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Video-based Instruction and Pre-degree Students' Academic Performance in Effect of Chemical Fertilizers and Pesticides on Human Health in Rivers State Nigeria

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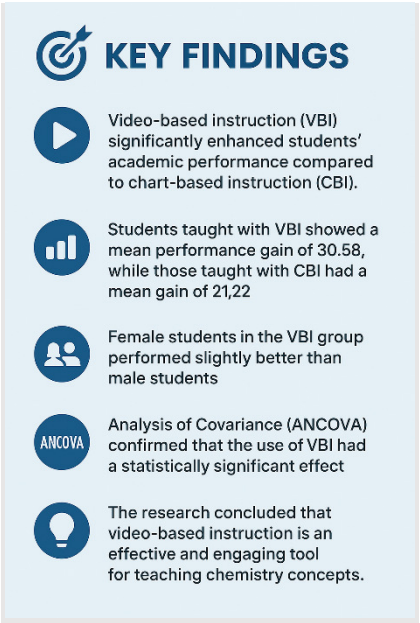
ABSTRACT

This study investigated video-based instruction and pre-degree students' academic performance in effect of chemical fertilizers and pesticides on human health in Rivers state Nigeria. Two research questions were answered and two null hypotheses tested at 0.05 significant level. The research design employed was quasi experimental which involved the use of pretest and posttest in two intact pre-degree chemistry classes. The population was made up of all the pre-degree chemistry students in the three universities in Rivers State. Purposive sampling technique was used to select a sample of one hundred and twenty seven (127) pre-degree chemistry students from the target population of the study. The instrument used to collect data was a teacher-made performance test named Chemistry Performance Test (CPT). The instrument consisted of twenty test items on chemical fertilizers and pesticides. CPT was validated and Kuder Richardson formula 21 (KR-21) was used to establish an internal stability of 0.83. The experimental group was taught with video-based instruction while the control group was taught same contents with chart-based instructional mode. Mean and standard deviation were used to answer the research questions while analysis of covariance was used to test the null hypotheses. The result showed that the students that were taught effect of chemical fertilizers and pesticides on human health with video-based instruction performed better than those that were taught with chart-based instruction. The result also showed that the female students that were taught effect of chemical fertilizers and pesticides on human health with video-based instruction performed better than their male counterpart in the same group. When subjected to statistical test, it was shown that there was a significant difference between the performance of students that were taught effect of chemical fertilizers and pesticides on human health using video-based instruction and those taught with chart-based instruction. It was also shown that there was no significant difference between the performance of the male and female students who were taught effect of chemical fertilizer on human health using video-based instruction. The study concluded that the use of video-based instruction to teach pre-degree students chemistry was more effective than the use of chart-based instruction. Based on the findings, it was recommended that chemistry teachers should use video-based instructional strategy to teach certain chemistry concepts and the male students should be encouraged to embrace learning with technology.

Keywords: *Students, chemistry, performance, fertilizer and pesticide, human health*



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INTRODUCTION

Chemistry is the scientific study of matter, its properties, and how it interacts with energy and other matter. The subject chemistry is concerned with the changes that happen (rusting of iron, growing of crops, burning of wood, digestion and assimilation of food in human body system among others) around us. Ababio (2010) defined chemistry as a branch of pure science which deals with the composition, properties, changes and uses of matter. Ugwu (2022) stated that the goal of teaching chemistry in school is to provide students with the skills required to succeed in personal endeavor, graduate school, the chemical industry, entrepreneurship, vocations or professional school. The above goal indicates that the objectives of teaching chemistry are to develop scientific values of inquiry, creativity, perseverance, accuracy and respect for natural products and their properties.

Ubom and Agwaule (2024) posited that chemistry is felt in almost all spheres of life. This therefore, makes it imperative that the study of the subject must hinge on innovative strategies that follow the trends of the present day. The overall 21st century teaching and learning of science and chemistry in particular goes beyond the traditional rote learning and aims to prepare students not only for academic success but also for success in a rapidly changing, technology-driven and interconnected world. The crucial skills of the present generation are creative thinking, information literacy, technology skills, digital literacy, adaptability, critical thinking, problem-solving, innovation and collaboration of knowledge. These skills help students learn and so they are vital to success in school and beyond. The 21st century skills aim to develop well-rounded individuals who can contribute meaningfully to society (George & Charles-Ogan, 2023).

Chemistry is one of the fundamental ingredients of science. There is therefore the need for proper dissemination of chemistry in schools, be it at the secondary school or the tertiary institution. The study of chemistry can be successful through integration of technology and practical which are conducted in well-equipped laboratories. The 21st century has brought with it, the era of technology integration in the teaching and learning of various school subjects. To integrate technology into teaching chemistry means utilizing computers, software, videos, over-head projectors, internet, phones, digital boards, goggle classroom, and similar tools to carry out instruction.

Video-based learning is one of the modern methods to integrate technology in the modern day teaching and learning. Cipher (2024) opined that one of the most common methods to gain limelight in recent years is video-based learning. Video-based learning is an educational approach where videos are used as a primary medium to deliver the content. The teaching of chemistry which used to rely solely on traditional classroom lessons or just written materials can be carried out with the aid of videos to enhance the academic performance and retention of students in chemistry. Video-based learning has become the most engaging form of learning which leverages the power of visuals and audio to enhance learning experiences of students. This method of teaching makes complex concepts more accessible and easy to understand. Vinikas (2022) opined that video-based learning is a remote instructional method that relies on live or pre-recorded video to teach new skills and knowledge. Video-based learning uses images, graphics, on-screen text, and audio to deliver a multi-sensory learning experience that fosters engagement and knowledge retention. The use of videos for instruction engages all senses of the learner. Learners particularly enjoy the flexibility, the ability to stir emotions, and the effectiveness of video-based learning. Educational videos provide an important content-delivery tool in many classes. Effective use of video is enhanced when instructors consider cognitive load, student engagement, and active learning. Educational videos have become an important part of education, providing an important content-delivery tool in many flipped, blended, and online classes (Brame, 2019). Effective use of video as an educational tool is enhanced when instructors consider three elements: how to manage cognitive load of the video; how to maximize student engagement with the video; and how to promote active learning from the video. The benefits of using video-based instruction are its ability to improve knowledge performance and retention, enable microlearning, on-line demand learning, and widely accessible content.

Chemistry is a branch of science that deals with the study of matter, its components, structures and the changes or reactions it undergoes under different conditions. Chemistry studies the properties of matter, laws and principles that guide the reactions which matter passes through. Chemistry is defined as the study of the composition, structure and properties of matter and the reactions by which one form of matter may be converted into another (Alan, 2023). The study of chemistry is crucial because it assists in the derivation of means through which human living can be enhanced. Chemistry is the subject that has great influence on the lives of citizens via implementation of industrial products in medicines, agriculture, domestic activities, such as cooking, combating of pests and insects, constructions and other spheres of life. The use of fertilizers and pesticides by human being has become so common that it has begun to have some negative effect on human due to inability to utilize well.

The food system is multifaceted and involves a web of activities such as the production, processing, transportation and consumption. One of the challenges of the food system is how the production of food impact individual and population health and growth. Population health is also key to factor in addressing food system challenges which may have been caused by the production system in the agricultural or industrial sector.

Davidson (2020) stated that global food production involves various agricultural practices, technological advancements, and the economic dynamics that influence how food is cultivated, processed, and consumed across different locals. Two modern practices to sustain the global food production in this era is the use of fertilizers and pesticides. Technological advancement plays a crucial role in shaping global food production methods by enhancing crop yields.

The use of fertilizers to enhance crop yields in the modern society cannot be over emphasized. Weneka and Filip (2023) asserted that the application of fertilizers and pesticides to enhance crop yields can sometimes be overused and this can be harmful to plants and humans who are the consumers of the crops. Fertilizers are natural or artificial substance that contain the chemical elements that improve growth and productiveness of plants (Britannica, 2025). Simply put, fertilizers are food or nutrients for plants. Plants need to grow so as to produce its fruition. Fertilizers are substances (natural or synthetic) that are applied to soil or plant tissues to supply plant nutrients. Many sources of fertilizers exist. Fertilizers can be naturally or industrially produced. Fertilizers can broadly be categorized into organic and inorganic type (Gubre et al., 2024). Fertilizers play a crucial role in ensuring that plants receive the nutrients they require for optimal growth and development. In as much as fertilizers ensure the optimal growth of plants, it also has its adverse effect on the plant if not applied responsibly and in turn have adverse effect on humans, who are the consumers of the fertilized plants.

Pesticides are chemical or biological substances or mixtures used for preventing, destroying or repelling any pest, insects or other organisms harmful to cultivated plants or to animals. Wayne (2019) defined pesticides as chemical or biological substances that are utilized to control, prevent or eliminate pests. The various types of pesticides include the following:

Herbicides: They are used to kill or control weeds which are unwanted plants.
Insecticides: They are used to kill or control insects
Nematicides: They are used to control nematodes, microscopic roundworms that can damage plants.
Fungicides: They are used to prevent the growth of fungi, including molds and mildew.
Molluscicides: They are used to control snails and slugs.
Rodenticides: They are used to control rodents

From the definition of the various types of pesticides, it is observable that pesticides are used by human beings for various reasons. For instance, pesticides are used in the agricultural sector to protect crops from pests and diseases, thus improving yield and quality. They can also be used in public health to control disease vectors like mosquitoes, thus reducing the spread of diseases like malaria. Nwachukwu et al. (2023) asserted that pesticides are very much utilized in various households and urban environments. They are used in households to control pests such as cockroaches, termites, rodents and also the management of weeds in gardens and lawns.

Pesticides are composed of biological or chemical compositions which might be harmful to human being. It therefore becomes imperative that students should be taught how to use it responsibly or come in contact with it responsibly because they are toxic substances. A study found that about three quarter of non-organic produce still had pesticides even after it has passed the complete processing cycle to get to the consumer. Pesticides are toxic to the environment and linked to health issues. This may suggest why (Grunner, 2023) opined that food security is a global growing dilemma. Pesticides can cause short-term adverse health effects, called acute effects as well as chronic adverse effects in the health of man. Any pesticide product consists of two parts namely; the active and the inert ingredients. Active ingredients are chemicals which actually control the pest while the inert ingredients are primarily solvents and carriers that help deliver the active ingredients to the target pest. The innert ingredient enhance the utility of the product. Some of the chemicals used to produce pesticides are copper sulpahate, metaldehyde, thiacloprid, thiodicarb, phorate, benomyl, cooper ammonium complex, eugenol etc.

Chemical fertilizers and pesticides can cause adverse effect on human health if not used with care or responsibly. Khan et al. (2022) stated opined that consumption diet of man which had received treatment using fertilizers and pesticides have contributed to a significant risk to human health. Fertilizers have both direct and indirect effects on human health. The direct exposure or inhalation of fertilizer powder from ammonia or nitrogen oxides can cause respiratory issues such as bronchitis, asthma, and lungs diseases. Other direct health effects of chemical fertilizers are skin redness and irritation, eye irritation and burning sensation. Heavy metals in fertilizers can disrupt the endocrine system which leads to malfunction of hormone production. Kumar and Dev (2023) stated that the Amines produced from the nitrogenous fertilizers can cause cancer in human beings. With the various adverse effects of fertilizers and pesticides on human health, students need to be taught these topics using innovative instructional strategies such as video-based instruction. Video-based instruction will make students to have a direct visualization of the effect of fertilizers and pesticides on human health and thus improve their academic performance in the taught concepts. It is based on this premise that the researcher sought to conduct this investigation. The researcher has observed that the performance of students in chemistry has continued to decline especially at the senior school certificate examination and university tertiary matriculation examination. Despite the importance of chemistry in science and technology, many students struggle to understand key concepts and thereby perform poorly in the subject. This has made some of them not to have admission into universities thus, they enroll for pre-degree

programmes. The use of traditional teaching methods which rely on lectures and textbooks, often fail to engage students and promote deep learning. The incorporation of video-based instruction has shown promise in enhancing students' performance in other subjects, but its effectiveness in chemistry education remains unclear. Students of this present generation love to watch video, and this has spurred the researcher to conduct this research by incorporating video-based instruction to investigate its effectiveness on students' learning outcome in the teaching of chemistry.

Aim and objectives of the study

The aim of this study was to investigate the effectiveness of video-based instruction on the academic performance of students in chemistry when taught effect of chemical fertilizer and pesticides on human health. The objectives were to:

1. Determine whether there is a difference between the performances mean score of students taught the effect of fertilizer and pesticides on human health using video-based instruction and chart-based instruction.
2. Ascertain if there is a difference between the performances mean score of the male and female students taught effect of fertilizer and pesticides on human health using video-based instruction.

Research Questions

The following two research questions were answered.

Research Question 1: What is the difference between the performance mean score of students taught the effect of fertilizer and pesticides on human health using video-based instruction and chart-based instruction?

Research Question 2: What is the difference between the performance mean score of the male and female students taught effect of fertilizer and pesticides on human health using video-based instruction?

Hypotheses

The two null hypotheses were tested at 0.05 significant level.

H_{O1}: There is no significant difference between the performance mean score of students taught the effect of fertilizer and pesticides on human health using video-based instruction and chart-based instruction.

H_{O2}: There is no significant difference between the performance mean score of the male and female students taught effect of fertilizer and pesticides on human health using video-based instruction.

Research design

Quasi experimental research design was used to carry out this investigation. In this design non-equivalent, non-randomized, intact classes were used. The design presented one experimental group and one control group.

Population of the study

The population was made up of all the pre-degree chemistry students in the three universities in Rivers State.

Sample and sampling technique

Purposive sampling technique was used to select a sample of one hundred and twenty seven (127) pre-degree chemistry students from the target population of the study.

Instrument for data collection

The instrument used to collect data was a teacher-made achievement test named Chemistry Performance Test (CPT). The instrument consisted of twenty test items on effect of fertilizers and pesticides on human on human health. Ten test items were set on pesticides while another ten were set on fertilizers. Each test item had four options. Each correct answer to CPT was scored five marks and each incorrect answer was scored zero mark. The test was graded in percentage. A table of specification was prepared. Two lesson plans were prepared for each of the two groups.

Validity of the instrument

Three experts in chemistry education validated the instrument, CPT. The experts scrutinized the test items based on the taught topics and made corrections which were used to review the instrument before administering the sample.

Reliability of the instrument

Kuder Richardson formula 21 (KR-21) was used to establish the internal consistency of the instrument. The instrument was administered to a group of twenty students in another school that were not part of the sample. An internal stability of 0.83 was established.

METHODOLOGY

The researcher briefed the intact class teachers who were used as the research assistants on the modality of the research. A pretest of CPT was first administered to the sample students in both the experimental and the control groups. After the administration of the pretest, the scripts were collated, marked and graded in percentage. The next phase was the teaching of the chemistry content (effect of pesticide and fertilizer on human health) to both the

experimental and the control groups by their intact class teachers. The intact class teachers carried out the teaching exercise to avoid the sample of the experimental study change or improve their behavior because it is being studied. The experimental group was taught with video-based instruction while the control group was taught same content with chart-based instructional mode. After the teaching, a posttest was given to the two groups. The posttest test items were reshuffled test items of the pretest. The scripts of the students for the posttest were also collated, marked and graded in percentage.

Method of data analysis

The analysis was done descriptively and inferentially. Mean and standard deviation were used to answer the research questions while analysis of covariance was used to test the null hypotheses at 0.05 significant level.

RESULTS

Research Question 1: What is the difference between the performance mean score of students taught the effect of fertilizers and pesticides on human health using video-based instruction and chart-based instruction?

Table 1 showed the mean and standard deviation on performance of students that were taught effect of fertilizer and pesticide on human health with video-based instruction and chart-based instruction. From (Table 1), it is evident that the students who were taught effect of fertilizer and pesticide on human health with video-based instruction in the experimental group had a performance mean gain of 30.58, SD = 10.83 and those taught with chart-based instruction in the control group had a performance mean gain of 21.22, SD = 13.56. The data analysed in (Table 1) showed that the students that were taught effect of fertilizers and pesticides on human health with video-based instruction performed better than those that were taught with chart-based instruction.

Research Question 2: What is the difference between the performance mean score of the male and female students taught effect of fertilizers and pesticides on human health using video-based instruction?

Table 2 showed the mean and standard deviation on the performance mean score of the male and the female students that were taught effect of fertilizers and pesticides on human health with video-based instruction. The data in (Table 2) revealed that the male students that were taught effect of fertilizers and pesticides on human health with video-based instruction had a performance mean gain of 29.97, SD = 11.52 while the female students taught with same video-based instruction had a performance mean gain of 31.68, SD = 14.18. It is evident from (Table 2) that the female students performed better than their male counterpart in the same experimental group.

H_{O1}: There is no significant difference between the performance mean score of students taught the effect of fertilizers and pesticides on human health using video-based instruction and chart-based instruction.

Table 3 above showed the test of significant effect using analysis of covariance (ANCOVA) on the difference between the performance of students that were taught effect of fertilizers and pesticides on human health using video-based instruction and those taught with chart-based instruction. It can be deduced from (Table 3) that a significant difference exists between the performance mean score of students who were taught with video-based instruction and those who were taught with chart-based instruction (F1, 124 =8.71, p = .00 p< .05, partial eta squared = .42). H_{O1} was rejected at .05 significant level since p-value was less than .05.

H_{O2}: There is no significant difference between the performance of the male and female students taught effect of fertilizers and pesticides on human body system using video-based instruction.

Table 4 showed the test of significant effect using analysis of covariance (ANCOVA) on the difference between the performance of the male and female students that were taught effect of fertilizers and pesticides on human health using video-based instruction in the experimental group. The result showed that there was no significant difference between the performance of the male and female students who were taught effect of fertilizers and pesticides on human health using video-based instruction F1, 63 =.41, p = .78 p > .05, partial eta squared = .04). H_{O2} was retained at .05 significant level since p-value was greater than .05.

DISCUSSION

Analysis on the mean and standard deviation on performance of students that were taught effect of fertilizers and pesticides on human health with video-based instruction and chart-based instruction was presented in (Table 1). The analysis showed that the students who were taught effect of fertilizers and pesticides on human health with video-based instruction in the experimental group had a performance mean gain of 30.58, SD = 10.83 and those taught with chart-based instruction in the control group had a performance mean gain of 21.22, SD = 13.56. Judging from the result in (Table 1), it is evident that the students that were taught effect of fertilizers and pesticides on human health with video-based instruction performed better than those that were taught with chart-based instruction. When this result was subjected to statistical test at 0.05 significant level, it showed that that a significant difference exists between the performance mean score of students who were taught with video-based instruction and those who were taught

Table 1: Mean and standard deviation on performance mean score of students taught effect of fertilizer and pesticides on human health using VBI and those taught with CBI.

		Pretest		Posttest		Gain	
Group	**N**	**Mean**	**S.D**	**Mean**	**SD**	**Mean**	**SD**
VBI	66	35.51	12.63	66.09	11.44	30.58	10.83
CBI	61	37.39	11.81	58.61	12.83	21.22	13.56

Key: VBI= Video-Based Instruction CBI= Chart-Based Instruction

Table 2: Mean and standard deviation of the performance mean score of the male and female students taught effect of fertilizers and pesticides on human health using VBI.

		Pretest		Posttest		Gain	
Gender	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Male	26	34.28	10.75	64.25	13.41	29.97	11.52
Female	40	36.25	11.13	67.93	12.88	31.68	14.18

Table 3: Summary of ANCOVA on the difference between the performances of students taught effect of fertilizers and pesticides on human health using VBI and those taught with CBI

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	25589.25[a]	2	4264.88	110.83	.00	.71
Intercept	5917.57	1	5917.57	153.78	.00	.55
Pretest	24275.67	1	24275.67	630.86	.00	.06
Group	1676.67	1	335.33	8.71	.00	.42
Error	9773.99	124	38.48			
Total	878230.00	127				
Corrected Total	35363.24	126				

a= R Squared = .732 (Adjusted R Squared = .746)

Table 4: Summary of ANCOVA on the performance of the male and female students taught effect of fertilizers and pesticides on human body system using VBI.

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	132.50[a]	2	44.17	230.30	.00	.54
Intercept	3945.39	1	3945.39	20572.61	.00	.91
Pretest	89.86	1	89.86	468.54	.00	.15
Gender	.08	1	.08	.41	.78	.04
Error	115.07	63	.19			
Total	5905.14	66				
Corrected Total	247.57	65				

a=R Squared = .463 (Adjusted R Squared = .602)

with chart-based instruction (F1, 124 =8.71, p = .00 p< .05, partial eta squared = .42). H_{O1} was rejected at .05 significant level since p-value was less than .05. This result agrees with the result of Offor and Chinda (2025), Igboanugo (2024), Derejaw et al. (2023), Pekdag (2020) Ominowa and Bamidele (2016) which revealed that students that were taught with video-based instruction performed better than those that were taught with traditional teaching method and that there was a significant difference between the performance of the students that were taught chemistry concepts with video-based instruction and those taught with traditional teaching method.

Analysis on the mean and standard deviation on the performance of the male and female students that were taught effect of fertilizer and pesticides on human health with video-based instruction was presented in (Table 2). The data in (Table 2) revealed that the male students that were taught effect of fertilizers and pesticides on human health with video-based instruction had a performance mean gain of 29.97, SD = 11.52 while the female students taught with same video-based instruction had a performance mean gain of 31.68, SD = 14.18. It is evident from (Table 2) that the female students performed better than their male counterpart in the same experimental group. When subjected to statistical test, the result showed that there was no significant difference between the performance of the male and female students who were taught effect of fertilizers and pesticides on human health with video-based instruction (F1, 63 =.41, p = .78 p > .05, partial eta squared = .04). H_{O2} was retained at .05 significant level since p-value was greater than .05.

This result is in agreement with the results of Okenwa (2022), Ekwe (2020) which revealed that the female students that were taught chemistry concepts with video-based instruction performed better than their male counterparts with no statistically significant difference. However, this result is not in agreement with the results of George (2023), Ukaegbu (2020), Effiong et al. (2022) which showed that the male students taught chemistry with video-based instruction performed better than their female counterpart in the same group. However, there was no statistically significant difference in performance based on gender.

Conclusion

Based on the findings of this study, it was concluded that the use of video-based instructional strategy significantly enhanced the performance of students in learning the effects of fertilizers and pesticides, with those in the experimental group outperforming their counterparts in the control group who were taught using charts. Furthermore, although female students in the experimental group showed slightly higher performance than their male counterparts, the difference was not statistically significant.

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