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THE CONSTRUCT, INTRODUCTION AND SITUATE OF RUDIMENTARY NUMBER SKILLS FOR CHILDREN IN NUMERACY LEARNING OUTCOMES

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Abstract:
The competence and positive disposition development toward mathematic subject has been observed an uphill task to learners across educational endeavors despite its need in life at home, paid work, participation in community and civic life. The Nigerian Education Policy (2013) made numeracy an important aspect of the specific objectives of primary education in Nigeria. However, the teaching-learning processes lithely attend to specification(s) of utilities. In Nigeria, most schools lack instructional materials; the available were mainly ready-made - majorly imported. Information and communication technology has greatly improved teaching and learning yet, observations revealed domination of foreign tongued instructional materials – uneconomical, alien, distractive and inadequate. This study constructs and investigates the effect of a locally produced, customized numeracy package, the Rudimentary Number Skills for Children (RuNS-K) on academic achievement of pupils in computer mediated environment with a view to improve pupils' performance in numeracy. Pre-test, post-test, quasi experimental research design was adopted. The population consist lower primary school pupils in southwest Nigeria. Multi stage sampling technique was employed to select study sample. One senatorial district, one of the five major cities in the district, three of the eighty-four public primary schools having functional computer laboratories were purposively sampled. An intact class in each school was randomly assigned into two experimental (ICT-integrated Learning Cycle and ICT-integrated Learners-self-

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controlled) and a comparison groups. Study instruments include the Rudimentary Number Skill for Children (RuNS-K) and the Test of Numeracy Achievement (TNA). The study found localized, customized packages needful for numeracy improvement. It also found significant improvement in numeracy performance in learners in ICT-integrated Learners-self-controlled (ICT- LSC) situation. The study further revealed customized ICT- LSC learning strategy as best influence for retention in pupils. It concludes that, interventions with customized, ICT-integrated learners-self-controlled situation improve learners' cognition both in performance and retention. Study recommends localized, improvised educational materials development and usage as aid to improving teaching-learning process and the entire education system in Nigeria.

Keywords: customized RuNS-K, learning cycle, learners'-self-controlled, numeracy, retention

1. Introduction

The ability of learning in any field of study is neither a product of genetic nor environment yet, can be developed harnessing the duo. Numeracy is an important aspect of the specific objectives of primary education in Nigeria (FRN, 2013). It is critical to progress at school plus laying a sound basis for scientific and reflective thinking in children. Numeracy, quantitative literacy and mathematical literacy have become very much 'in-vogue' terms in the educational circles. It is a contested term rooted in its social, economic, cultural and historical context (Coben, 2003). Numeracy is, according to Willis (1992) 'having the competence and disposition to use mathematics to meet the general demand of life at home, in paid work and for participation in community and civic life.'

Math for Families (2005) saw numerate people as those who can:

- use what they know to figure out what they don't know,
- use reasoning and evidence to prove a point,
- explain what they are doing as they work with numbers, symbols and geometric objects,
- know which processes to use to solve problems and can tell why,
- talk about their ideas and show their thinking.

However, numeric concept and skill have been identified as the most problematic and dreaded by learners at all educational levels in Nigeria (Adeleke, 2010, 2015) and as exemplified in Table 1 remain unabated. Emphatic stress is consistently pointed at the development of children's numeric skills for its inestimable future,

immediate needs and benefits with the view that children can easily be tamed early to love, friend and discover that mathematics is all around them hence, they can be made to use, enjoy and think about mathematics without even realizing it using a 'catch them young' approach.

Table 1: Performance in WASSCE (2006 – 2008) in Nigeria

Subject	**% of Passes at Credit Level (Grades 1 – 6)**			**% of Failure**		
	2006	**2007**	**2008**	**2006**	**2007**	**2008**
Further Mathematics	43.68	29.52	37.81	27.15	36.90	32.39
General Mathematics	41.92	46.75	57.27	24.95	24.24	17.23

SAS/JTA/OPC, Aug; 2009

Information and communication technology (ICT) is currently wielding influence into every facet of work and human endeavors. It has been found an effective tool in reforming education (IBDR/World Bank, 2008) and capable of enhancing learning at every educational levels and educational communities (Adeyanju, 1988; Commission of the European Committees, 2001). However, the intonation and ascent of languages, environmental differences and cultural background raise utility issues with a number of ICT packages imported and adopted in learning situations in Nigeria. The attempts at resolving numeracy learning issues degenerates into several other challenges with the monster remaining unresolved. These observed, founded problems gave rise to questions begging answers if the present predicament will improve hence, this study.

The research questions are:

What psychometric properties are needful in the customized numeracy improvement package?

In which of the customized package integrated learning situation will it improve pupils' performance in numeracy?

The study is frame worked on the psychological theory of constructivism. Constructivism was popularized by Piaget (1896 – 1980) who articulated mechanism by which knowledge is internalized by learners through processes of accommodation and assimilation to the end of creating new knowledge from learned experiences.

2. Methodology

The study adopted quasi experimental research design. The entire population of lower primary III school pupils in southwest Nigeria makes the population. Multi stage sampling technique was employed to select study sample. One senatorial district of the fifteen; one of the five major cities in the sampled senatorial district; three of the eighty-

four public primary schools in the three cities that has functioning computer laboratories were purposively sampled. An intact class in each of the schools was randomly assigned into the study. The three schools were randomly assigned to two experimental and control groups.

Two instruments were used for the study. The first was the Rudimentary Number Skill for Children (RuNS-K). This was a customized package developed by researcher. RuNS-K was integrated into two selected learning strategies – learning cycle and learners-self-controlled learning strategies purposively. The second instrument was the Test of Numeracy Achievement (TNA) which was administered as pre-test and post-test on the pupils to assess performance.

The Learning Cycle (LC) is an established learning method in science education and consistent with contemporary theory about how individual learn. It was found easy to plan, useful in creating opportunity for learning and adaptable with the customized ICT package. Learners in LC experimental group explored diverse representations of a common reality which provided opportunity to transfer skill or understanding of what was learnt into a new situation. This, according to Taber (2011) is closely related to constructivist tradition. The idea was for learners to generalize knowledge following investigation of several instantiations of a concept in numeracy. The cycle helps learners to connect new knowledge to existing schemata. It is at this point that LC as originally conceived (Karplus, 1960) completes its three segments of Exploration – Concept Invention – Concept Extension.

The Learners-self-controlled learning strategy was chosen to satisfy growing tendency toward individualization of instruction. This became necessary in view of problems of individual differences constituted in crowded classroom into which one of the three classes in the study fell. There are many methods of self-instruction. The two most widely adopted are the Keller Plan and the Audio-Tutorial System (Wikipedia, 2008). In this study, the Keller Plan also known as Personalized System of Instruction (PSI) in digitalized form (integrated with customized RuNS-K package) was adopted. This integrated audio, visual and synchronized presentation of lessons in numeracy hence, multimedia, interactive and responsive learners-self-controlled learning technique.

The integration of ICT into LC and LSC in this study is based on the relative effectiveness of the primary senses in human information processing of Treicher (1967) that, we learn one percent through taste, one and a half percent through touch, three and a half percent through smell, eleven percent through hearing and eighty-three percent through sight. He further postulated that, people generally remember 10% of what is read, 20% of what is heard, 30% of what is seeing, 50% of what is seeing and

heard, 70% of what is said as they talk and, 90% of what is said as they do the thing. The researcher thus employed pupils' senses of receiving information from a vast array of sources through the package. These were with the objective of satisfying the necessity of pre-stated research questions and for more open ended possibilities for students' success.

3. Results and Discussions

RQ-1: What psychometric properties are needful in the customized numeracy improvement package?

Answer to the first research question requires that a table of specification was drawn on essential numeracy content for the age grade and level of study as specified in the curriculum. Ten (10) cognitive levels were decided upon and merged with three (3) taxonomic goals according to Bloom, Englehart, Furst, Hill and Krathwohl (1956) which included knowledge, application and synthesis (Table 2). The numeracy contents were sorted, examined, fine-tuned and transliterated for instructional purpose. This followed Mehrens and Lehmann (1978), Rossiter (2011) expressed opinions that only content validity matters and, nothing more than content validity is required to validate a measure because content validity completely covers the C→M relationship. Therefore, educators are mostly concerned with content validity for achievement tests. The local language of the study area is Yoruba. The objects and pictures were carefully selected into the package, mostly drawn from the locality, day to day encounter and backgrounds familiar to the children. These relate the learners adequately with the content of the package. The blueprint ensured that the test contents met with the study objectives. The validity and reliability of RuNS-K were trial tested in a pilot study with two separate schools outside the sampled population. Test-retest method was used on the two groups of eight and eleven pupils' in intact classes. The pilot study followed Crocker's (1965) suggestion that sample for test-retest should be small to generate adequate reliability coefficients. This method has been used in establishing reliability of instruments earlier and found appropriate (Soyibo & Akintolu, 1985; Adesoji, 2005).

Table 2: Blueprint of the Instruments' Construction

Bloom's Taxonomy Cognitive Level	K	A	A/S	Total
Addition	3	1	3	7
Subtraction	2	3		5
Multiplication	2		1	3
Division	1	1	1	3
Figure to Words	1		2	3

Words to Figure	1	2	1	4
Greater than, Less than (<, >)	2		2	4
Spending money	1		1	2
Shapes Recognition (Painting)	2		3	5
Quantitative Reasoning (mixed with pictorial illustrations)			3	3
Total	15 (37.5%)	8 (20%)	17 (42.5%)	**40 (100%)**

**K = knowledge; A = application; A/S = analysis/synthesis

On completion of the package development, RuNS-K was integrated into the two learning strategies (LC and LSC) on the two experimental groups. In employing this method, the same test was administered after an interval of two weeks (Borg & Gall, 1970) using RuNS-K and the scores obtained subjected to Factor analysis. The results were as presented in Table 3.

Table 3: Instrument Component Analysis

Component	**Initial Eigen values**			**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	1.782	89.077	89.077	1.782	89.077	89.077
2	.218	10.923	100.000			

Extraction Method: Principal Component Analysis

Table 3 gave two distinct factors. It should be noted that the first factor has an Eigen value of 1.782 for 89.077% observed variance. Wiberg (2004) quoting Hambleton (2004) opined that, once there is one factor with distinctly larger eigenvalue, it is possible to assume that there is uni-dimensionality in the test and this connotes validity. The reliability of the RuNS-K was ascertained through the trial test resulting in Cronbach alpha value of 0.876 (Table 4). This was strengthened in correlation coefficient value analysis, Pearson correlation r-value = 0.782 at $p < 0.05$ (Table 5). According to Berg (1995), the r-value of 0.78 is high enough to justify the reliability of the instrument.

Table 4: Reliability of the Instrument

Cronbach Alpha	**No of Items**
.876	2

Table 5: Correlation Coefficient of the Instrument

		Pre-test	**Post-test**
Pre-test	Pearson Correlation	1	.782(**)
	Sig (2-tailed)		.000
	N	19	19

Post-test	Pearson Correlation	.782(**)	1
	Sig (2-tailed)	.000	
	N	19	19

**Correlation is significant at the 0.01 level (2-tailed)

To this end, it RuNS-K was found justiciable and determined for use in classroom situation for learning purpose.

RQ-2: In which of the customized package integrated learning situation will pupils' performance in numeracy be improved?

This research question was addressed by subjecting the pupils post tests to test of independent sample analysis (Table 6). Table 6 showed that the average total scores in post test of learners in the two experimental groups are 13.9677 (LC) and 14.8125 (LSC). The t-value obtained in the test of difference between LC and LSC at post test was -1.095 at $p = 0.278$. Since $p < 0.05$, the conclusion was that, there exists a difference in the performances of the two groups.

Table 6: Effects of Learners exposure to ICT-integrated strategies

	Group	**N**	**Mean**	**Std Deviation**	**T**	**P**
Post-test	LC	31	13.9677	3.10359	-1.095	0.278
	LSCI	32	14.8125	3.02076		

It however became necessary to emphasize the point of differences and pinpoint the learning situation aided more by the customized, integrated package. Further analyses were done to achieve this using Analysis of Covariance which will equally remove effects of previous knowledge. The result is as shown in Table 7. Table 7 reflects differences in pupils mean scores due to variation in the ICT-integrated strategies adopted at each situation ($F_{2, 92} = 4.904$, $p < 0.05$). It also showed that pupils residual or previous knowledge did not influence post test score ($F_{2, 86} = 1.487$, $p > 0.05$) and any such effect was removed. In the final analysis however, it became obvious that the effect of intervention with customized, integrated learning package spans through the experimental groups. Learners in LSC strategy performed best with mean score = 14.779; LC was next with 13.940 and Comparison group 12.362 mean score (Table 8). We can then conclude that, customized ICT-integrated strategies will significantly improve performance of pupils in numeracy especially in the LSC situation.

Table 7: Differences in Mean Scores due ICT-integrated Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected model	107.664[a]	3	35.888	3.972	.010
Intercept	1829.908	1	1829.908	202.510	.000
Pre test	1.487	1	1.487	.165	.686
Group	88.623	2	44.312	4.904	.009
Error	831.326	92	9.036		
Total	18897.000	96			
Corrected Total	938.990	95			

a = R Squared = .115 (Adjusted R Squared = .086)

Table 8: Influence of Learning Strategy on Performance

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LC	13.940[a]	.544	12.859	15.021
LSCI	14.779[a]	.538	13.711	15.847
CM	12.362[a]	.543	11.283	13.440

a = covariate appearing in the model were evaluated at 8.625 values of pretest.

Learning outcome is not restricted to performance alone in the cognitive domain. The ability to recall (retention) what was learnt plays a part in learning outcome. This was also assessed to ascertain and give predictive answer to the research question. Table 9 revealed result of test for differences in retention scores of learners according to group using pre test as covariate in ANCOVA. Pupils in LSC still performed best (Mean = 14.694), LC (Mean = 13.954) and CG (Mean = 12.400). At this juncture, it is proven that, customized ICT-integrated Learners-self-controlled learning strategy will best influence and improve performance of pupils in numeracy.

Table 9: Retention Score of Learning Techniques

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LC	13.954[a]	.549	12.863	15.045
LSCI	14.694[a]	.543	13.616	15.772
CM	12.400[a]	.548	11.312	13.489

a = covariate appearing in the model were evaluated at 8.625 values of pretest.

The efforts at inventing a customized, ICT-integrated learning package are not misplaced. The University of Tasmania (UTAS, 2009) invested in action research on the use of learning cycle as an authentic teaching skill in primary education. The process adopted was of knowledge management rather than simple training and skill

development. It applied the learn-do-study-act model. This was in tandem with this study that, rather than in abstraction, observable phenomena and active participation might yield more effective learning in dreaded numeracy. The ICT-integrated package – RuNS-K, was not exclusively used but a tool in enhancement of the learning strategies. Learning cycle and Learners-self-controlled learning strategies have been experimented at different education levels and subjects (Chiviacowsky, Wulf & Lewthwaite, 2012; Herin, 2007; Post, Fairbrother & Barros, 2011; Taipjutorus, Hansen & Brown, 2012) and the use of ICT in education is not new. However, Nigerian Education Policy reiterated that, teaching in the primary school shall be participatory, exploratory, experimental and child-centered (FGN, 2013). This corroborates the undaunted efforts at inventing a package that help Nigerian child in improved numeracy. Suitably then, the study ended with the application of an ancient axiom – 'I hear and I forget, I see and I remember, I do and I understand.'

4. Conclusion and Recommendation

The study concluded that, taxonomic goals of Bloom and associates which included knowledge, application and synthesis are relevant psychometric properties needful in customizing learning improvement packages. It also established that, controlling for pupils residual knowledge, the effect of intervention with customized, integrated learning package in learners-self-controlled learning situation will best improve learners' cognition both in performance and retention.

The study hereby recommends that, localized and improvised educational materials should be developed to aid the teaching-learning process and the entire education system in Nigeria. Efforts should be intensified at encouraging teacher's innovation at developing customized instructional materials rather than reliance on foreign, cosmetic, expensive and less relevant, imported materials.

References

1. Adeleke, A. G. (2010). Comparative Effectiveness of Two ICT-Integrated Learning Strategies on Mastery of Numeracy among Lower Primary School Pupils in Ile-Ife, Nigeria. Thesis submitted to the Institute Of Education, Obafemi Awolowo University, Ile-Ife, Nigeria.
2. Adeleke, A. G. (2016). A Survey of Internet Usage for Learning in Nigerian Secondary Schools. Journal of Media Educational Technology and

Communications (JOMETEC), Obafemi Awolowo University, Ile-Ife, Nigeria. 3 (1), pp.102-106.

3. Adesoji, O. O. (2005). A STUDY OF Relative Effectiveness of Learning Cycle and Concept Mapping Approaches for Correcting Students Misconceptions in Chemistry. Unpublished PhD Thesis submitted to the Department of Special Education and Curriculum Studies, Obafemi Awolowo University, Ile-Ife, Nigeria, p.55.
4. Adeyanju, J. L. (1988). The Application of Educational Technology in Pre-Primary Education. Journal of Educational Media and Technology (JMT), 2(1), pp.72-9.
5. Berg, S., Benz, C. R., Lasley, T. J. and Raisch, C. D. (1999). Exemplary Technology Use in Elementary Classrooms. Journal of Research in Computing in Education, 31(2), pp.111-22.
6. Bloom, B., Englehart, M., Furst, E., Hill, W. and Krathwohl, D. (1956). Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook 1 – Cognitive Domain. New York, Toronto: Longmans, Green
7. Borg, W. R. and Gall, M. D. (1993). Applying Educational Research: A Practical Guide (3rd Edition).. New York, Longmans.
8. Chiviacowsky, S., Wulf, G. & Lewthwaite, R. (2012). Self-controlled learning: the importance of protecting perceptions and competence. *Front. Psychology* 3:458. DoI: 10.3389/*fpsyg*.2012.00458.
9. Coben, D. (2003). Adult Numeracy: Review of Research and Related Literature. National Research and development Centre for Adult Literacy and Numeracy.
10. Commission for European Communities (2001). Information and Communication Technologies in Development: The Role of ICT's in EC Development Policy. Brussels, Commission of the European Communities. Available at http://europa.eu.int/rapid/pressreleasesaction.do?reference=ip/02/116.
11. Crocker, C. (1965). Statistics for Teachers. London: Fann Ltd.
12. Dooley, T., Dunphy, E., Shiel, G., Butler, D., Corcoran, D., Farrell, T., NicMhuirí,S., O'Connor, M. and Travers, J. (2014). Mathematics in Early Childhood and Primary Education (3-8 years) Teaching and Learning. Dublin, National Council for Curriculum and Assessment.
13. Federal Republic of Nigeria (2013). National Policy on Education, 6th Edition. Lagos: NERDC.

14. Herin, G. (2007). Promoting Lifelong Learning Through the Use of Self-Regulated Learning: a Guide for Intermediate Educators. *All Regis University Theses*. Paper 275.
15. International Bank for Reconstruction and Development (IBRD)/World Bank (2008). Global ICT Results. Accessed at http://web.worldbank.org/wbsite/external/topics
16. Jack, G. U. (2017).The effect of learning cycle constructivist-based approach on students' academic achievement and attitude towards chemistry in secondary schools in north-eastern part of Nigeria. Educational Research and Reviews, Vol. 12(7), pp. 456-466.DOI: 10.5897/ERR2016.3095
17. Karplus, R. (1977). Science Teaching and the Development of Reasoning. Journal of Research in Science Teaching, 14, pp.169-175.
18. Kizilcec, R. F., Perez-Sanagustín, M and Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in Massive Open Online Courses. Computers & Education 104 18-33. www.elsevier.com/locate/compedu
19. Mehrens, W. A., and Lehmann, J. I. (1978). Measurement and Evaluation. 2nd Edition. United States: Holt, Rinehart and Winston, Inc.
20. Pease B., Pease A. (2004). The Definitive Book of Body Language. New York, NY: Bantam Books.
21. Post, P. G., Fairbrother, J. T. and Barros, J. A. (2011). Self-controlled amount of practice benefits learning of a motor skill. *Res. Q. Exerc. Sport* 82, 474-481.
22. Rossiter, J. R. (2011). Measurement for the Social Sciences, The C-OAR-SE Method and why it must Replace Psychometrics. Accessed at www.springer.com/978-1-4419-7157-9
23. Soyinbo and Akintola (1985). Selected Science, misconceptions amongst some Nigerian Certificated Students. In Helm, H., Taber, S. K. and Mike, W. (eds). Constructivisim and Concept Learning in Chemistry: Perspectives from a Case Study. Havering College of Further and Higher Education. London: Rochampton Institution.
24. State of Victoria (2009) Numeracy in practice: Teaching, Learning and using Mathematics. Paper No. 18. Melbourne, Education Policy and Research Division, Office for Policy, Research and Innovation, Department of Education and Early Childhood Development. pp.6-10.
25. Taber, K. S. (2011). Constructivism as Educational Theory: Contingency in Learning, and Optimally Guided Instruction. In J. Hassaskhah (Ed.). Educational Theory. Nova Science Publishers. Pp.39-61.

26. Taipjutorus, W., Hansen, S. and Brown, M. (2012). Improving Learners' Self-efficacy in a learner-controlled online learning environment: a correlational study. In M. Brown, M. Harnett & T. Stewart (Eds.), Future Challenges, sustainable futures. Proceedings ASCILITE Wellington. Pp907-911.
27. Treicher, D. G. (1967). Are you missing the boat in training aid? Film and AV Communication, 1, 14–16.
28. University of Tasmania (2009). Action Research: An Approach to Professional Learning. Faculty of Education Presentation. Sharon Fraser.
29. Wiberg, M. (2004). Classical Test Theory vs. Item Response Theory: An Evaluation of the Theory test in the Swedish Diving-license Test. UMEA Universitet, ISSN 113-2685.
30. Willis, S. (1992). Being Numerate: Whose Right? Who's Left? Literacy and Numeracy Exchange, Autumn 1992.

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