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THE RELEVANCE OF 'O' LEVEL MATHEMATICS IN NURSING: A SURVEY OF PRACTICING NURSES' EXPERIENCES IN ZIMBABWE.

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Abstract

The purpose of this study was to evaluate the relevance of 'O'-Level mathematics in nursing practice. It was motivated by the observation that the nurse recruitment policy and advertisements for nurse training are silent on 'O'- Level mathematics as a requirement for nurse training although nursing practice involves numerical calculations. A descriptive survey was used to collect data from a cluster sample of 145 qualified nurses from 5 hospitals. Self- administered questionnaires and personal experience reports were used. The study revealed that, the majority of nurses (68%) did not pass 'O'-Level mathematics. They reported experiencing problems with calculating drug dosages, controlling intravenous fluid flows, assisting with fracture traction settings and were not confident to apply for degree studies in which mathematics courses are compulsory. Lack of 'O'-Level mathematics limited nurses' upward academic mobility as well as their utility value. The majority reported that 'O'-Level mathematics is necessary for nursing and called for it to be considered as one of the requirements for nurse training recruitment. A Chi- square test at 5% level of significance confirmed that, nurses' evaluation of the relevance of mathematics to nursing practice was not associated with their "O'-Level mathematics results hence objective. The study recommends a nation wide survey and consideration of 'O'-Level mathematics as a requirement for nurse training. Schools of nursing can also consider introducing special 'O'-level mathematics bridging courses to cover the gap with current trainees

Key words: 'O'-level mathematics, nurse education, nurse training

INTRODUCTION

A sustainable policy is one that is relevant in terms of time, technology and benefits to the target population. It is necessary to question policy relevance from beneficiaries' point of view as a source of feedback for policy makers. Otherwise the policy suffers obsolescence or ends up being a limiting rather than facilitating factor for the development of the intended beneficiaries. These sentiments support the current study, which questions the necessity of 'O' Level mathematics for nursing. The study was motivated by the observation that, 'O' Level mathematics is not a requirement for student nurse recruitment despite the fact that nursing involve the applications of mathematics in health service delivery.

In Zimbabwe, the Education Secretary's Circular Minute Number 2 of 2001 guides the schools' formal curriculum. Its subsection 4.2, "Core Subjects" point 4.2.1 states that: "All learners are expected to study the following core subjects up to 'O'-Level: English Language, History, Mathematics, Science, Integrated, Physical Science, Biology or Chemistry, Technical/ Vocational/ Commercial or Business subjects."

If this is taken as a subject priority list, then mathematics is on the third position of what Zimbabwe considers to be worthy knowledge. Point 4.2.2 of the same secretary's 2001 circular emphasises that, "Core subjects are compulsory for all learners to study in order to realize the educational goals of Zimbabwe." Although no mention of a need to pass the subjects is done, one can interpret this to mean that current secondary school graduates without 'O'- Level mathematics have violated the requirements of this circular and may not realize the educational goals of Zimbabwe.

The General Nurses (Training) Regulations (2000: 1344) second schedule, section 6(1); "Educational Qualifications" specifies that, to train for a State Registered Nurse's Certificate, the applicant should be: "The holder of a General Certificate of Education with passes in five subjects at ordinary level at grade A, B or C, one of which must be English Language and at least one must be a science subject."

The "must" implies that English Language is a compulsory subject. Acceptable science subjects are stipulated in paragraph 4 on page 1345 of the regulations as follows:

(a)* Biology (b) *Chemistry (c) *Human Biology (d)* Human and Social Biology (e) *General Science (f) *Physics (g)* Physical Science (h) Mathematics
or any combination of subjects marked*

When one regards this as a priority list, mathematics is at the bottom. If one considers the subject combinations marked (*), then mathematics is out of the race. It is not marked, leaving one wondering whether mathematics is not necessary for nursing.

Nurse recruitment based on these regulations results in a mixed bag of nurses with and without 'O' Level mathematics. Unfortunately the general nurses' curriculum does not have mathematics courses to bridge the mathematics content gap. Recruitment policies in which the necessity of a subject is overlooked were also implemented in education in 1980. For one to train as a teacher in 1980s, the regulations required 5 'O'-levels including a language. The policy overlooked mathematics and English language. According to Zvobgo (1997) the policy was relevant to facilitate recruitment and training of many teachers to promote the implementation of the education for all policy.

According to Gatawa (1998), in 1985 colleges of education and University of Zimbabwe lecturers complained of the poor English Language in students' essays. The employment sector expressed dissatisfaction on the level of English Language in reports from graduates without 'O'-level English language. Such pressure forced the Ministry of Education to revert to the requirement of a pass in 5 'O' Level subjects including English Language in 1985. The policy was revised because of the evaluation from implementers and beneficiaries.

Complaints against the teacher recruitment policy that did not consider mathematics were raised by a Curriculum Development Unit Study, cited by Nziramasanga's commission (1999:333) report. It noted that third year primary school student teachers had extreme mathematical deficiencies. They failed tests on time, percentages, decimal numbers and fractions intended for grade 6 and 7 pupils. In 2005, the ministry of education re-introduced a pass in 'O'-Level mathematics as a recruitment requirement for all student teachers to improve the quality of teachers and education in general.

The policy developments in education cited above reveals that recruitment policies based on political agendas and problems of that day, can be reversed if they affect quality of services. From this angle policy evaluation is encouraged by Kapfunde (2004), who points out that policy evaluation is the examination of the effects of on-going policies on their targets in terms of goals and realized benefits. From this perspective the motive and purpose of policy evaluation is to provide feedback to policy markers on the

efficacy of the policy as seen by beneficiaries using it. The implication of this observation is that practicing nurses should be the population for an evaluation of the necessity for 'O'-Level mathematics for nursing.

According to Reams and Stricklin (2006), the complexity of current nursing practice calls for critical thinking and problem solving skills. The observation motivated the National Advisory Council on Nursing Education to aim for (60%) degreed nurses by 2015. This dream will be difficult to realize in Zimbabwe when 'O'-Level mathematics is not a requirement. Degree courses such as Biostatistics for a Bachelor of Nursing Education whose entry requirement is a nursing certificate will hold nurses without 'O'-level mathematics back when they fail and repeat the biostatistics course.

Motivation for the study

The researchers were disturbed by the deficiencies of basic 'O'-Level mathematics concepts exhibited by nurses in Biostatistics at undergraduate level. The majority failed to present and interpret data on linear graphs, pie-charts and histogram. Such limited mathematics content affects the nurse first, he/she fails the course and repeats incurring more costs. At times the nurse opts to drop out and a national human resource is lost. These manifestations of a mathematics deprived curriculum motivated to seek answers to three research questions:

- *What 'O'- Level mathematics grades do practicing nurses have?*
- *How does limited 'O'- Level mathematics content affect nurses' day-to-day operations?*
- *Is 'O'- Level mathematics necessary for nursing?*

Hypothesis

The following pair of hypothesis on the necessity of 'O'-level mathematics was raised:

H₀: Nurses' evaluation of the need for a pass in 'O'-level mathematics is not associated with their 'O'-Level mathematics results.

H₁: Nurses' evaluation of the need for a pass in 'O'-level mathematics is associated with their 'O'-Level mathematics results.

Rationale

This study is necessitated by the need to provide informative feedback from practicing nurses to policy makers in Health Education. It is most probably the first policy evaluation on the nursing curriculum in Zimbabwe, hence a source of insights for further research on health education policies and debate on policy issues.

METHODOLOGY

Research Design

The study is influenced by the positivists' philosophy, which regards knowledge as an objective phenomenon, that can be established by measurement of variables. From this angle and the need to identify nurses' evaluation called for a descriptive survey research design. The descriptive survey was considered ideal because of its purpose of identifying variables and their distribution and possible factors contributing to the distribution. The design benefits from the use of large samples and triangulation to validate findings.

Since this study did not have the objectives and purpose for overshadowing 'O'-Level mathematics in nursing, it was advised by Scriven (1972) in Guba and Lincoln (1981) to apply the goal-free model. This model allows the evaluator to examine the actual policy effects against a profile of demonstrated needs in the day-to-day operations of individuals who benefited from it. The suggestion advised the researchers to identify tasks in nurses' duties which are affected by inadequate, or lack of 'O'-Level mathematics content.

Instruments

The major instrument used was a questionnaire. It sought nurses' demographic data, their 'O'-Level mathematics results, tasks affected by limited mathematics content and their evaluation of the necessity for a pass in 'O'-Level mathematics for nursing.

Questionnaires were considered appropriate since nurses are literate. Each respondent answered the same question. They were easy to administer to a large population which is geographically scattered. Individual nurses' views were gathered from a large population within a short time. Questionnaires ensured respondent anonymity and were kept for reference and further analysis.

Population and Sampling

The population of this study was composed of all qualified nurses in Zimbabwe. Data were collected from 145 qualified nurses from Mutare and Rusape hospitals in Manicaland, Murambinda, Mt St. Marys and Marondera hospitals in Mashonaland East Province.

Since each hospital was considered a unique cluster with homogeneous nurses experiences, cluster sampling was used. Cluster sampling was also encouraged by the fact that, the number of nurses at each hospital

(sample frame) is known. Nurses' views were considered to vary according to the hospital. There was proportional sampling from hospital to hospital and simple random sampling of nurse respondents within each hospital. Cluster sampling ensured high sample representativeness. The sample size of 145 was considered statistically large enough for the variable (nurses' views on the necessity for 'O'-level mathematics) to be normally distributed and findings generalized.

Data collection and Analysis

A pilot study was carried out at Chinhoyi hospital. The Chinhoyi case study provided leads for key questions in the main survey questionnaire. Researchers worked with an assistant from each hospital to facilitate entry, and permission granting for the study. Self-administered questionnaires were distributed and collected on the same day.

Data were analyzed by screening questionnaires for completeness and answering of key research questions. A Chi-square test was carried out at 5% level of significance to test for the association between nurses' evaluation of the necessity for 'O' level mathematics and nurses 'O'-Level mathematics results. It was justified by the assumption that (1) data were randomly and independently sampled, (2) all categories were mutually exclusive and (3) expected frequencies were at least 10 in each category as recommended by Bless and Kathuria (1993). Then supporting self-reported experiences of situations where mathematics was required is presented as reported to reduce distortion of respondent's views. Findings are presented as grouped data to protect informants and satisfy ethical requirements.

Findings and Discussions

Table 1, Respondents distribution by Gender and Location
N=145

Location	Gender		Total
	Male	Female	
Mutare	14	21	35
Rusape	10	15	25
Murambinda	7	15	22
Mt. St. Mary's	11	17	28
Marondera	15	20	35
Total	57	88	145

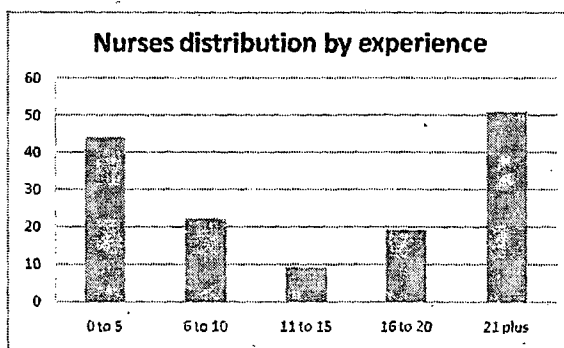
Table shows that, the majority (61%) of respondents are female. This can be a reflection of the natural distribution of nurses by gender in Zimbabwe. The nurse distribution by gender in South Africa also shows female

domination. "Of the just under 20 000 nurses in South Africa, nearly 14 000 are female" (Mafalo, 2007:24). History traces from Florence Nightingale in the 1850s assigns nursing to the female domain. This gender distribution shows that time and campaigns for gender equality in all professions has not yet had a significant effect in nursing. Views expressed in this study reflect female dominated variables.

Table 2, Respondent distribution by Gender and Nursing Experience
N=145

Gender	Nursing Experience in Years					Total
	0-5	6-10	11-15	16-20	21 and more	
Male	19	8	2	7	21	57
Female	25	14	7	12	30	88
Total	44	22	9	19	51	145

The majority (54%) of nurse respondents have been in the nursing field as practicing nurses for more than ten years. This provides a wealth of nursing experiences from which to evaluate the need for a pass in "O"-Level mathematics.



The experience depression from (11 to 15) years shown by the bar-graph can be accounted for by the brain drain in the health sector. Experienced nurses with (11 to 15) years left Zimbabwe for greener pastures during the hyper inflation years 2006 to 2009.

Table 3: 'O'-Level Mathematics grade held by responding Nurses
N=145.

Gender	'O' Level Mathematics Grade						Total
	A	B	C	D	E	U	
Male	3	4	12	20	7	11	57
Female	1	10	17	13	20	27	88
Totals	4	14	29	33	27	38	145

The table shows a negatively skewed distribution of 'O'-Level mathematics grades. The majority (68%) of respondents reported having an 'O'-Level failing grade (D, E and U). This forms the appropriate population for the evaluation of the necessity of 'O'-Level mathematics as experienced from tasks they found difficult to perform.

Table 4: Nurses' Views on Necessity for 'O' Level Mathematics
N=145

Views	Necessary	Undecided	Not Necessary
Frequency	85 (59%)	16 (11%)	44 (30%)

The majority (59%) of nurses reported that a pass in 'O'-Level mathematics is necessary for their day-to-day operations. The necessity is supported by the following paraphrases from questionnaires.

- Nursing is a scientific practice that involves facts and figures, data collection, presentation and interpretation aimed at solving problems.
- On admission into any ward, temperature, age, body weight, respiration and pulse rate are collected, calling for 'O' Level mathematics.
- For variables like the pulse rate, the nurse counts for five to ten seconds then multiply by 12 to estimate the pulse rate per minute, the data is recorded at specified intervals depending on the illness.
- Line graphs are plotted to show trends and interpreted to determine the patient's reaction to treatment. The nurse's interpretation influences the patient medication and discharge plan. The nurse needs to be well versed with normal ranges of body temperature and pulse rate to be able to detect any abnormalities hence the call for applied knowledge of the normal distribution curve.

Nurses reported that, during cholera outbreaks, patient treatment involves collection of blood pressure, pulse rate and fluid circulation monitoring. The sphygmomanometer uses numbers to show blood pressure. What is important here is not the numerical readings but the interpretation, which is important in preventing fatal complication in patients. Nurses also need to carry out blood or fluid circulation rate calculations to facilitate safe intravenous infusion. Any error in the calculation puts the life of the patient

at risk. Furthermore, the intravenous fluid must flow at a given rate calculated before setting the infusion pump rate for the drip. Mathematical calculation errors lead to the patient's circulatory system being over hydrated or increasing the dehydration rate.

The maternity ward was reported as one of the areas where the nurse's 'O'-Level mathematics is required. One respondent pointed out that, the Expected Date of Delivery (EDD) is calculated with accuracy from the last menstrual period day (L.M.P) by adding 7 days to the day and 9 to the month. For example, a mother whose last menstrual day was 15 March 2010 can be expected to deliver on $(15 + 7 = 22, 03 + 9 = 12)$ which is 22 December 2010. The nurse's accuracy in such calculations facilitates the monitoring of the pregnancy during Ante Natal Care period in order to detect preterm labor, post dates pregnancy and any abnormalities associated with gestational age, hence midwives should have good 'O'-Level mathematics. Regular baby weighing monitors the child's growth rate. Without 'O'-Level mathematics such nursing tasks affects the nurse's competence.

Drug administration is based on patient body weight. When doses are calculated incorrectly a patient can be overdosed or under dosed resulting in reactions and even death. For example, the recommended bilharzias drug praziquantel is 40mg per kg body weight. Each tablet contains 600mg of praziquantel. For a nurse to determine the number of tablets that a 60kg patient requires, it calls for good 'O'-Level mathematics.

Of interest to note is the observation that most drugs come in multidose vials which need to be dissolved and administered in liquid form. For example Benzylpenicillin that is administered as 0,1ml per kg of patient weight (Todd et al, 2000) is present in 5-mega-unit powder form vial. Mathematics is required for the correct quantities of water to dissolve it and maintain the correct concentration before calculating the patient dosage.

Management of fractures involve the mathematics of pullies and weights. These are calculated as 5% of patient's body weight. Mathematical calculation errors for determining weights results in bone compression or dislocation of the proximal joint leading to prolonged hospitalization or permanent disability.

Situations presented above illustrates that 'O'-Level mathematics is actually one of the subjects whose content nurses say is a necessity. Nurses (68%) also reported that they dreaded applying for degrees due to the fear of

failing courses such as Biostatistic, Biophysics and Biochemistry, which require 'O'-Level mathematics content. This finding supports Mafalo (2007: 25) who said, "I wanted to become a doctor, but my mathematics probably wasn't good enough. So I chose nursing." In this case, a nursing curriculum deprived of 'O'-Level mathematics limits nurses' upward academic mobility in life.

Table 5: Hypothesis test table for Association of Nurses' Views and 'O' Level

Mathematics Results

Table 5: Nurses' Views and 'O' Level Mathematics Results. N= 145

Nurses' View	'O' Level Mathematics Results		Total
	Passed (A, B, C)	Failed (D, E, U)	
Necessary	26 (27.55)	59 (57.45)	85
Undecided	9 (5.19)	7 (10.81)	16
Not Necessary	12 (14.26)	32 (29.74)	44
Total	47	98	145

Table 5 which was generated for hypothesis testing based on Nurses' responses shows observed and (expected) frequencies in brackets. At 5% level of significance, $V=2$ df, chi-square critical value $X^2_{crit} = 5,991$. Calculated $X^2_{calc} = 4,799$.

Since $X^2_{calc} = 4,799 < X^2_{crit} = 5,991$; the null hypothesis was not rejected. The study concluded that nurses' evaluation of the necessity for 'O'-Level mathematics is not associated with the nurses' 'O'-Level mathematics results. From this test, the study considered the findings as an objective evaluation of the necessity for 'O'-Level mathematics as a requirement for nurses training.

CONCLUSION

The study revealed that the majority of practicing nurses (68%) have grades D, E and U in 'O'-Level mathematics. Their working experiences (more than ten years) show that mathematics is necessary for nursing. Nurses without 'O'-level mathematics reported having problems with day-to-day nursing activities such as patient demographic data collection, presentation, calculation of traction weights, setting of infusion pump and analysis of findings. These are critical decisions determining the life or death of a patient. They must be considered seriously. Nurses' evaluation was not associated with their 'O'-Level mathematics results but based on their practical experiences.

The study recommends considering a pass in 'O'-Level mathematics as a requirement for nurse training. Schools of nursing can introduce 'O'-Level mathematics bridging courses to top-up the mathematics content of those nurses without passes in mathematics at 'O' Level. An alternative special mathematics curriculum for nurses named "Nursing Mathematics" not necessarily 'O'-level mathematics can be introduced in nursing schools for those without a pass in 'O'-level mathematics. Further research can be carried out at national level to verify findings.

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