaching of chemistry with game among chemistry students in secondary school. The level of academic achievement of the

control group was moderate while the level of achievement of the experimental group was relatively high. The moderate achievement of control group could be attributed to the effectiveness of the method of teaching used in the classroom. The relatively high achievement of the experimental group might have resulted from the use of chemical game which was not used for the control group. This means that the use of game had greater effect on the teaching of chemistry. The reason for this could be attributed to the fact that game release tension, clear boredom and bring about informality to learning. It could also be that the pleasure derived in playing the game, more often brought the students (experimental group) closer to what they learned in school than those who did not complement their learning with game. Again, one would expect that for effective teaching and learning of abstract concept such as those in chemistry, teaching aids are required. The game might have played the role of an aid.

9.0: Conclusion:

Attempts have been made in this work to make case for complementing chemistry teaching with games. Its justification is that, it could go a long way in promoting the development of proper scientific knowledge, attitude and values. By so doing, chemistry teaching and learning will be more meaningful, enjoyable and enriched, thereby reversing the dwindling trend of performance in chemistry.

10: Recommendation:

The results obtained from this research showed that the group of students that were taught with chemical game performed better than the group that was taught without chemical game. The researchers therefore make the following recommendations.

- i. Teachers should be encouraged to make effective utilization of games as complement to classroom teaching
- ii. Where the games are not readily available, they should be improvised.
- iii. Teachers should not be too conservatives in their methods of teaching, as this may hinder the use of more appropriate methods when necessary.

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