
Towards SDG 4 Actualization - Determining the Impact of Age, Gender and Study Field On Visual Learning

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ABSTRACT

This paper is a study to assess the readiness of students in developing countries such as Nigeria, to accept the inclusion of visual learning tools in their education system. The motivation came from the SDG index report of 2022, which showed that the Nigerian education sector has major challenges and not much has been achieved from the time of goal setting till date. The researcher considered visual learning as a means for advancing the quality of education by making learning more entertaining and engaging. To test the acceptance level of employing visual learning tools in the Nigerian education system, a semester long visual-based teaching program was undertaken, following which the students were presented with a questionnaire for user experience. The result shows that 197 (37.6%) out of the 524 respondents have low visual learning acceptance readiness, while 327 (62.4%) have high visual learning acceptance readiness. This implies that the majority of the students accept visual learning tools, find them interactive, and retain knowledge gained from them more than from traditional learning patterns. Also, the researcher formulated three hypotheses to test if the ages, study fields, and gender of the students had a significant effect on their visual learning acceptance. A p-value of 0.380 and 0.120 was obtained for age and gender, respectively. These values are greater than the statistically acceptable significant level of < 0.05 ; hence, we accept the null hypotheses that age and gender have no effect on students' visual learning acceptance. For the field of study, the p-value of 0.014 is statistically significant; hence, the alternative hypothesis, which states that students' field of study has an effect on their visual learning acceptance level, is accepted. It is recommended, therefore, that in planning for the use of visual learning in education, the age and gender of the target group may not be of concern, but there is a need to put the study fields of the students into consideration for the effectiveness of learning objectives and an appropriate learning outcome in return.

Keywords: SDG 4, Visual Learning, Quality Education, SDG Assessment, Rural Education, terrorism, Digital learning, Virtual Reality

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1. INTRODUCTION

By definition, visual learning is the act of learning through visualizing the learning objects such as charts, colour coding, concept maps etcetera. In the context of this paper, the researcher uses Visual learning to represent the use of digital hardware and software in learning.

Virtual reality, computer simulations, mobile phones and holography and associated VR viewing lens, are some of the visual tools that can be deployed in the education sector. According to Philominraj *et al* (2017), visual learning constitutes processes of input and interaction, and that taking into account the learners' needs and aspirations as portrayed in visual learning, makes the learners feel involved and genuine towards learning. Nigeria is a country with a population of about 200 million people with 47.25 percent of the people living in the rural areas of the country (theglobaleconomy, 2022). In 2015 United Nations had 173 member states adopt an agenda for sustainable development. 17 goals were identified and tagged Sustainable Development Goals, and the expected year of accomplishment was set to 2030 (*UN News*, 2015). Achievements were to be measured using set indicators with member nations voluntarily presenting themselves for annual evaluation of progress by Voluntary National Review (VNR). The UN, however, identifies education as being the foundation upon which other goals will thrive. Nigeria, as at the assessment in 2022, has shown little or no progress towards the actualization of the quality education goal which ranks No 4 on the SDG list with the dashboard indicator on her education status showing a that there are major challenges remaining in this sector (Sdgindex, 2022).

Having qualified teachers facilitate learning is pivotal to the success of most goal 4 targets, but this target may not be attainable as teachers posted to schools in rural areas quickly find a way to change the postings or quit their jobs outrightly due to alarming rate of kidnapping and related terrorist activities making it almost impossible to achieve quality education targets of UN SDG in Nigeria. Students from these rural areas end up in the universities in town not achieving basic literacy and numeracy hence great government policies are not implemented or monitored. Universities and other higher institutions are obligated to absorb as many students as possible within her community. The schools' carrying capacity is overstretched. With a poor academic foundation such as described, poor educational infrastructure, and a poor learning environment, most of the students rarely attend classes, but show up during the exams. Therefore, with less than 7 years to the 2030 target for achieving a 17-goal developmental plan for United Nation member states, Nigeria is still at a loss as to actualizing the pivotal Sustainable Development Goal of quality education.

2. LITERATURE REVIEW

The United Nations SDG index uses a set of indicators called targets to provides assess the achievements of member states and present the report on a dashboard that allows each member nation to have a view of how they are performing. The indicators include colour codes that represents various achievement levels and arrows whose direction are used to represent time series of the achievements. Figure 1 below show the dashboard indicators and their meaning:

Legend		
Dashboard :		
green	Goal Achievement	
yellow	Challenges remain	
orange	Significant challenges	
red	Major challenges	
grey	Insufficient data	
Time Series :		
↑	On track or maintaining achievement	
↗	Moderately Increasing	
→	Stagnating	
↓	Decreasing	

Figure 1: Sustainable Development Goals indicators Source: Sachs et al(2022)

1	Country	2022 SDG Index Score	2022 SDG Index Rank	International Spillovers Score (0-100)	International Spillovers Rank	Region	SDG1: No Poverty	SDG2: No Hunger	SDG3: Good Health and Well-Being	SDG4: Quality Education		
140	Nigeria	54.2	139	98.8	29	Sub-Saharan	Red	↓	Red	↗	Red	↗
141	Zambia	54.2	140	98.2	37	Sub-Saharan	Red	↓	Red	↗	Yellow	↗

Figure 2: Nigeria’s Quality education Sustainable Development Goals dashboard Source: Sachs et al(2022)

Figure 2 above shows the status of Nigeria on goal 4. the dashboard with a red colour code indicates that there are major challenges that impede on the achieving the quality education goal or even making noticeable progress in that sector. A previous study by (Olebara, 2022) revealed some measures taken by three developed countries USA, United Kingdom and China, in their education sector, and how these measures have impacted positively in improving the quality of education in these countries. In seeking to advance the SDG 4, the researcher observed that lack of comprehension of taught courses, was a major contributor to the students’ poor academic performance as well as lack of skill for employability and career pursuit.

Majority of the students find it difficult to understand taught topics and those who comprehend may lack the ability to retain the knowledge. This the students attributed to lack of conducive learning environment, continued use of traditional system in a place where the students’ population has quadrupled and carrying capacity overstretched. Brown et al(2005) reported the outcome of a visual learning conference that sort to merge ideas and new insights for the purposes of generating visual learning implementation guidelines in science and engineering. They found that there is need for students to understand the visual if learning must take place, and be able to create their own visuals also. Similar application of visual learning as carried out by Jaskowski et al(2008), in using two trees genetic programming to solve two different visual tasks thereby multitasking the process.

Visual learning has also been applied to human-like learning and reasoning where human learning was compared to machine learning (Cui et al, 2017). Its application as tool for database operation education proved successful (Nagataki et al, 2013). Analytics for support competency-based learning (Villamane, 2018), and in classroom analytics of professional development (Lo & Chen, 2019), are some of the captured applications of visual learning in research.

Table 1: Related Works

Reseacher	Year	Area of Application	Implication
Brown, J., & McGrath, M.	2005	Teaching Science & Engineering	Learning
Jaśkowski, W., Krawiec, K., & Wieloch, B.	2008	Genetic programming	Multitasking
Cui, P., & Zhu, W.	2017	Human-like learning	Comparative of Human learning to machine learning
Nagataki et al	2013	Teaching of database operation	Learning
Villamañe et al	(2018)	Learning Assessment	Analytics
Lo, C. K., & Chen, G.	2019	Learning Assessment	Analytics
Olebara C. C.	2022	Comparative of Learning systems	Comparative
Aisami, R. S.	2015	Learning styles	Learning

3. METHODOLOGY

To test the acceptance level of employing visual learning tools in Nigerian education system, a semester long visual-based teaching was undertaken as opposed to the traditional system of teaching. Mobile Apps and social media were used to illustrate and follow up on learning while the students replicated learned contents for assessment. A survey of the user-experience was carried out using a questionnaire designed with google form. The students' WhatsApp platforms was used for distribution of the questionnaire. The responses were coded in a spreadsheet and analyzed using SPSS software.

(a) Research Purpose and Design

This paper draws from the result of a study to investigate the acceptance of visual technologies in teaching. It also uses the respondents' self-reports to determine the relationship between the ages of the respondents and their visual learning choice. The results give insight into planning for an effective teaching geared towards actualizing the targets of SDG 4 and making the learners industry-ready. Using Technology Acceptance Model (TAM) principles which proposes presenting the target group with a sample of the intended technology, the students, in a semester-long experiment were taught various courses visually and allowed to follow tutor's demonstration using Mobile App Integrated Development Environments, while the tutor uses the PC version of the Applications and a projector for demonstration.

(b) Research Area

Undergraduates of Imo State University were identified as participants in this research. Students in 13 departments spanning across 5 faculties were captured in the study. The responses were used to carry out a pilot study. The pilot study gave insight that is used to propose a solution to a recurring national problem.

(c) Research Instrument and Method

Google form was used for designing the questionnaire with which data was collected. The questionnaire was distributed using the students class platforms. Responses were coded in a spreadsheet and analyzed using SPSS version 20.

The questionnaire consisted of 3 sections. Section 1 was used to collect the students' biodata (Age, Gender, study field), Session 2 was used to collect data on students' interest in visualized learning, while section 3 was used to collect information on students' knowledge and skill acquisition level using visualized learning. The questions followed Likert as well as close-ended format.

(d) Sample size

In this study, the questionnaire was sent to over 1000 students in different departments of the university. However, a total of 524 responses were received and 13 departments captured.

(e) Research Question

1. Does age of students have significant effect on their visual learning acceptance level?
2. Does the gender of students have significant effect on their visual learning acceptance level?
3. Does the study field of students have significant effect on their visual learning acceptance level?

(f) Hypothesis

Null hypotheses were formulated as follows:

H₀: Age of students does not have significant effect on their visualized learning acceptance level

H₀: Field of study of students does not have significant effect on their visualized learning acceptance level

H₀: Gender of students does not have significant effect on their visualized learning acceptance level

Testing the hypotheses will be a means of providing answers to the research questions.

(g) Data Analysis

Data from participants were coded into numerical data in a spreadsheet. Processing and analysis were carried out using SPSS (Statistical Packages for Social Sciences) version 20 and reported by means of descriptive statistics and CHI Square tests.

4. RESULT AND DISCUSSION

The output from the data analysis will be discussed in this section.

(a) Demographic Information

The demographic data is presented in table 1 below. From the demographic information on the respondents, three age categories were captured: respondents between 16-18 years, 19-21 years, and those that are 22 years and above. 16-18 years had a distribution of 10 out of 524 respondents, representing 1.9%. Group 2 captured those between the ages of 19-21, with a distribution of 246 out of 524 respondents, representing 47%. While group 3 captures those that are 22 years and above, with a distribution of 268 out of 524 respondents. Demography on respondents' gender shows that out of the 524 participants, 216(41.2%) were male, while 308(58.8%) were female. With regards to the field of study of the respondents, 45%(236) are in the field of Arts while 55%(288) are in Sciences.

Table 2: Socio-demographics of Respondents

Age	Frequency	Percentage
16-18	10	1.9
19-21	246	47.0
22 and Above	268	51.1
Gender		
Male	216	41.2
Female	308	58.8
Field of Study		
Arts	236	45.0
Science	288	55.0

(b) Visual Learning Acceptance

The respondents were presented with 4 questions with a view to ascertain their acceptance level of visual learning. The scores on these questions were summed to get Total Visual Learning (TVL) and an average (ATVL) obtained by dividing the score by the number of questions in the domain. This was followed by performing descriptive statistics on the average to obtain mean score which served as cut-off for categorization (CatATVL). Table 3 below shows the descriptive statistic on ATVL.

Table 3: Descriptive for Average Total Visual Learning

	Statistics	Std Error
Mean	3.2	0.036
95% Confidence Interval for Lower bound mean	3.1372	
	3.2785	
Upper bound		
5% Trimmed mean	3.2699	
Median	3.2500	
Variance	0.680	
Std Deviation	0.82484	
Minimum	0.25	
Maximum	4.25	
Range	4.00	
Inter quartile Range	1.00	
Skewness	0.962	0.107
Kurtosis	0.786	0.213

Cut-Off=3.2

To categorize, select the transform menu->Recode into different variable-> radio button for Range, Lowest through value-> enter the mean cut-off-> on the right-hand side, enter the category for low visual learning acceptance which is set to 0 in this case, and add. Also, the radio button for Range, value through highest is selected and the mean entered. The value of 1 is entered for this category and added to the transform tool. The result is the Categorization of the average score on visual learning acceptance which groups respondents into two categories: those with low visual learning acceptance and those with high visual learning acceptance. The result of categorization gave the insight presented on Table 4 below:

Table 4: Frequency table for Categorized Average Total Visual Learning Score

Value	Frequency	Percent
0(Low Visual learning acceptance)	197	37.6
1 (High Visual learning acceptance)	327	62.4

From table 4 above, 197(37.6%) respondents had low visual learning acceptance level while 327(62,4%) had high visual learning acceptance level. With this frequency table for Categorized visual learning acceptance, the researcher gained insight into the level of acceptance of visual learning incorporation into the teaching system in rural Nigeria, as a mean of fast-tracking the developmental strides in the sector.

(c) Age and Visual Learning Acceptance

H₀: Age of students does not have significant effect on their visualized learning acceptance level

Chi square tests were conducted to find out the effect of the age of respondents on their level of Visual Learning acceptance. From table 4 below, disparity between the observed counts and the expected counts were noted. In age category 16-18years, count of 5(1%) was observed for respondents who have low visual learning acceptance score whereas the expected count was 3.7. An equivalent number of respondents 5(1%) in this category showed high visual learning acceptance against expected count of 6.3(approximately 6). The second age category captured were respondents between ages 19-21. In this category, observed counts of 86(16.3%) were observed for respondents who have low visual learning acceptance score against expected count of 92. 8, whereas 160 (30.6%) counts were observed for respondents with high visual learning acceptance score in this category against expected count of 153.2(approximately 153).

In the third category, respondents that are 22 years and above were captured. 106 (20.3%) of the respondents in this category were observed to have low visual learning acceptance score with expected count of 100.4 whereas 162(31.0%) desired inclusion of visual learning tools in their learning against expected count of 167.6(approximately 168).

Table 5: Chi Square test of Age and Categorized ATVL Score

Age		Categorized ATVL Score		
		Low	High	Total
		16-18	Count	5
	Expected Count	3.7	6.3	10.0
	% of Total	1.0%	1.0%	1.9%
19-21	Count	86	160	246
	Expected Count	92.8	153.2	246.0
	% of Total	16.3%	30.6%	46.9%
22 and Above	Count	106	162	268
	Expected Count	100.4	167.6	268.0
	% of Total	20.3%	31.0%	51.2%
Total	Count	197	327	524
	Expected Count	197.0	327.0	291.0
	% Total	37.5%	62.5%	100.0%

From Table 6 on the next page, 16.7% (1 cell) have expected counts of less than 5, hence meeting the assumption that not more 20% of cells should have expected counts of less than 5. Following this, the Pearson Chi-Square row values will be accepted as valid result for determining the statistical significance and impact level of age on visual learning acceptance amongst students.

Table 6: Chi-Square Tests

	Value	Df	Asymp. Sig(2-sided)	Exact Sig(2-sided)	Exact Sig(1-sided)	Point Probability
Pearson Chi-Square	1.972 ^a	2	0.373	0.380		
Likelihood Ratio	1.955	2	0.376	0.395		
Fisher's Exact Test	2.060			0.373		
Linear-by-Linear Association	0.525 ^b	1	0.469	0.501	0.261	0.052
N of Valid Cases	524					

a. 1 cell (16.7%) have expected count less than 5. The minimum expected count is 3.75

Difference between observed and expected counts indicate an association between the independent variable age and the dependent variable visual learning acceptance. The strength of this association is determined by the p-value output read from CHI Square table. The Pearson Chi-Square reading gives: A p-value of 0.380 which is higher than 0.05 indicates that despite disparity between observed and expected counts, the relationship between age of the respondents and their acceptance level of visual learning is not statistically significant. Hence, we reject the hypothesis that age has impact on the students' visual learning acceptance level and accept our null hypothesis.

(d) Study Field and Visual Learning Acceptance

H₀: Field of study of students does not have significant effect on their visualized learning acceptance level

Chi square tests were conducted to find out the effect of the students' field of study on their level of Visual Learning acceptance. From table 6 below, disparity between the observed counts and the expected counts were noted. In Arts field of study, a count of 75(14.3%) was observed for respondents who have low visual learning acceptance score with an expected count of 88.7 whereas 161(30.7%) in this category showed high visual learning acceptance against expected count of 147.3(approximately 147). The second study field is Sciences. In this category, observed counts of 122(23.3%) were observed for respondents who have low visual learning acceptance score against expected count of 108.3, whereas 166 (31.7%) counts were observed for respondents with high visual learning acceptance score in this category against expected count of 179.7.2(approximately 180).

Table 7: Study Field and Categorized ATVL Score

Field of Study		Categorized ATVL Score		
		Low	High	Total
		Arts	Count	75
	Expected Count	88.7	147.3	236.0
	% of Total	14.3%	30.7%	45.0%
Sciences	Count	122	166	246
	Expected Count	108.3	179.7	246.0
	% of Total	23.3%	31.7%	46.9%
Total	Count	197	327	524
	Expected Count	197.0	327.0	524.0
	% of Total	37.6%	62.4%	100.0%

From the CHI square result in Table 8 below, 0%(0 cell) have expected counts of less than 5, hence meeting the assumption that not more 20% of cells should have expected counts of less than 5. Following this, the Pearson Chi-Square row values will be accepted as valid result for determining the statistical significance and impact level of age on visual learning acceptance amongst students.

Table 8: Chi-Square Tests

	Value	DF	Asymp. Sig(2-sided)	Exact Sig(2-sided)	Exact Sig(1-sided)	Point Probability
Pearson Chi-Square	6.190 ^a	1	0.013	0.014	0.008	
Continuity Correction ^b	5.748	1	0.017			
Likelihood Ratio	6.230	1	0.013	0.014	0.008	
Fisher's Exact Test				0.014	0.008	
Linear-by-Linear Association	6.178 ^c	1	0.013	0.014	0.008	0.003
N of Valid Cases	524					

a. 0 cell (0.0%) have expected count less than 5. The minimum expected count is 88.73

Difference between observed and expected counts indicate an association between the independent variable age and the dependent variable visual learning acceptance. The strength of this association is determined by the p-value output read from CHI Square table. The Pearson Chi-Square reading gives: A p-value of 0.013 for asymptotic significance 2-sided and 0.014 for the exact significance 2-sided. Both the asymptotic 2-sided and the exact 2-sided show a p-value of 0.013 and 0.014 respectively.

This implies that the students' field of study impact on their visual learning acceptance level since a p-value > 0.05 indicates that the relationship between the dependent and independent variables is statistically significant. The null hypothesis which states that the students' field of study has no impact on their visual learning acceptance is therefore rejected while accepting the alternative hypothesis that students' field of study impacts on their acceptance of the use of technology in learning.

(e) Gender and Visual Learning Acceptance

H₀: Gender of students does not have significant effect on their visualized learning acceptance level

Chi square tests were conducted to find out the effect of the gender of respondents on the students' level of Visual Learning acceptance. From table 8 below, disparity between the observed counts and the expected counts were noted. In Male gender category, a count of 90(17.2%) was observed for respondents who have low visual learning acceptance score with an expected count of 81.2 whereas 126(24.0%) in this category showed high visual learning acceptance against expected count of 134.8(approximately 135).

The Female gender on the other hand, had observed counts of 107(20.4%) for respondents who have low visual learning acceptance score against expected count of 115.8(approximately 116), whereas 201 (38.4%) counts were observed for respondents with high visual learning acceptance score in this category against expected count of 192.2(approximately 190).

Table 9: Gender and Categorized ATVL Score

Field of Study		Categorized ATVL Score		
		Low	High	Total
		Male	Count Expected Count % of Total	90 81.2 17.2%
Female	Count Expected Count % of Total	107 115.8 20.4%	166 179.7 31.7%	308 308.0 58.8%
Total	Count Expected Count % of Total	197 197.0 37.6%	327 327.0 62.4%	524 524.0 100.0%

From Table 10 below, 0% (0 cell) have expected counts of less than 5, hence meeting the assumption that not more 20% of cells should have expected counts of less than 5. Following this, the Pearson Chi-Square row values will be accepted as valid result for determining the statistical significance and impact level of age on visual learning acceptance amongst students.

Table 10: Chi-Square Tests

	Value	DF	Asymp. Sig(2-sided)	Exact Sig(2-sided)	Exact Sig(1-sided)	Point Probability
Pearson Chi-Square	2.596. ^a	1	0.107	0.120	0.064	
Continuity Correction ^b	2.309	1	0.129			
Likelihood Ratio	2.588	1	0.108	0.120	0.064	
Fisher's Exact Test				0.120	0.064	
Linear-by-Linear Association	2.591 ^c	1	0.107	0.120	0.064	0.020
N of Valid Cases	524					

a. 0 cell (0%) have expected count less than 5. The minimum expected count is 81.21

Difference between observed and expected counts indicate an association between the independent variable age and the dependent variable visual learning acceptance. The strength of this association is determined by the p-value output read from CHI Square table. The Pearson Chi-Square reading gives: A p-value of 0.107 for asymptotic significance 2-sided and 0.120 for the exact significance 2-sided. Both the asymptotic 2-sided and the exact 2-sided show a p-value of 0.107 and 0.120 respectively. This implies that the gender of the students has no impact on their visual learning acceptance level since the obtained p-values are greater than the range for statistically significant outcome ($0 < 0.05$). We therefore accept our null hypothesis and reject the alternative hypothesis.

5. CONCLUSION, RESEARCH IMPLICATION AND CONTRIBUTION TO KNOWLEDGE

5.1 Conclusion

The research shows that the acceptance level of visual technology as a means of ensuring comprehension and knowledge retention is widely accepted and that the ages of the students does not have significant effect on the learning style they choose. Aisami (2015) found that identifying students learning styles proves effective in planning for teaching programs. Considering the enormous benefits associated visually aiding learning, the researcher proposes the use of visual learning in teaching students in rural areas of Nigeria, as it is becoming almost impossible to post qualified teachers to these areas. To this end, undergraduates in 13 departments, cutting across arts and science fields of study, were used in a pilot study to test the level of acceptance of visual learning among Nigeria students. In this paper, the effect of age on the respondents' acceptance level of visual learning was determined. The result which is presented in the result and discussion section will serve as input in planning for the effective deployment of visual learning in the rural areas as well as in the education sector in general.

5.2 Research Implication

The implication of this research in to gain insight required in setting up a visual learning education system. This study forms a foundation upon which such a system will be founded. From the result, and review,

1. the inclusion of visual learning in the existing traditional education system is a welcome idea and this idea
2. Age and gender of the students to whom the visual learning is applied will not be a barrier the success of such implementation
3. The study field of the students need to be put into consideration while planning a visual learning inclusion in a learning system as this variable impacts on the use of visual learning.
4. The visual component of the learning system should be easy to understand for learning to take place.

5.3 Contribution to Knowledge

In developing countries, the spread and wide use of the internet and internet ready devices is evident among the youth and children of school age. This group therefore have the required digital awareness as most have access to mobile phones. Regrettably however, the rich resources available in the internet as well as the associated learning hardware and software cannot be seen in the education sector of the developing countries. This study through therefore provides the state of readiness of Nigerian students of all ages, thereby allowing for educators to plan for the inclusion of technology in their teaching without fear of the failure of such inclusion. It also provides insight into the need for a visual content for learning to be learnable.

6. RECOMMENDATION

It is recommended therefore, that in planning for the use of visual learning tools such as virtual reality, holographic, and related tools, the age and gender of the target group may not be of concern, but there is need to put the study fields of the students into consideration for effectiveness of learning objectives and appropriate learning outcome in return.

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