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Framing Mathematical Models on University Students' Retention of Knowledge in Educational System Analysis

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Abstract
Mathematical model forms a frame of reference, mode of analysis and guides reflective decision making which may provide an explanatory system for knowledge retention in a concept. Hence, this study investigated framing of mathematical models and its effects on students' retention of knowledge in a concept of educational system analysis. The study was a pretest-post test control group research design aimed at providing baseline information on knowledge and learning management in university education for meta-cognitive development. The population included 143 final year undergraduate and post graduate students of educational management department in public universities in Cross River State, Nigeria. The entire population was used as a sample in view of the small population size for the study in 2016/2017 session. The instrument designated 'Educational System Analysis Concept Retention Test (ESACRT) was designed to collect data for the study. The instrument was validated and had a reliability co-efficient of 0.89. Three research hypotheses formulated guided the study. Data collected were analyzed using mean and analysis of covariance (ANCOVA). The study revealed that university students taught with framing of mathematical models retained more information than those taught with lecture method. Though the female university students' mean knowledge retention was higher than their male counterparts, there was no significant interaction of the framing and gender of students on their knowledge retention. It was concluded that framing mathematical models in a concept of educational system analysis could guarantee knowledge retention. It was recommended among others that university management should give attention to instructional capacity development of teachers and knowledge retention of university students in the field of educational management.

Keywords: Framing, mathematical, models, retention, knowledge

Introduction

Educational instruction is a personality task that is both an art and science of guiding and inspiring learners; through appropriate teaching methods, materials and learning experience. In Egbochukwu (2012), educational managers influence workers and learners with their talents and skills for instructional service delivery. The leadership role may arguably be aptly exemplified in university management task performance of what constitutes framing of mathematical models in a concept of educational system analysis. Framing mathematical models seem to involve behaviour modification principles in building pro-social behaviour towards meta cognitive development of university students (Ekanem, 2016; Ekwere, 2016). Indeed, educational systems analysis is an important concept in the field of educational management which may require new capacities and orientation for knowledge retention. All these crystallize into Knowledge and Learning Management (KALM) perspective for students to experience learning in cognitive, affective and psychomotor domains.

University education is variously identified as a solid tool for transformation and empowerment of individuals and the society. This notion is predicated on the fact that education is a process by which the society deliberately transmits its retained knowledge, skills and values from one generation to another. Knowledge retention in this study is the capturing of knowledge at the university education level in order to use it later. It is a critical component of successful learning and development. According to Ekwere (2016), universities in Cross River State tend to lack active strategies to support and develop successful learning that can retain and transfer valuable knowledge in education systems analysis. Also, Ekanem and Okon (2015) and Agwu (2009) report that poor learning management is identified as the main reason for relatively low positive change in behaviour among learners in universities in Nigeria. Effective Knowledge and Learning Management (KALM) in an educational system may yield high knowledge retention rate (FME, 2011).

It seems that universities in the state lack viable plan for providing long term knowledge retention to transform and empower the society. Framing is a modern instructional technique which involves visual arrangement for substantial amount of information to be put in a form of matrix. Framing of mathematical models describes a system using mathematical concepts and language in order to stimulate real-life situation with mathematical equations and project the future. Therefore, framing of mathematical models enables learners to gain self-regulating ability and confidence to assure personal responsibility for learning (Nsedu, 2012; NUC, 2014). According to Leiken (2015), the mathematical models have the capacity to translate problem in an educational systems analysis into a traceable mathematical

formulations for theory and numerical analysis to proffer insight and answers. The models are based on quantification which depends on empirical outcome.

University education in the state seems to fail to involve the use of threshold conditions of students flow analysis in enhancing university student knowledge retention. According to Nsedu (2012), university students in Nigeria lack sufficient knowledge and understanding to use mathematical inputs to minimize and control repetition and dropout rates in educational management. Hence, educational management students are denied the rights as it relates to educational development and attaining sustainable educational national goals ahead of deadline of year 2020 (UNICEF, 2017; FRN, 2013). University education as an instrument of social change and social mobilization in the society, is a repository of indices of educational system analysis namely: entry rate, intra-system rate and ratio between levels of education (Ekanem, 2018). The fact that educational systems analysis connotes a process of using various parameters to determine flow of students, teachers and other resources within and outside the system, necessitates framing of mathematical models (Okwori, 2011; UNESCO, 1997).

The theoretical framework adopted in this study is Managerial Grid theory by Blake-Mouton propounded in 1964. It states that a leader is concern for people and also for tasks. In other words, administrators as leaders are concerned about teachers and students in their task of teaching and learning. The implication of this theory for this study is that instructional leaders are task oriented in planning, organizing and monitoring the teaching-learning process for knowledge retention by students in an education system. Evans (1970) noted that managerial grid theory involves a paradigm shift of thinking out of the box, backed up with four leadership behaviours of directive, supportive, participative and achievement-oriented.

A schematic diagram derived from the theoretical framework of this study illustrates the relationship among the concept of the investigation as conjectured in figure 1.

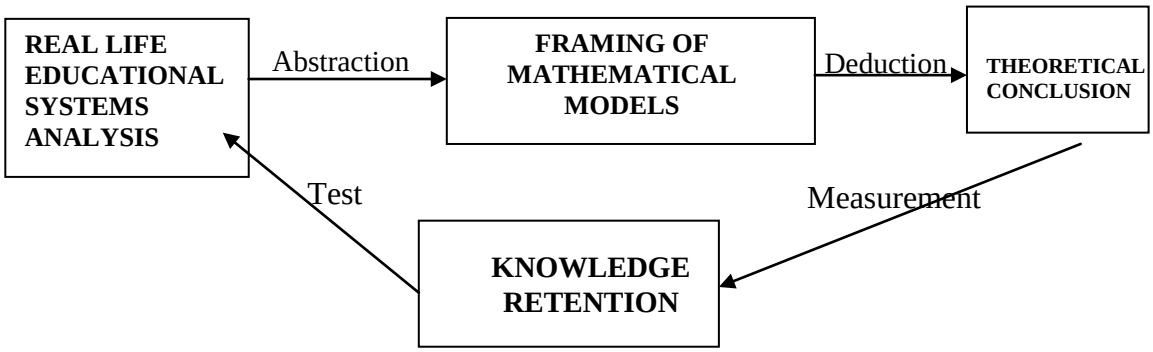

Figure 1: Schematic diagram of a relationship of framing mathematical models and knowledge retention among university students.
Source: Adapted from Nsedu (2012). Inaugural lecture in University of Uyo, Uyo 5th April p.5.

Abstraction can be made from the real world of educational system analysis in order to define the problems, formulate objectives and produce mathematical models. Logical deductions are then applied to mathematical models for identification of variables, behavioural patterns and parameter values in order to derive theoretical conclusion. On the basis of conclusion, complex measurement of appropriate rate of knowledge, interest and skills acquired by the university students after learning. Measurement determines the extent of integration of other disciplinary knowledge into whole known as meta-discipline (Hernes, 2017; Ekanem, 2016). It also assists to assess the degree of change taking place in selected group of students. Hence, the ability of students to understand, effectively manage the educational resources and achieve internal efficiency in the educational system. The sustainability of the conclusion and its refinement could be tested with appropriate knowledge retention for real-world connection vis-à-vis resource utilization, costs and system's efficiency in education systems (Bua, 2016).

Based on knowledge and learning management of university education, this research sets out to find out framing of mathematical models on knowledge retention in a concept of educational system analysis by university students for capacity development of university teachers and students. Specifically, the objective of this investigation is to examine framing and conventional lecture methods of instructional delivery in the concept of educational systems analysis. It also examines the extent of knowledge retention in educational system analysis by male

and female university students in both federal and state owned universities towards knowledge transformation.

Statement of the problem

Universities in Cross River State of Nigeria appear not to give priority attention it deserves to instructional capacity development management. The present situation depicts inadequancy among teachers and students in some educational management subjects such as educational system analysis. It was observed that inappropriate use of instructional strategies were challenges in effective knowledge retention in the subject concept. The administrators, both in federal and state universities are compelled to accept whatever instructional delivery means by teachers, irrespective of whether they are able to deliver the goods required or not. This acceptance by the administrators leads to teachers' uncertainties in positively impacting learning with appropriate teaching methods in educational system analysis.

The perceived way out of this challenge of knowledge and learning management may be to frame mathematical models in order to develop the capacities of teachers and guide educational management students for knowledge retention. The teachers and students perceived educational system analysis and mathematical models as difficult because of being numerical-phobic. Male and female students cannot regulate learning the subject in order to explain patterns of regularities with proper understanding between the key variables in the concept as one of the key subjects in Educational Management.

The fact remains that no matter how laudable university education may be, if instructional strategy fails to provide effective capacity development and knowledge retention by students, university education may not be a solid tool for transformation. Therefore, the question is, could framing of mathematical models in educational system analysis transform knowledge and learning for effective knowledge retention by university students if properly managed? This investigation aimed at providing an answer to this poser.

Research hypotheses

In addressing this problem, the following research hypotheses were formulated to guide the study:

1. There is no significant difference in the mean scores of subjects taught with mathematical models framing and those taught with lecture strategy on educational systems analysis concept retention test (ESACRT).
2. There is no significant difference in the mean scores of male and female students taught by mathematical models as measured by ESACRT.

3. There is no significant interaction between teaching methods and students' gender on ESACRT.

Methodology

The research design for the study was a pretest post test design type. The area of the study was Cross River State, Nigeria. The state has two public universities (federal and state universities) and also one private university. The public universities are located in Calabar, the seat of government of the state. The entire population of 143 final year undergraduate and post-graduate students of Educational Management Department in the two public universities was used as the sample, as the entire population was manageable.

These students were randomly assigned to experimental group and control groups as the two main intact streams used in the study. Hence, the federal owned university had 27 male and 24 female students in the experimental group while control group comprised of 21 male and 16 female students. Also, the state university was made up of 17 male and 12 female students in the experimental group with 14 male and 12 female students in the control groups. A total of eight groups of the two main streams of experimental (4 groups) and control (4 groups) were used in the study.

The subjects responded to a researcher constructed questionnaire titled 'Educational System Analysis Concept Retention Test (ESACRT)'. The test consists of 100 multiple choice questions on educational system analysis and its applications. Each question had an option A to D in which each of the respondents' shaded one option considered correct. The test items were designed to contain three basic types of student flow analysis specification: Entry rate, intra-system students flow rates and students flow rate between levels of education (Ekanem, 2018). The instrument was face validated and the reliability co-efficient of 0.79 obtained using Richardson R-20 methods since the multiple choice items were scored dichotomously. For greater stability, the test items were further subjected to test-retest reliability using Pearson's Product Movement Correlation (PPMC) and a coefficient of 0.89 was obtained. Hence, the instrument was reliable for successful realization of the research objectives.

The researcher administered the research instrument with the help of two research assistants. The pretest was administered to experimental and control groups in order to determine students' prior knowledge of educational systems analysis concept. The post test was administered after six weeks of treatment. A delay of two weeks after the first post test was observed in order to obtain data from the subjects. Data obtained from the two groups were subjected to Analysis of Co-variance (ANCOVA).

Presentation of results

Data emanating from the study were subjected to analysis based on three hypotheses using covariance analysis. Inferences were drawn and findings of the study presented in table 1.

Table 1: Analysis of covariance (ANCOVA) of knowledge retention score of university students by teaching methods and gender.

Variation sources	Sum of square	df	Mean square	Cal. F-value	Critical f-value	Decision
Covariates	3816.76	1	3816.66	93.94		
Posias	3816.66	1	3816.66	93.94		
Main effects	1098.89	3	367.34	9.13		
Methods	990.14	1	991.15	24.71	3.84	S
Gender	79.17	1	79.17	1.98	3.84	NS
Interaction	10.39	3	3.45	00.90	3.84	NS
Method & gender	6.25	1	6.25	0.16	3.84	NS
Explained	2130.62	7	3043.65	75.57		
Residual	5389.17	134	40.22			
Total	**26694.84**	**142**	**198.34**			

df = 142, $p<0.05$

Ho1: There is no significant difference in the mean scores of subjects taught with mathematical models framing and those taught with lecture strategy on educational systems analysis concept retention test (ESACRT).

Result in Table 1 revealed that the f-calculated value of the main effect of teaching method on the mean knowledge retention scores of students taught with framing mathematical models and those taught with other teaching methods was 24.71. This was higher than f-critical value of 3.84 at 142 df and 0.05 level of significance. Hence, the null hypothesis was rejected. This was interpreted to mean that there was a significant difference in the mean knowledge retention scores of students taught with the framing and those taught with lecture method.

Ho2: There is no significant difference in the mean scores of male and female students taught by mathematical models as measured by ESACRT.

Also, the f-critical value of 3.84 was greater than the observed f-ratio of 0.16 when considering the effect of gender on knowledge retention in educational systems analysis concept. This means that the null hypothesis was not rejected. Hence, there was no significance difference in the mean scores of male and female students

taught with mathematical models. Also, the low mean scores suggested no in-depth knowledge retention of the concept for both male and female students.

Ho3: There is no significant interaction between teaching method and students' gender on ESACRT.

Again, the f-observed value of 0.01 was less than the critical f-value of 3.84 for 142 df at 0.05 level of significance in consideration of the interaction effect of method and students' gender. Therefore, the null hypothesis was not rejected, meaning that the interaction effect of framing and gender of students' on their retention of the concept was not significant.

Discussion

Framing mathematical models was a teaching strategy to teach properly and cover curriculum contents in the concept of educational system analysis. The dominant conventional 'talk and chalk' lecture method emphasized rote-learning of the concept. Framing of mathematical models was well planned and executed to build capacity of teachers and self-regulate students' thoughts logically to the mathematical equations in the concept.

This finding was in consonance with NUC (2014) and Egbochukwu (2012) that inappropriate instructional delivery method seemed to be a re-occurring reason for poor knowledge retention in Nigerian universities. Framing mathematical models has dual effectiveness of building capacity of teachers and enhancing knowledge retention of university students on educational system analysis.

The finding was contrary to the reports in Ekwere (2016) that doubted the efficiency of framing mathematical models in capacity building and in knowledge management. This was probably due to the difficulties of some researchers in quantification of key relationship in parameters of mathematical models to tackle social challenges. This investigation ascertained that mathematical models as an empirical inter-disciplinary outcome was strengthened with this finding that mathematical equations in problem solving and policy making boosted knowledge and learning management (Leikin, 2015; Ekanem, 2017). The meta-knowledge acquired by students was in flow analysis, goal attainment and mobilizing university resources (Ekanem & Okon, 2015).

The result of the analysis of hypothesis 2 revealed that there was no significant difference between male and female students taught with mathematical models. This means that the university students did not have an indepth knowledge retention in educational system analysis when applying framing of mathematical models

strategy in the concept. The plausible explanation to this finding was that both male and female students did not have adequate meta-knowledge to apply science and mathematics in contents to make connections among work and global enterprise. Also, there was no optimum contribution of knowledge by the university teachers, as no education system can rise above the quality of teachers (FME, 2011). Eventually, the university education, though an investment, has failed to foster the worth and development of individuals, society as well as equality of opportunities to Nigerians (FRN, 2013; UNICEF, 2017).

The higher female mean retention score than their male counterparts indicated that university education in Cross River State, Nigeria were not effectively managed for equity and equality of educational opportunity. The finding confirmed the report of UNESCO (1997) that improvement of human resources and co-vocational capacities of adult population were achieved through the strategy of education flow analysis during the post-apartheid era in South Africa.

In analyzing hypothesis 3, there was no significant interaction between teaching method and gender of university students. The teaching method added developmental values through scientific and quantitative knowledge though not significant. This finding supported a research report of Nsedu (2012) that framing of mathematical models boosted meta-cognitive learning in terms of intellectual ability, social development, productivity and entry behaviour in learning activities even when students were in same chronological age. In this study, the administrators and teachers were the most decisive factors in the knowledge and learning management process for improvement in the interaction rate of students after learning with framing of mathematical models. Quality management being a focus in knowledge production drove educational reforms for universities to be high performing institutions. To this end, the university education was not left to the whims caprices of non-professionals.

Conclusion

The study investigated framing mathematical models on university student retention of knowledge in educational system analysis. Framing mathematical model on student retention in the concept was found to be effective. The framing strategy could not significantly interact with the university students and the male student knowledge retention level was lower than that of their female counterparts. This study established that universities in Cross River State, Nigeria had not given adequate attention to instructional development management for student knowledge retention as a vital component of successful learning and development. Therefore, the curriculum planning should not only be limited to achievement of knowledge

retention in concept of educational system analysis, but also be extended to other aspects of educational management practices.

Recommendations

1. Educational planners should integrate framing of mathematical models to be studied as an instructional strategy by pre-service and in-service teachers' programme in educational system analysis. This will build up developmental capacities of teachers in educational management since knowledge is dynamic.
2. University management should pay greater attention to promote scholarship and quality learning in order to promote knowledge retention. This will direct student learning behaviour to improve upon the poor knowledge retention level of male and female students.
3. University management should embark on constant capacity development programmes in new methods to impart valuable knowledge and skills to teachers. This is to improve the interaction of teaching methods with the students in order to stimulate long term knowledge retention in subject concept.
4. Textbook authors in educational planning should integrate framing of mathematical models in their text books. This is to ensure concept clarity, empirical outcome and mastering of subjects by the university students.

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