The Use of Exploratory Data Analysis in Measuring the Impact of the Use of ChatGPT AI Tool on the Academic Performance of University Students

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THE USE OF EXPLORATORY DATA ANALYSIS IN MEASURING THE IMPACT OF THE USE OF CHATGPT AI TOOL ON THE ACADEMIC PERFORMANCE OF UNIVERSITY STUDENTS

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ABSTRACT
The use of Artificial Intelligence (AI) has changed the way people do things especially in carrying out academic work. AI tools are useful and of great importance in Nigerian tertiary institutions. Their usefulness cannot be overemphasized as Lecturers and students use them to find timely solutions to their academic related problems.This research work is centered on assessing the impact of the use of Chat GPT AI tool as against other AI tools on the overall performance of university students (undergraduates) in Northern Nigeria with a focus on cadets of the Nigeria Police Academy, Kano from five different departments : Physics Chemistry, Biology, Mathematics and Computer Science departments. A total of 250 respondents was targeted . The survey used Google form as a survey tool and then distribution was done via email. Data from the Google form was retrieved in Google sheets, Cleaned, Processed and Exploratory Data Analysis (EDA) was done in GoogleColab IDE using Python Programming Language.
Keywords: Artificial Intelligence, Data Analysis, ChatGPT, Academic Performance

1.0   INTRODUCTION

The use of Artificial Intelligence tools has become very rampant among individuals globally as a result of the fact that it makes accessing information, processing data as well as dissemination of important information a lot faster and easier[3].
Artificial Intelligence tools are used in virtually every facet of life[16]. They are also commonly used by students worldwide in their academic work for projects and assignments as well as for recreation as seen in VR, Gaming, AR etc. Artificial Intelligence has impacted positively in diverse sectors globally and the education sector is not left out with the introduction of diverse AI tools such as Quizlet, Grammarly, Quillbot as well as MOOCs which are used for learning and self-development[6]. ChatGPT is one of the very many AI

tools used in higher education by both lecturers and students[7][3].

Artificial Intelligence, AI is "the field of computer science dedicated to solving cognitive problems commonly associated with human intelligence [1]; such as learning, problem-solving, and pattern recognition."
• AI is "the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."[16]

Lecturers in institutions of higher learning have adopted the use of different AI tools in making teaching easy for them as well as easing learning for their students [8]. Students make up the larger population of AI tool users use these tools to carry out various tasks ranging from gaming and Virtual Reality (VR), generating social media content, creating beautiful art pieces to academic learning[23].

According to [15], diverse tools have been adopted by university students to make learning a lot simpler and easy to follow but Chat GPT happens to be more commonly used in different parts of the world.

There are a large number of Massive Open Online Courses (MOOCs)[1] for the online study such as coursera.com. The growing amount of activate users of MOOCs courses shows that the electronic and distance learning methodologies are appreciated by the society[3]. And some of the courses can give students a real opportunity to get official degree of some distinct and very respectable university[7]. At the same time, we can observe recent advances of Virtual Reality (VR), Augmented Reality (AR) and Artificial Intelligence (AI) and its application to educational process. For example, in neurosurgery, VR technologies already have a serious impact - 3D Oculus Surgical Theatre is used for simulating surgery process of removing brain tumours[23].

2.0 RELATED WORKS

Variety of IT trends were discussed [28], such as artificial intelligence (AI), cloud computing (CC), the internet of things(IoT), data analytics and big data, cyber-security, and virtual and augmented reality (VR and AR), and how it improve communication and collaboration. It also discusses how big data analytics is used to make better decisions, integrate AI into tertiary institutions, the potential of mobile learning apps, and how virtual reality is used in science education, cloud computing implications, and gamification applications [8] The study seeks The study seeks to assess the impact of AI on education. More particularly, it seeks to ascertain how AI has affected education, looking at various aspects of education, including administration, instruction, and learning. This study takes a retrogressive approach, entailing assessing secondary data and materials or

studies that have been undertaken while this research is centred on the impact of AI on learning; academic excellence to be precise [25].

The study examined artificial intelligence creative compliance, and the future of science education: a study of Nigerian universities lecturers. An online cross-sectional questionnaire survey among science education lecturers were used across federal universities in five states and the Federal Capital Territory(FCT),Abuja.The survey used Google Forms as the survey tool and WhatsApp as the distribution platform. [14]_This paper presents a dataset collected from students at an applied university in Jordan to understand their usage and perception of AI tools, specifically chatbots like ChatGPT and Bard, in their educational processes. The dataset is derived from a questionnaire that consists of two main sections while this work sheds light on various AI tools and their impact on the scores attained by the police cadets (students).[18] Exploratory data analysis was carried out by using libraries like Pandas, Matplotlib and Seaborn to analyze amazon review datasets which contain review of electronic data items.[20]The dataset "World Happiness Report 2021" was used to analyze and extract various information in both numerical and pictorial form.[27] The findings of the study reveal a prevalent use of AI technologies in education in Nigeria, encompassing evolutionary software modelling, student performance prediction, multimedia e-learning platforms and frameworks, and the incorporation of Moodle learning

3.0 DESIGN METHODOLOGY

In this study, some research questions happen to be the driving forces. They are:

1. How useful is the ChatGPT AI tool in effectively solving students' academic problems?
2. What significance is the use of ChatGPT on students' academic work?
3. How familiar are students with the use of different AI tools?
4. How efficient are the results generated from ChatGPT?
5. In what ways can ChatGPT foster academic integrity?

The figure above clearly shows that cadets who use ChatGPT AI tool for their academic work ended up improving their learning capability .It makes learning a lot simplified and concise. Secondly, it unleashed the cadets curiosity to acquire new knowledge as it exposed them to a much seamless output which can be further streamlined if the generated information is not favourable. Thirdly, cadets who use ChatGPT have considerably better CGPA compared with those who don't.Lastly, ChatGPT users amongst the cadets are observed to be better at critical thinking which in turn improved their capability to carry out research.

Exploratory Data Analysis(EDA) was carried out using Python Programming because it is a multipurpose object oriented programming language which supports statistical computing with different packages and functions. [30] The following Python libraries were used for this project:

*Numpy:A short form for Numerical Python. It provides functions for carrying out element-wise computations with arrays or mathematical computations between arrays

*Pandas: provides functions and rich data stuctures which makes working with structured data expressive, easy and fast. It uses 'DataFrame' which comes in two dimensional tabular form i.e rows and columns

*Matplotlib: is used for producing plots and other 2D-visualizations .It provides an interactive environment for plotting and exploring data.

3.1 MATERIALS AND METHODS

This research made use of Google Form in collecting primary data from cadets from seven different department(Physics Chemistry, Biology, Maths Computer Science , Biochemistry and Forensic Science) of Nigeria Police Academy. The form is divided into three (3)sections : The first section(Section A) is Demographics where information such as Age, Department , Level and CGPA were captured. The second section(Section B) is centred on the usage of ChatGPT and other AI tools by cadets. The third section (Section C) highlights Perceived Effect Of The Use Of Chatgpt And Other AI Tools On Students' Academic Performance. Email was used as a medium for the distribution of the questionnaire .

GoogleColab was used as an IDE for the writing of the Python program because it makes it easy to incorporate other Google services such as Google Cloud Support, Google Drive and Google Sheets. It also permits a free cloud-based environment which makes coding easy and seamless. GoogleColab is preferable for this project because of its support of Graphics Processing Units(GPUs) and Tensor Processing Units (TPUs) which is of essence when working on Exploratory Data Analysis, Machine Learning and Deep Learning Projects

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

4.0 DATA ANALYSIS PHASES

When carrying out Data Analysis, there are seven (7) phases involved . They include but are not limited to:

i. **Data Requirements**: In this work ,details such as the cadet's department, level, CGPA, Frequency of use of ChatGPT and many more were captured in order to assess the impact of ChatGPT AI tool on the overall academic performance of the cadet.

ii. **Data Collection:** Data was collected using a Google form(structured in form of a questionnaire) which is an online cloud resource which students/cadets can fill and submit . The questionnaire is composed of three (3) sections namely: Section A: Demographics, Section B: Usage of ChatGPT and other AI tools, Section C: Perceived Effect of the Use of ChatGPT and other AI tools on Students' Academic Performance

iii. **Data Processing :** The data collected for this research was processed and organized for analysis using Google sheets. It involved arranging the data in table format called **Structured Data** for further analysis.

iv. **Data Cleaning:** The data used for this research was scanned for inconsistencies , errors and duplicates and they were all removed. Data cleaning entails data quality maintenance, identifying data inaccuracy, record matching ,outlier data identification, textual data spell checker and data sorting.

v. **Exploratory Data Analysis:** After cleaning the data and certifying they are error-free, they can then be analyzed.

Data Sets

This data set was extracted from the survey questionnaire(in Google sheet) into Google sheets and later converted into a .csv file. A total of 250 respondents were targeted but only 234 respondents were gotten. After data cleaning, the total became 210. The column headers: S/N, Gender, Age ,Department, Level/Regular Course, CGPA etc

After importing the Python libraries as earlier stated, the data is then uploaded and read into the IDE.

5.0 RESULTS AND DISCUSSION

S/N	RC9 CADETS' CGPA (USERSOF CHATGPT)	RC9 CADETS' CGPA (NON-USERS OF CHATGPT)
1	3.5	1.4
2	3.4	2.5
3	4.6	2.3
4	3.1	2.9
5	3.7	2.4
6	3.2	2.1
7	3.6	2.3
8	3.3	2.7
9	4.6	2.4
10	4.4	1.4
STD	0.578	0.495
Variance	0.334	0.245
Mean	3.740	2.240
SE	0.106	0.077
RE	0.028	0.035

S/N	RC7 CADETS' CGPA (USERSOF CHATGPT)	RC7 CADETS' CGPA (NON-USERS OF CHATGPT)
1	4.4	2.7
2	3.7	2.4
3	4.1	1.8
4	3.4	2.7
5	3.3	3.1
6	2.5	2.3
7	4.1	2.5
8	4.4	2.4
9	2.6	2.2
10	4.2	3.3
STD	0.702	0.435
Variance	0.493	0.189
Mean	3.670	2.540
SE	0.156	0.060
RE	0.043	0.024

S/N	RC8 CADETS' CGPA (USERSOF CHATGPT)	RC8 CADETS' CGPA (NON-USERS OF CHATGPT)
1	3.4	3.1
2	4.2	2.4
3	2.7	2.1
4	3.6	1.5
5	4.2	2.9
6	2.8	2.2
7	3.2	1.2
8	3.7	2.4
9	4.1	3.2
10	4.1	2.7
STD	0.566	0.653
Variance	0.320	0.427
Mean	3.600	2.370
SE	0.101	0.135
RE	0.028	0.057

KEY: STD: STANDARD DEVIATION
SE: STANDARD ERROR

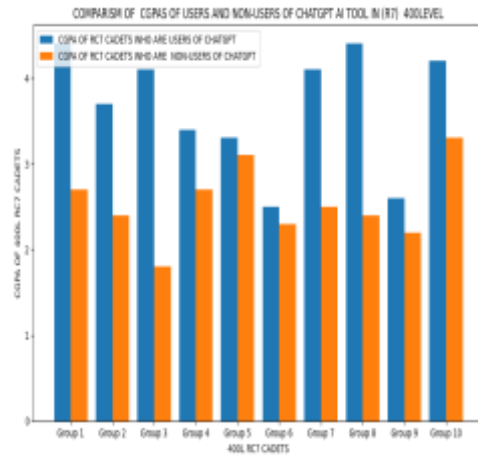| S/N	RC6 CADETS' CGPA (USERSOF CHATGPT)	RC6 CADETS' CGPA (NON-USERS OF CHATGPT)
1	3.2	2.5
2	2.9	2.6
3	4.2	4.1
4	3.6	2.9
5	3.4	2.6
6	3.2	1.5
7	4.2	3.6
8	4.4	2.5
9	3.4	2.4
10	3.6	3.2
STD	0.500	0.716
Variance	0.250	0.512
Mean	3.610	2.790
SE	0.079	0.162
RE	0.022	0.058
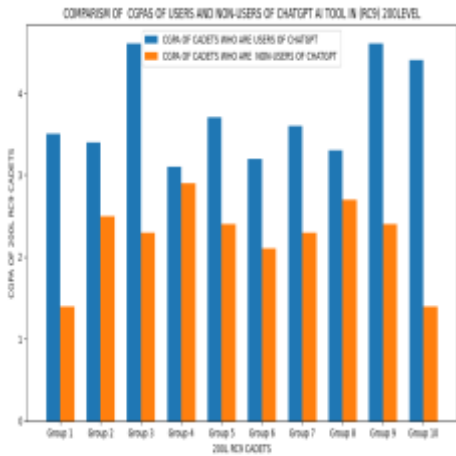
FIGURE 1

FIGURE 3

FIGURE 2

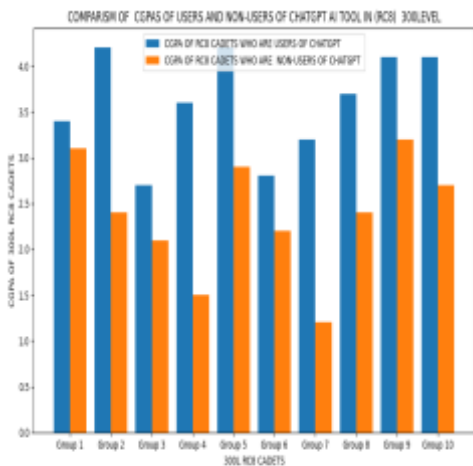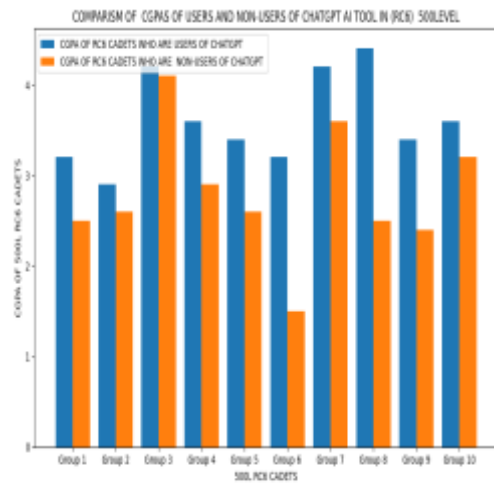**FIGURE 4**

Python codes in Google Colab using Exploratory Data Analysis was used to plot the graphs in Figures 1 to 4 using the matplotlib library function .The blue bars clearly show CGPA of cadets who use ChatGPT while the orange bars show the CGPAs of cadets who do not use ChatGPT. The x-axis shows the groups of the different cadets depending on their levels (200level to 500level excluding 100level) while the y-axis shows the CGPAs of the two categories of cadets

From the graphs , it can be clearly seen that Cadets who used ChatGPT for their academic work performed better than those who did not. This is not to rule out the efficacy of other AI tools but to show that relatively, compared with other AI tools such as Gemini, Grammarly, Quillbot Etc ChatGPT is the most sought after and has positive impact on the academic performance of cadets which is evident in this work.

CONCLUSION

The use of AI tools is still not very popular in some sectors and some persons still claim not to have used them before even academics and students.Hence the

need for government regulatory bodies to inform and sensitize the citizenry on the importance of the use of AI tools.

There is also this misconception that AI has come to take up the jobs of some persons. This is a myth which is totally untrue. Rather, AI has come to simplify tasks, get jobs done faster and make life a lot better for people. For future work, I recommend that they explore more AI tools and how they can be of essence.

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