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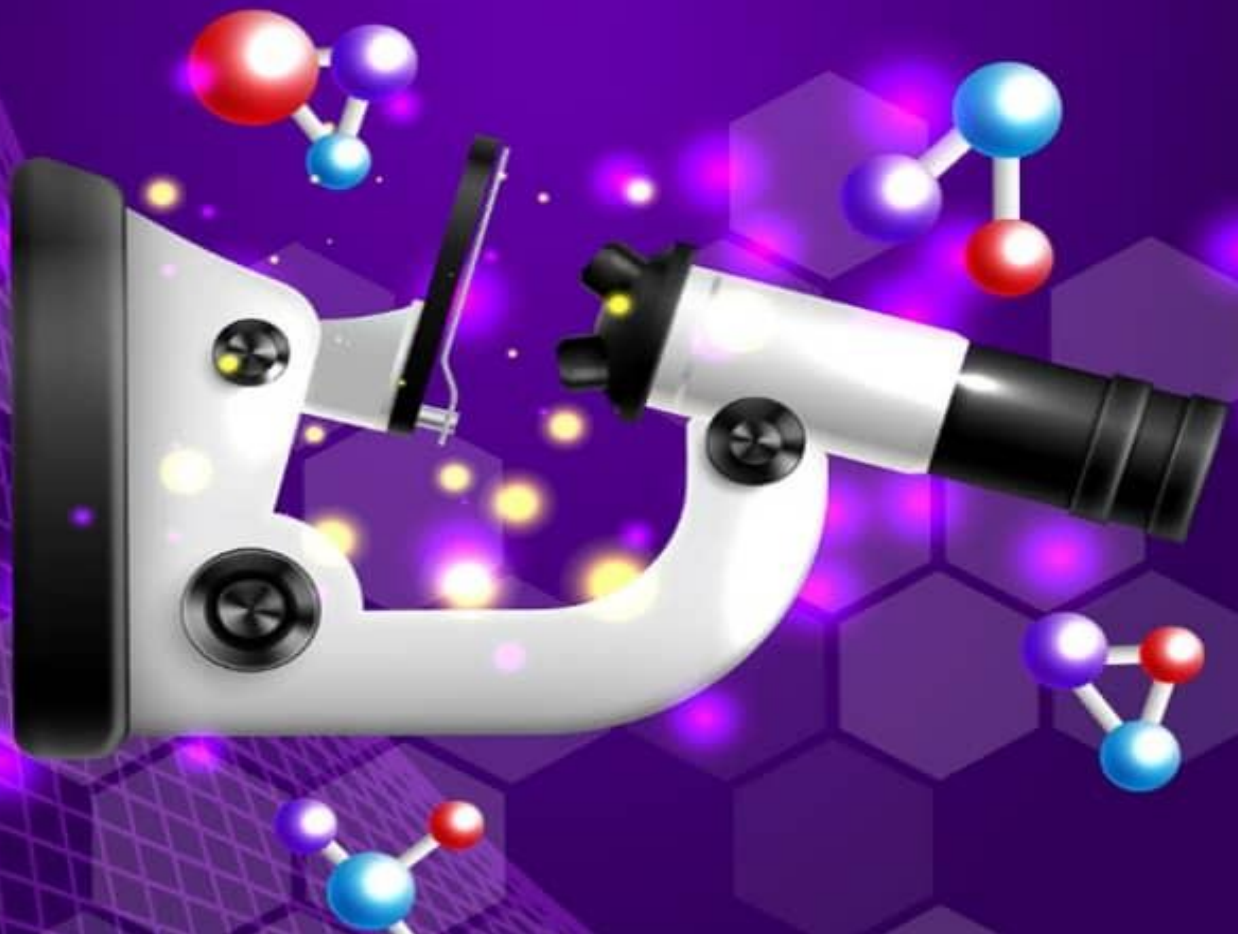


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AI-Based Analysis of Students' Perceptions of Poor Performance in Chemistry External Exams

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Abstract

This study investigated utilization of Artificial Intelligence to understand the perception of students on the causes of poor performance in external chemistry examinations in Owerri West Local Government Area of Imo State. The research employed a survey method for analysis where a total of 140 students were selected by means of random sampling from fourteen schools in the region. Eleven of the schools are public schools where as the other three are private owned schools. Data collection was through a Researcher Constructed Questionnaire (RCQ), by employing AI tools such as natural language (NL), clustering algorithm (CL), and predictive models (PM). The study comprised of three research questions and two hypotheses. Descriptive statistics, frequency, percentage and mean as well as Pearson Product moment correlation were used. Results from our study show that lack of knowledge on the use of AI, poor teaching methods, teachers' poor qualifications, lack of teaching experience and inadequate instructional materials were some of the leading factors. It is therefore recommended that steps should be taken by private school owners and government to recruit qualified and experience personnel on the use of AI and also create awareness on the importance of AI and its utilization in the performance of students in chemistry. Furthermore, teachers are advised to teach with appropriate computer teaching aids and instructional materials so as to improve their method of teaching.

Keyword: Artificial Intelligence, Academic Performance, Chemistry, External Examination

INTRODUCTION

The role of education in developing countries cannot be over emphasized. In Nigeria, education is viewed as the key to success in diverse fields of life. Academic performance in examinations remains one of the major issues in the education industry. It is the medium for assessing academic achievements. Poor academic performance of Nigerian students in external examinations especially in core science subjects such as mathematics, physics, biology and chemistry is a direct pointer to the issues confronting educational systems in Nigeria today (Fehintola, 2019).

Chemistry education refers to the teaching and learning of chemistry. It is concerned with the study of properties, composition and behavior of matter. This field encompasses a wide range of educational activities, strategies, and methodologies aimed at imparting knowledge, understanding chemical principles and processes.

It is a pivotal subject in secondary education, essential for students aiming for careers in science and technology. Chemistry education plays a vital role in developing scientific literacy, preparing future scientists, enhancing problem-solving skills, promoting citizenship among others; despite its importance, students in Owerri west Local Government under perform in

external chemistry examinations. Understanding the root causes of these poor performance is crucial for developing effective interventions.

In the recent past, there have been reports of poor academic performance in the WAEC and NECO results all over the country. This is mostly seen with the science subjects (Ibe&Madusnum, 2011).Chemistry which is one of the core science subjects is not left out in this. In the past few years, there have been more “failure” than “pass” in the performance of students at WAEC examinations as shown in Table 1 below,

Table 1: Chemistry WAEC Results (2015-2022) in Owerri-West, Imo State Secondary Schools
WAEC REF.RD-23/NEC/VOL1/678)

Examination Year	Total Sat	% Pass	% Fail
2015	3,454	46.16	53.84
2016	4,792	44.37	55.63
2017	5,119	45.00	55.00
2018	5,234	43.67	56.33
2019	6,282	45.67	54.33
2020	4,445	44.09	55.91
2021	5,345	46.01	53.99
2022	5,223	45.77	54.23

Statement of the Problem

The poor performance of chemistry in external examinations cannot be overemphasized. Attempts have been made at researching on the causes of poor academic performance of chemistry students in external examinations. However, very little information is available in literature on the view or perception of students on the causes of the poor performance in the external examinations. Quite a lot has been geared towards the teacher-related problems in the teaching of science subjects (Ajagun 2010, Usman 2013). Research has also identified other engendering factors. These include poor motivation, wrong orientation, self-esteem, emotional factors, study habits and poor interpersonal relationships (Aremu & Sokan 2013).

As a result of the innumerable consequences of poor academic performance on the society as well as its destructive and social effects on the students, this study aims to investigate the underlying factors contributing to this trend by utilizing artificial intelligence (AI) to understand students’ perceptions of the causes of poor performance in chemistry exams

Objectives

The objectives of the study were to determine students’ perception on

1. Causes of poor performance in chemistry.
2. Teaching methods on students’ academic performance in chemistry external examinations.
3. The use of instructional materials on students’ performance in chemistry external examinations.

4. The effect of school ownership (public or private) on the performance of students in chemistry examinations.
5. Effect of gender on poor performance in chemistry.

Research Questions

For the purpose of this research, the following research questions were raised

1. What are the students' perceptions on the causes of poor academic performance in chemistry examinations?
2. What are the students' perceptions on the effect of gender on student's poor performance in chemistry?
3. What are students' perceptions of the impact of instructional materials on their performance in chemistry external examinations?
4. What are students' perceptions of the effect of school ownership (public or private) on students' performance in chemistry examinations?
5. What are students' perceptions of the effect of gender on poor performance in chemistry?

Hypothesis

1. There is no significant difference between the perceived causes of poor performance in chemistry between students in public schools and students in private schools.
2. There is no significant relationship between teachers' use of instructional materials and the academic performance of students.

Methods

A survey design was adopted for this study. The target population was all the senior Secondary School Students in Owerri West Local Government Area of Imo State. There are a total of fourteen secondary schools where chemistry is taught and offered as a subject for examination in WAEC and NECO. Eleven of the schools are public secondary schools while the other three are private owned schools. Ten chemistry students were selected randomly from each of the fourteen schools giving us a total of one hundred and forty students (140) for this study. For the purpose of this study, the researcher self-constructed and used a questionnaire tagged "Investigation of perceived causes of poor performance of students in chemistry at External Examinations" using AI to gather data from the students.

The questionnaire was divided into two sections tagged sections "A" and "B". The section "A" was designed to obtain biographic data from students while the section "B" was designed to obtain information on students' perception as to the reason or causes of their poor performance in chemistry at external examinations, as well as teachers' years of teaching experience and students' academic performance. Students who were not sure of this information were asked to inquire from their teachers.

Furthermore, the section "B" of the research material delved into elucidating the relationship between teacher's use of instructional materials and students' academic performance and gender relationship with academic performance of students. The instrument was designed using a four point Likert type scale with strongly agree, agree, disagree and strongly disagree.

Experts in the fields of Measurement and evaluation, Guidance and Counselling and Psychology were approached to validate the content of the research questionnaire on the basis of appropriateness, comprehensiveness and clarity. Their criticisms and corrections were useful in strengthening the face and content validity of the instrument.

As a way of determining the reliability of the instrument, it was administered on two groups of senior secondary school students offering chemistry in Owerri West L.G.A of Imo State who were not included in the study. A two week test re-test reliability method was carried out on the sample and the obtained scores correlated using Pearsin Product Moment Co-efficient. Correlation coefficient of $r=92$ was obtained, thus a strong indication that the instrument was adequate for the study.

The questionnaires were administered in the schools by the researcher who was assisted by the chemistry teachers in the respective schools. They were all collected, properly filled and thereafter scored. The scoring was done by assigning 4,3,2 and 1 points to the strongly agree, agree, disagree and strongly disagree respectively. Academic performance of students in chemistry was sourced from the West African Examination Council (WAEC) Imo State Office. Data obtained were analyzed using frequency counts, percentages, mean, t-test and Pearson's Product Moment Correlation (r). mean cut off of 2.5 was adopted.

RESULTS

Research Question 1: What are the causes of poor performance of students in chemistry as perceived by the students?

In order to answer this question, frequency, percentage, mean and standard deviation of students' perception of the causes of poor performance was analyzed. The mean cut off point used was 2.50. All items with mean of 2.50 and above were accepted and were regarded as being in agreement (accepted) while those with less than 2.50 were rejected and regarded as being in disagreement (rejected).

The result from this research question is summarized in Table 2. From the result gathered, 92.8% of the respondents were of the opinion (agreed) that teachers' educational qualification has an effect in teaching as well as the academic performance of students in chemistry examinations. Similarly, majority of the students (91.0%), also held the view that teaching strategy has significant effect on the academic performance of students. Other items with positive acceptance include teachers' use of instructional materials (71.2 %), teacher's years of experience (90.1%), students' retention abilities (90.0%), students' emotional problems (90.1 %), and inadequate coverage of the syllabus (95.5 %) and students' consideration of the subject as being difficult (80.2 %).

On the other hand, majority of the students (56.6% and 52.7%) did not believe that students' study habits and students' interest in the subject can militate against students' performance in chemistry external examinations.

Table 2: Students' perception towards the causes of their poor performance in chemistry

S/no	Item	Agree %	Disagree %	Mean	SD	Decision
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1.	Teachers' educational qualification	92.8	7.2	3.30	0.61	Accepted
2.	Teachers' teaching strategy	91.0	9.0	3.20	0.65	Accepted
3.	Teachers' use instructional materials	71.2	28.8	3.20	1.14	Accepted
4.	Teachers' years of experience	90.1	9.9	3.31	0.62	Accepted
5.	Students' study habits	44.4	56.6	2.36	0.78	Rejected
6.	Students' retention ability	90.0	10.0	3.50	0.60	Accepted
7.	Students' emotional problems	90.1	9.9	3.12	0.77	Accepted
8.	Interest from students	47.3	52.7	2.32	0.81	Rejected
9.	Inadequate coverage of Syllabus	95.5	4.5	3.50	0.52	Accepted
10.	Subject is considered difficult by students	80.2	9.8	3.14	0.77	Accepted

Research Question 2: *What is the effect of gender on the performance of students in chemistry external examinations as perceive by the students.*

The result in Table 3 shows that female students' perception of poor academic performance (M= 15, SD= 2.322) was slightly higher than the male (M=14.06, SD= 3.714). The t-test results, $t(138) = 0.6743$, $p > .05$ showed that gender has no effect on the perception of poor performance of students in chemistry.

Gender	Male	Female
N	62	78
Mean	3.164	3.266
SD	0.8977	0.8822
T	0.6743	
Df	138	
SEM	0.1140	0.9998

Sig= 0.151

Research Question 3: *What are the methods/ strategies of improving students' performance in chemistry examinations?*

Table 4 shows the result of the percentage frequency count of respondents' perception on the teaching methods that could improve students' performance in chemistry. From the result, majority (91%) of the respondents were of the opinion that the use of native language (mother tongue) will boost students' performance in the examinations being considered. Moreover, most of the respondents believed that students' performance in chemistry examinations would improve with the use of practical classes (95%), demonstration method of teaching (97%) as well as

improved use of instructional materials (98%). On the other hand, most of the students (60%) did not see lecture method of teaching as a way of improving their performance.

Table 4: Students' Perception on how to improve their academic performance in chemistry

Item	Agree%	Disagree%	Mean	SD	Decision
The use of native language in teaching chemistry will improve students' performance in chemistry external examinations	91%	9%	3.44	0.67	Accepted
The use of practical in teaching chemistry boosts students' performance	95%	5%	3.46	0.51	Accepted
Student's performance would get better with demonstration method of teaching	97%	3%	3.48	0.52	Accepted
Students performance would get better by use of lecture method in teaching	40%	60%	2.23	0.7600	Rejected
Students performance would be improved by use of instructional materials	98%	2%	3.51	0.48	Accepted

Ho1. There is no significant difference in the perceived causes of poor performance in chemistry between students in private and public schools.

To test this null hypothesis, t-test was run and the result summarized in table 5.

Table 5: Comparison of Students' performance in private and public schools

School Type	N	Mean	SD	T	df	Sig	SEM
Public	110	15.33	1.44	15.8124	138	0.323	0.1373
Private	30	20.44	1.98				0.3615

The t-test result revealed a significant difference between the scores of respondents from private and public schools. (Public: M=15.33, SD=1.44). (Private M=20.44, SD= 1.98). $t(138) = 15.8124$ $P < 0.05$). Based on this, the null hypothesis was rejected implying that there is a significant difference in the perceived cause of poor performance in chemistry between students in private and public schools.

H₀2: *There is no significant relationship between teachers' use of instructional materials and students' performance.*

Table 6 below gives a Pearson Product Moment Correlation conducted to ascertain the relationship between teachers' use of instructional materials and the performance of students in chemistry. From the result, the Person Product Moment Correlation Coefficient (r) = 0.63 and a probability level (P value) of 0.034 which is less than the chosen 0.05 alpha implies a null hypothesis of no significant relationship between teachers' use of instructional materials and students' performance was rejected. Therefore, the alternative was accepted.

Table 6: Correlation of teachers' use of instructional materials/strategies and students' performance

Variables	Performance	
Instructional Materials	Pearson Correlation	0.63
	Sig (2 –tail)	0.034
	N	140

4.0 Discussion

This study principally focused on the investigation of utilization of AI in perceived causes of poor performance of chemistry students in external examinations. The study has therefore revealed that the perceived causes of poor performance from the students' point of view include teachers' educational qualifications, teachers teaching methods and strategies, teachers' inappropriate use of teaching materials and teachers' teaching experience. The students also acknowledged that low retention, inadequate coverage of the syllabus and poor exposure to practical work are other factors responsible for this menace. The findings of this research was seen to be in line with findings of other researchers; Adaramaja et al. (2020), Zakariya & Bamidele (2015) and Hussein & Abdirahman (2024) who reported that teachers' educational qualifications, teaching methods and teachers' experience are factors responsible for the poor performance of students in examinations (Usman,2013).

The study also revealed that there is no significant difference on the opinion of students as to their performance with regards to gender. Findings on the strategies to be adopted to improve students' performance in chemistry in external examinations emphasized on the need for teachers to improve in their methods of teaching chemistry. Apart from integrating practical sessions more, there is also need to improve on the present use of instructional aids.

Furthermore, the hypotheses tested showed some difference in the perceived causes of poor performance in chemistry between students in public schools and their private school counterparts. It could therefore be inferred that from the findings of this study, the teaching profession needs to do more to retain experienced teachers as the need for experience in this field can't be over emphasized.

Conclusion and Recommendation

Chemistry remains the bedrock of sciences. Its knowledge is vastly applied in various fields such as pharmacy, medicine, engineering etc. Unfortunately, poor performance in chemistry

especially in the “O” level examinations have become endemic. Consequently, this issue has been a matter of concern in the recent past.

Findings from this study has revealed the importance of having our more experienced professionals treated with respect so we can get the best out of them. Steps should be taken by private school owners and government to recruit qualified and experience personnel on the use of AI and also create awareness on the importance of AI and its utilization in the performance of students in chemistry. On the other hand, the use of instructional materials in teaching should be enhanced as they have been found to be a really good demonstration tool. Furthermore, students’ performance in chemistry will be massively improved if students are being handled by well qualified teachers.

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