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Aims

The aims of The African Journal of Behavioural and Scale Development Research (AJB-SDR) are to: (i) provide a platform for researchers in behavioural fields to disseminate their research findings in Africa and beyond, (ii) promote the use of modern analytical approaches that will give research work in Africa credibility and global acceptance, (iii) facilitate the publication of quality articles presented by scholars all over the world during annual forum of the Association of the Behavioural Research Analysts and Psychometricians which is held in various regions, (iv) promote professional relationship and exchange of ideas among scholars that are devoted to scale development research and (v) provide a medium for disseminate empirical- based information on modern theories in the field of scale development.

Publication Details

The African Journal of Behavioural and Scale Development Research (AJB-SDR) is owned and published by the Association of Behavioural Research Analysts and Psychometricians (AB-ReAP). The journal is published biannually; *two issues in a year*. Each shall have both print and online versions. Both local and overseas subscription shall be made through the pay platform on AB-ReAP website, www.abreap.org. All correspondence should be directed to the Editor-in-Chief through info@abreap.org and copy joadeleke@yahoo.com.

Exploring modern analytical tools in Behavioural and Scale Development Research

The aim of publishing the current issue is to make available articles that will educate readers on the use of sundry statistical tools to answer research questions and develop credible measuring scales. Arowojolu and Onuka made use of Descriptive statistics, Analysis of Variance (ANOVA) and Partial Least Squares (PLS) to provide answers to the stated questions in the their work titled: **Assessment of Contributions of Demographic Variables to the Levels of Possession of Work Skills among University Senior Non-Teaching Staff in Ogun State, Nigeria**. Oladipo-Abodunwa et al used a new approach to develop a scaled named: **Student Mathematics Engagement Scale**. The authors used Exploratory factor analysis (EFA), Horn parallel analysis (HPA), confirmatory factor analysis (CFA) and Ordinal alpha reliability coefficient They also used R- programming version 3.4.0 for EFA to establish interaction between the scale items and their components. Other analytical approaches used by the authors are, independent model Chi-square analysis using maximum likelihood estimates, Principal axis factoring extraction method with oblimin rotation and horn parallel analysis. The authors also itemised cut points by Kline, (2005) that can assist prospective researchers in the field of scale development: values of chi-square ($\chi^2 \geq 1$), Probability level ($p \geq 0.05$), degree of freedom ($df \geq 1$), Tucker-Lewis index ($TLI \geq 0.95$), adjusted goodness of fit index ($AGFI \approx 1$), goodness of fit index ($GFI < 0.95$), Normed fit index ($NFI \geq 0.95$), incremental fit index ($IFI \geq 0.90$) comparative fit index ($CFI \geq 0.90$), Root mean square residual ($SRMR \leq 0.08$) and root-mean-square error of approximation ($RMSEA \leq 0.06$). Jimoh also used Content Validity Index (CVI) and percentages to carry out a study titled **Critical Thinking as a Correlate of Numeracy Learning Outcome Among Middle Basic Pupils in Kwara State, Nigeria**. Gbenga-Akanmu also reported the results of the study titled **Enhancing Retention and Performance in Numeracy Concepts through Meta-cognitive Training in Computer-mediated Classrooms** using Mean, standard error and Analysis of Covariance (ANCOVA). Onasoga et al used frequency, percentages and independent t-test to present results of the work titled **Nurses' Perception on Factors Responsible for Workplace Violence against Nurses in Selected Hospitals in Ilorin, Kwara State**. Other authors used various statistical tools too, because of the empirical nature of all the articles.

J. O. Adeleke
Editor-in-Chief

The African Journal of Behavioural and Scale Development Research Publication Guidelines

The African Journal of Behavioural and Scale Development Research (AJB-SDR) will be publishing articles by members of the Association of Behavioural Research Analysts and Psychometricians (AJB-SDR). Exceptions will be made for a non-member who is a co-author with a member, or who is invited to write for a special issue of the journal, or for other special/specific reasons.

- Articles submitted to AJB-SDR must be written in English, following manuscript guidelines (see below) and will be anonymously reviewed by referees. The editors will notify the senior author of the manuscript if it does not meet submission requirements.
- Articles are judged for (a) significance to the field of behavioural research and scale development from a global perspective, (b) comprehensiveness of the literature review, (c) clarity of presentation, and (d) adequacy of evidence for conclusions. Research manuscripts are also evaluated for adequacy of the rationale and appropriateness of the design and analysis. Scholarly relevance is crucial. Be sure to evaluate your information. Articles should move beyond description to present inquiry, critical analysis and must provoke discussions.
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index allowed is 15%, Hence, authors are advised to ensure this before sending the manuscripts.

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- Writing and editorial style shall follow directions in the *Publication Manual of the American Psychological Association* (6th ed., 2009). References MUST follow the APA style manual. Information on the use of APA style may be obtained at www.apa.org.

Manuscript Guidelines

- Manuscript length, including all references, tables, charts, or figures, should be 3,000 to 5,000 words. **Maximum length is 6,000 words.** Shorter pieces of 1500-3000 words, such as policy review or critique papers are welcomed.
- All text should be double-spaced, with margin 1 inch (2.5 cm) all round and left and right justified.
- Paragraphs should be indented using the "tab" key on the keyboard. No extra spacing should be between paragraphs.
- Tables, Figures, and Charts should be kept to a minimum (not more than 4 per article) and sized to fit between 5.5 x 8.5 inches or 14 x 20 cm
- Abstract should be limited to 100-200 words.
- Include four or five keywords for database referencing; place immediately after the abstract.
- Cover page shall include the following information: Title of the manuscript; name(s) of author, institution(s), complete mailing address, email address, business and home (mobile) phone

numbers, and fax number. Also on the cover page, please include a brief biographical sketch, background, and areas of specialisation for each author. Please do not exceed 30 words per author.

SUBMISSION REQUIREMENTS

All articles should be submitted directly to Dr. Simeon Ariyo at simeonariyo@yahoo.com for text similarity test. Only articles that meet the

requirement of maximum of 15% similarity index will be forwarded to the reviewers for assessment.

NOTE

AB-ReAP adapted Journal guidelines of International Society for Teacher Education (ISfTE)

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Critical thinking as a correlate of numeracy learning outcome among middle basic pupils in Kwara State, Nigeria

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ABSTRACT

Primary education in Nigeria is expected to prepare and produce pupils that can think critically in a reflective manner so as to enhance scientific development and employability skills. This study examined critical thinking as a correlate of numeracy learning outcome among middle basic pupils in Kwara State, Nigeria. Descriptive survey design of correlation type was adopted. The population of the study comprised universal basic education students while the target population comprised pupils of the middle basic schools in Kwara State. Simple random sampling was used at different stages of selection to sample 2, 315 respondents. Three research objectives, three research questions were raised while one research hypothesis was postulated. Two research instruments (Quantitative Reasoning Scale and Numeracy Performance Test) were self-developed and used for data collection. Content Validity was ascertained via Item Level Content Validity Scale (S-CVI) and obtained 87.6 and 92.5 respectively. Test of split-half reliability was adopted and obtained reliability coefficient of KR 0.76 and KR 0.88. The findings revealed that pupils sampled had below average (44.61%) critical thinking in form of quantitative reasoning. Another finding revealed that there was a positive and high significant relationship between critical thinking and learning outcome. It was concluded that critical thinking skills is a significant factor in influencing learners' learning outcomes. It was recommended that examiners (internal and external) should try as much as possible to prepare questions that will require the testees to use higher thinking abilities in solving numeracy tasks both at the terminal and at the end of session. This might develop their potentials in tackling issues and enhancing high learning outcomes.

Key Words: Correlate, Critical Thinking, Learning Outcomes, Middle Basic Schools, Numeracy, Quantitative Reasoning

Introduction

One of the significant aims of functional education is to prepare and produce citizens who will be well informed, that could acquire and understand those principles of education that could be used to solve societal problems. One of the aims and objectives of primary education as stated in the Federal Republic of Nigeria, (2013) is to prepare and produce pupils who will be able to think, act and handle situations in an intelligent manner so that they can tackle their immediate problem (Federal Republic of Nigeria, FRN, (2013). Whatever type of education (primary, secondary or tertiary) that is provided must give room to the learners to acquire different thinking skills that can allow them to reason logically and innovatively. To

achieve this stated objective, pupils must be trained the way they can reason logically, intelligently and critically so as to deal with issues in everyday life.

Thinking is therefore, a process of reasoning about something especially educational issues. It is the thought of mind that is exhibited by an individual which is usually initiated by specific goals that would produce flow of ideas that could solve issues or tasks. There are several ways an individual can think, it could be in form of concrete, abstract, converging, divergent, creative, analytical sequential (linear), holistic and critical. In this study, emphasis is placed on critical thinking.

The word Critical is coined from the Greek word

“*Kritikos*” meaning ability to judge. In literature there is no single definition that fully captured the meaning of critical thinking. It could, therefore, be defined as the ability to carefully judge issues or problems in order to determine the accuracy, worth, validity or value of those issues or tasks. Since this definition involves valued judgment it is therefore, connected with the last three levels of Blooms’ taxonomy of educational objectives as observed by Ennis (1993). Hence, critical thinking concentrates on: (1) Analyzing–ability to separate material or task into component parts and show relationships between parts. (2) Evaluating–ability to judge the worth of material against stated criteria. (3) Creating–ability to put together the separate ideas or parts to form new whole, establish new relationships (Anderson & Krathwohl, 2001).

Quantitative reasoning produces essential non-numerical inferences about quantities and how they relate in the problem situation. It is often the “glue” that holds arithmetic reasoning and algebraic reasoning together (Smith, & Thompson, 2007). It is the application of basic mathematics skills, such as algebra, to the analysis and interpretation of real-world quantitative information in the context of a discipline or an interdisciplinary problem to draw conclusions that are relevant to students in their daily lives (Peer review, 2014). Quantitative reasoning is also called quantitative literacy and/or mathematical literacy. It focuses on mathematics or statistics acting in the real world.

Learning outcomes could be described as what learners are expected to demonstrate at the end of significant learning experiences. They are actions/performances that are in terms of knowledge, skills and values upon completion of a course or series of several courses. Numeracy learning outcome therefore, a measure of the degree of success in performing specific tasks in numeracy by the learners (pupils) after being exposed to series of instructions (Changeiywo, 2000). Numeracy is one of indices in measuring learning outcomes. The development of numeracy skills in a child begins at the early life of him, even without visiting the four-walls of a classroom.

Numeracy is the ability of an individual to manipulate numbers, figures and to make well-reasoned judgments derived from the numbers and figures at hand in a variety of ways. Education & Training (2009) observed that numeracy is the effective use of mathematics concepts to meet the general demands of life at school and at home, in paid work, and for participation in community and civic life. Numeracy skills involve understanding numbers, counting, solving number problems, measuring, sorting, noticing patterns, adding and subtracting numbers, etc.

The motivation for this study was derived from the statement made by Dwyer, Gallagher, Levin & Morley (2003) that the knowledge of learners’ mathematical concepts can help in solving quantitative reasoning tasks and vice-versa. Afshar, Rahimi & Rahimi (2014) *also assumes that* learners with higher level of quantitative reasoning are likely to accomplish high performance in numeracy skills. This study therefore, examined the extent to which findings by these scholars could be upheld.

There have been series of studies that have been carried out by earlier scholars that assessed critical thinking alongside other variables, for example, Emir (2009), education faculty students’ critical thinking disposition according to academic achievement. He found that students’ critical thinking disposition differed according to academic achievement. It was also found that critical thinking disposition of the students did not show any difference according to academic achievement. It was also observed that academic achievement had no impact on critical thinking and critical thinking disposition. Karagol. & Bekmezci (2015) examined the relationship between academic achievements and critical thinking dispositions of teacher candidates in Faculty of Education. They found that critical thinking dispositions of teacher candidates do not differ according to gender, but on the basis of academic achievement, it differs according to the gender. Their findings also revealed that critical thinking dispositions and academic achievements of teacher candidates do not differ according to type of school. Critical thinking dispositions of teacher candidates differ

according to field of study. However, there was also a positive and weak relationship between critical thinking dispositions and academic achievements of teacher candidates.

Furthermore, Taghva, Rezaei, Ghaderi & Taghva, (2014) studied the relationship between critical thinking skills and students' educational achievement: Case study of Eghlid Universities. The finding of the study revealed that there was a significant relationship between teachers' critical thinking and students' educational achievement. Nordin & Dakwah, (2015) researched on critical thinking as a predictor of students' academic achievement: a study on Islamic Studies students at Pahang Islamic College, Sultan Ahmad Shah, Kuantan. They found that most of the students sampled were in the average level in Watson Glaser Critical Thinking Appraisal (WGCTA), with 99 (65.1%) out 152 respondents sampled. The study also revealed a strong, positive correlation between two variables, with lower level of critical thinking of participants associated with high grades of CGPA. The finding also revealed no correlation between students' critical thinking level and their academic achievement (measured by CGPA).

The second variable of interest is numeracy learning outcome, literature have shown that there have been series of research reports both within and outside Nigeria on numeracy. For instance, the Federal Ministry Education (1999) reported the monitored learning achievement carried out when UBE programme was about to be launched and the findings revealed the national numeracy results in form of the mean percentage. The result revealed that there was generally poor performance. The mean performance scores on numeracy test was 32.2%. Osagie & Ehiametalor (2010) carried out a study on assessment of learning achievement of primary four pupils in Edo State. The finding revealed that the scores on numeracy test showed a general poor performance with an average performance of 33.64%. The Kwara State Ministry of Education and Human Capital Development (2011) gave it annual education sector performance report. Public primary school 2 and 4 pupils were tested in Mathematics. The

results obtained in Mathematics reveals that 42.00% of the primary 2 pupils sampled responded correctly to questions raised on counting, addition and subtraction, fractions and shapes while 34.00% of primary 4 pupils sampled responded well to roman numerals, division /square root, LCM and area. National Population Commission, Nigeria and RTI International (2011) reported Nigeria DHS EdData Survey 2010 national literacy, reported that the Nigeria DHS EdData Survey 2011 national numeracy was 58.00% for children aged 5 to 16 years of those who can correctly sum numbers.

Furthermore, assessment and evaluation of UBE programme in Nigeria were subjected to several national assessment exercises since it was launched in 1999. The Universal Basic Education Commission (UBEC) conducted National Assessments on Learning Achievement especially in 2003, 2006, 2011 and 2013. The Federal Ministry Education (2013) also assessed achievement of primary 4, 5, 6 pupils and students in JSS 1 in English Language and Mathematics. For instance, the performances of pupils in Mathematics were Primary 4 (51.63%), Primary 5 (50.36%) and primary 6 (52.94%).

In another development, the Rivers State Ministry of Education (2013) researched on Monitoring of Learning Achievement (MLA) in Rivers State public schools. At the primary level, it revealed that mean score in numeracy was put at 49.60%. The National Population Commission and RTI International (2016) reported the 2015 Nigeria education data survey (NEDS) conducted and it revealed a mean score of 73.6% in numeracy.

Statement of the Problem

All the studies that examined critical thinking combined other variables such as students' academic achievement and misconceptions about psychology; student teachers' scientific process skills; students' educational achievement; academic achievement. However, none of the studies combined numeracy as one of the variables and most importantly the targeted audiences were students of secondary and tertiary institutions. Critical thinking has not

been examined at the lower level of education as highlighted by the National Policy on Education (2013). Hence, the study correlates critical thinking and numeracy learning outcome at the middle basic level of education in Kwara State, Nigeria

Purpose of the Study

This study is guided by the following research objectives:

1. investigate the mean level of critical thinking among pupils of middle basic schools in Kwara State Nigeria.
2. determine critical thinking as a correlate of numeracy learning outcome among middle basic pupils in Kwara State, Nigeria.

Research Questions

1. What is the mean performance in critical thinking among middle basic pupils in Kwara State Nigeria?
2. What is the mean performance in numeracy learning outcome among middle basic pupils in Kwara State Nigeria?

Research Hypothesis

H₀: There is no significant correlation between critical Thinking (Quantitative Reasoning) and numeracy learning outcome among middle basic pupils in Kwara State, Nigeria.

Methodology

Descriptive survey of correlation type was adopted for this study. It correlated critical thinking with numeracy learning outcome. Universal basic schools in Nigeria comprised three levels (i.e. Lower, middle and upper) basic and that of Kwara State in not an exception and the programme is 9 years, 3 years for each level. The population for this study therefore, comprised 299,546 basic pupils (Primary 1 to 6) in both public and private schools in Kwara State (Kwara State Ministry of Education and Human Capital Development, 2019). This population was therefore, stratified into 202,015 pupils in public schools and 97,531 pupils in private schools in the state. The target population comprised pupils in middle basic

(i.e. primary six) with 27,799 in public and 2,713 in private schools (Kwara State Annual School Census Report, 2018).

The state has three senatorial districts (i.e. Kwara Central, North and South) which have 16 Local Government Areas (LGAs) in all. Kwara Central comprised Asa, Ilorin East, Ilorin South and Ilorin West LGAs); Kwara North comprised Baruteen, Edu, Kaima, Moro and Patigi LGAs) while Kwara South consisted of Ekiti, Ifelodun, Irepodun, Isin, Offa, Oke-Ero and Oyun LGAs. Two LGAs were sampled from each senatorial district using simple random sampling technique. This amounted to six LGAs sampled in the state. In each LGA sampled, the existing number of primary schools (public and private) was listed and 10 percent of them were sampled using simple random sampling technique. In any school visited, 30 pupils in basic six were sampled using simple random sampling technique. In all, 54 and 26 public and private schools respectively were sampled. In the course of data collation and entry, it was discovered that some of the questions were not answered in QRS and NPT therefore, those scripts were discarded. This reduced the sample size to 2,315 pupils.

The researcher employed two data collection instruments: Quantitative Reasoning Scale (QRS) and Numeracy Performance Test (NPT). Each of the instruments contained twenty (20) items. The first instrument (QRS) has three sub-sections which tested higher order thinking skills such as analyzing and evaluating. The first two categories (analyzing and evaluating) had seven items each while the last level (creating) has six items. The instrument was constructed in form of multiple-choice items with four options (A–D) and the outputs were transformed to percentage for easy computation.

The second instrument (NPT) has four sub-sections viz: Number and Numeration, Algebraic Processes, Geometry and Mensuration and Statistics and Probability. These are sub-themed in the Mathematics National curriculum that national curriculum was based. The second instrument was also constructed in form of multiple-choice items with four options (A–D) and the outputs were also transformed to percentage for easy

computation.

For the two instruments, Content Validity (CV) via Item Level Content Validity Scale (S-CVI) was computed. Seasoned classroom teachers were used as raters to ascertain that those items addressed the identified thinking skills and the curriculum content for QRS and NPT respectively. Those responses were computed and obtained Content Validity of 87.6 for QRS and 92.5 for NPT.

Reliability estimate was computed on the two instruments. This was carried out in two steps. The first step was the computation of item analysis which primarily focused on the item-level information. This determines the desired

quality of test items via item difficulty and discrimination. The second step was the computation of reliability estimate itself. Test of split-half reliability was adopted. Kuder Richardson KR 20 formula was employed and obtained reliability coefficient of KR 0.76 and 0.88 for QRS and NPT respectively. Percentage mean was used to answer the two research questions raised. Statistical Package for Social Science Window Version 23.0 was to analyse the data collected.

Method of Data Analysis

Research Question 1: What is the mean performance in critical thinking among middle basic pupils in Kwara State Nigeria?

Table 1: Distribution of Respondents Based on Critical Thinking Level

Critical Thinking	Score Range	Frequency	Percentage (%)
Low	0–33	776	33.00
Average	34–66	1220	51.89
High	67–100	355	15.11
Total	0–100	2351	100.00
Mean Performance	44.61%		

Results in Table 1 reveal the critical thinking of the sampled pupils. It shows that 776 (33.00%) had low critical thinking level, 1,220 (51.89%) were in average level while the rest 355 (15.11%) had high critical thinking. This

implies that the mean performance of pupils' critical thinking was put at 44.61%.

Research Question 2: What is the mean performance in numeracy learning outcome among middle basic pupils in Kwara State Nigeria?

Table 2: Distribution of Respondents Based on Numeracy Learning Outcome Level Obtained

Level of Thinking	Score Range	Frequency	Percentage (%)
Low	0–33	407	17.31
Average	34–66	1,528	64.99
High	67–100	416	17.70
Total	0–100	2,351	100.00
Mean Performance	52.42%		

Results in Table 2 reveal the performance of pupils in numeracy. It shows that 407 (17.31%) had low-level of numeracy, 1,528 (64.99%) were at average level while the rest 416 (17.70%) had high level. Going by the mean score computed, the pupils sampled obtained a mean score of 52.42% in numeracy.

H₀: *There is no significant correlation between critical Thinking (Quantitative Reasoning) and numeracy learning outcome among middle basic pupils in Kwara State, Nigeria.*

Table 3: Correlation between Critical Thinking Numeracy Performance

		QRS	NPT
QRS	Pearson Correlation	1	0.841**
	Sig. (2-tailed)		.000
	N	2,351	2,351
NPT	Pearson Correlation	0.841**	1
	Sig. (2-tailed)	.000	
	N	2,351	2,351
**Correlation is significant at 0.05 level (2-tailed)			

Table 3 reveals the result of correlation between critical Thinking (Quantitative Reasoning) and numeracy learning outcome among middle basic pupils in Kwara State, Nigeria. The coefficient r-value is 0.841 computed at 0.05 level of significant. Since computed sig. (0.00) at 2-tailed is less than the chosen sig. (0.000) shows that the hypothesis is rejected. This implies that there is a positive and high significant correlation between quantitative reasoning (critical Thinking) and numeracy learning Outcome which is symbolically written as $r_{(2,349)} = 0.841, P < 0.05$.

Discussion of the Findings

Findings of this study revealed that, mean performance in critical thinking ability was 44.61%, which is below average performance. The level of critical thinking found suggests that pupils relied on the reproduction of knowledge rather than having the opportunities to construct in a given task especially in academic work. The finding is in contrary to the assertion of Nordin & Dakwah, (2015) who found that more of the students sampled obtained 65.1% critical thinking using Watson Glaser Critical Thinking scale. Differences in the findings could be attributed to differences in the instrument used in the study (Quantitative Reasoning) used to evaluate critical thinking and the one used by Nordin & Dakwah in 2015 was Watson Glaser Critical Thinking scale. Differences in findings could also be attributed to locale; the present study was carried out in Kwara State, Nigeria while Nordin & Dakwah, (2015) carried out their study in Pahang Islamic College, Sultan Ahmad Shah, Kuantan, Malaysia. Another

reason could be the level of education at which the studies were carried out Nordin & Dakwah, (2015) studied students in secondary school while the present study was carried in primary school.

This study revealed that there was a positive and high significant correlation between Quantitative Reasoning (Critical Thinking) and Numeracy Performance (Learning Outcome). This suggests that the higher the critical thinking ability of the pupils, the higher would their performance in numeracy test. This implies that pupils that possess higher level of critical thinking skills tends to have better capabilities of utilizing and processing, organizing, understanding information properly. Hence, have a good performance in any academic tasks.

It must be mentioned that literature reveals that there has been inconsistency in the findings generated by the earlier scholars. For instance, the finding of Taghva, Rezaei, Ghaderi & Taghva, (2014) revealed that there was a significant relationship between teachers' critical thinking and students' educational achievement. In the same vein, Nordin & Dakwah, (2015) finding revealed that there was no correlation between Islamic Studies students' critical thinking level and their academic achievement (measured by CGPA).

Conclusion and Recommendations

Critical thinking skill is a significant factor that can influence learners' learning outcomes. When pupils think critically in their academic work, there is likelihood that it might boost

creativity and *enhances lifelong learning*. It was concluded from that there was a high and positive significant correlation between critical thinking and numeracy learning outcome. Hence, the following recommendations are put forward in the course of this study:

1. Examiners (internal and external) should try as much as possible to prepare questions that will require the testees to use higher thinking abilities in solving numeracy tasks both at the terminal and at the end of session. This might develop pupils' potentials in tackling issues and enhances high level of learning outcomes.

2. Pupils need to develop reflective thinking. This might allow them to have good memory to synthesize different ideas and recall facts quickly to solve mathematical concepts to solve daily issues.

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