

Standards for Science, Technology and Mathematics Educational Research

(A BOOK OF READINGS)



Edited by: T. D. Baiyelo & Temi Busari

Standards for Science, Technology and Mathematics Educational Research

Copyright © August 2003

ISBN 978-060-054-x

Published in Nigeria by
VICTORY PRINTERS NIG. LTD.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or be transmitted, in any form, or by any means, mechanical, electronic, photocopying or otherwise without the prior written consent of the publisher.

NASER Academic Press

Designed and Printed in Nigeria by
VICTORY PRINTERS NIG. LTD.

15 St. Finbarr's College Road, Akoka, Yaba-Lagos.

Tel: 234-1-8046892, 0803-300-7531

E-mail: victoryprinters@yahoo.com

NATIONAL STANDARDS FOR SCIENCE EDUCATIONAL RESEARCH

by

Fidelis A. Onwioduokit (Ph.D)

Department of Science Education

University of Uyo, Uyo.

Abstract

The chapter discusses standard required in research works involving Science Education. From previous literature, it has been observed that researchers in Science Education, though mostly empirical, have many procedural and methodological weaknesses. To correct these, the paper outlines and discusses appropriate procedures and research methods for each peculiar and strategic research in Science Education. Novel methods of ensuring comparability of research groups are also discussed. It is recommended that publishers of book and journals in Science Education should be more cautious in their assessment of articles for publication.

Introduction

Research is seen as a systematic, objective and accurate search for the solution of a well defined problem (Mouly, 1970). Kerlinger (1960) and Nwana (1981) define research as a process of finding out solutions to problems while others (Fox, 1969; and Nwankwo, 1984) see it as a process of getting and developing valid knowledge about something. It is worth noting that research, although in most cases, aims at solving problems as well as cross-validate previous solutions and problems. In this respect, the etymology of the word, re-search, that is to search again, is utilized. The first search may have been limited.

Research, therefore is not just an activity. It is a systematic and objective intellectual activity undertaken for the purpose of either solving a known problem or expanding the body or existing knowledge (Onwioduokit, 2000). There are, therefore, fundamentally four elements of research. These are intellectuality, purposefulness, objectivity and systematicity. Research works in Science Education should utilize the four elements.

Since science Education has to do with educating the citizenry in science, the importance of effective research and research standard is enormous. Possible areas of research in science education include the following: Science curricula, teaching methods, science laboratory, gender and science, class size, science teachers' variables and science students' variables. The variables, in this case, include both organismic and phelogenic factors. Assessment of students' performances in science and the application of science in the house specifically, and the society in general are also possible areas of research.

Besides the present challenges in science and science teaching, the future changes must be appropriated and researched into. These include the production of locally standardized science materials, computed - assisted learning, greater levels of integration of science, better ways of assessing teachers' efficiency with respect to teachers and learners factors, more functional science curricula to meet with technological requirement of the emerging highly scientific and sophisticated society.

According to Akpan (1999) more indebt studies of the cognitive response of Nigerian students and factors that would improve understanding and application science are needed. The end product of science education is the production of citizens who are literate in science and are capable of inculcating scientific culture in the life of others, thus enabling them to be able to live comfortably in the

scientific and technological environment.

Quite a number of research work have been carried out in science education. These have covered such areas as learners and learners' characteristics (Okebukola, 1985, and Aigbomian, 1985), teachers' factors (Okpala and Onocha, 1988; and Akezuilo, 1989), teaching and learning resources (Ogunniyi, 1983; Usman, 1993; and Onwiodokit, 1998); and curriculum and assessment of learning outcome (Jegede, 1991; and Ivowi, 1992).

In a study on the research efforts in science education, Ogunleye (1994) noted that most imperial studies so far carried out have many procedural and methodological weaknesses. The implication of this is that some sort of standard is needed in science education research. The purpose of this paper therefore is to discuss the required standards in procedure and methods in science education research.

Concept of Standard

The term standard generally has to do with the required expectation or accepted level of quality. It is, perhaps, easier to conceive the implication of standard with respect to measurements and measuring instruments. For instance, "one foot" as it is known today, with a ruler, used to be subjected to human feet which could never be uniform. Expressions like "*Stone throw*", and "*one span*", were used and there were highly subjective. The distance referred to as a "*Stone throw*" is, of course dependent on who is throwing the stone. It was to avoid such ambiguity that standard measuring instruments were introduced.

In the same way, attempts should be made to standardized research ventures in order to avoid wastage and abuse, and so enhance the quality of research findings in science education.

Standard in Science Education Research

In research generally, there are possible steps that must be followed if the findings would be of any use to the community. Right from a search for topic through the way data are analysed and inferences are drawn, there are principles and tradition to follow. But a careful search into many published articles shows the breach of such traditions. Standards in the areas of research procedure and methods are the focus of this paper.

Standard in Research Procedure

To achieve the required result in the research venture, certain standard procedural steps in carrying out research in science education are very crucial. While a survey study may require the administration of questionnaires across the population, experimental work requires a more meticulous handling of the research setting. For instance, in administering treatment to different research groups, the followings should be carefully considered:

- (i) The choice of research group, among others.
- (ii) Ensuring the comparability of research groups.
- (iii) Ensuring parity among the research assistants who are meant to undertake the treatment.

(i) The choice of research groups: After determining the population and the sample, consequently, the researcher in experimental study will need to decide on the research groups. While some may prefer the experimental and control groups to be within the same school as could be the case in using different arms of a particular class or grade of students), others do prefer having the groups in different schools. There are some still that will prefer having the same group to serve as both experimental and control. It should be stated here that each setting has its own advantages as well as disadvantages. However, to avoid experimental contamination (a situation where subjects from experimental and control groups meet to exchange ideas, notes,

etc), especially for long ranged treatment, it is advisable to work with groups at different schools.

(ii) Comparability of research groups: It is worth noting that unless the research groups were comparable at the beginning, the post treatment difference found among or between groups cannot be attributed to the treatment condition, confidently. In science education research much should be done to ensure this comparability. Beside the general randomization processes involved in each stage, there are other methods of ensuring comparability of research groups. These include matched-group, matched pairs and random-block techniques. Each of these involves pretesting of the subjects based on certain critical variables and, perhaps, counterbalancing of all these, matched pairs teaching seems preferred.

This is because it matches individuals' characteristics rather than group.

The steps involved here are:

- (i) Testing the subjects based on the critical variables
- (ii) Rank-ordering marks earned in each critical variable
- (iii) Distributing subjects with marks of the same rank to different groups. For example, 10 scores for distribution to two

Research groups, we have:-

Raw Scores	Ranks	Distribution
65	1ST	A1
65	1ST	B1
53	2ND	A2
42	3RD	B3
35	4TH	B4
35	4TH	A4
35	4TH	B4
28	5TH	A5
25	6TH	B6
25	6TH	A6

it should be noted that where there is only one score in a given rank, while it is assigned to a group, the other group without such a high score should be compensated with an additional lower rank. In the example above, the third rank was assigned to group B who is also compensated for by being assigned the next two lower ranks.

By checking the grade points of each score.

Group A	Grade Point	Group B	Grade Point
A1	1	B1	1
A2	2	B3	3
A4	4	B4	4
A5	5	B4	4
A6	6	B6	6
	18		18

When the grade points are either the same about the same in the two groups, a high index of comparability can be assumed.

(iii) Ensuring parity among research assistants

The issue of parity among research assistants especially when they are involved in the treatment conditions is very crucial. While some researchers prefer one person to administer treatment to both experimental and control group, others prefer such to be done by different assistants. However, because of some basic common conditions the two groups should be subjected to at about the same time and moreso to avoid bias, it is advisable to use two different assistants for the purpose.

In doing this, the researcher should note that the two individuals are basically different. They should, therefore, be trained with respect to the research and a good index of parity be obtained before they are allowed to carry out their responsibilities.

Standard in Research Methods

In most published articles, especially in empirical study, one finds the sub-heading "research methodology". But methodology is the study of different methods. In writing a research report, what is needed is not the study of methods rather the actual method used in the research. So, it is research method and not methodology.

Research method determines the quality of the findings. Standard is required in selecting sample, determining sample size, drawing up research instruments as well as the use of appropriate statistical tools in analyzing the data. It is not uncommon to find studies where non-parametric statistics are used for analyzing parametric data. For instance, some research instruments are completely out of tune with the purpose of the study and unfortunately some of these have been published; having escaped the eyes of the editors. There is need for national standard in science education research.

Conclusion and Recommendation

The chapter has discusses standards in science education research mainly with respect to research procedure and method. It is noted that the findings of every research cannot be more acceptable than the procedure and method used in the research work. The need for national standard is advocated. Editors of journals and books in science education should be more meticulous in ascertaining the standard of the articles to be published.

References

- Akpan, B. B (1999) *Perspectives on Education and Science Teaching from the eyes of Uduogie Ivowi*. Abuja: Foremost Educational Services Ltd.
- Fox, D. J. (1969). *The Research Process in Education*: New York: Holt, Rinehart and Winstone
- Ivowi, U. M. O. (1993). *Curriculum, Development in Nigeria Ibadan: Sam Bookman Educational and Communication Services*
- Kerlinger, F. N. (1966). *Foundation of Behavioural Research*. New York: Holt, Reneharts and Winston
- Mouly, C. J. (1970). *The Science of Educational Research*. New York: Holt, Rinchart and Winston
- Nwana, O. C. (1981). *Introduction to Educational Statistics*: Ibadan, Heinemann Educational Books.
- Nwankwo, J. I. (1984). *Mastering research in Education and Social Sciences*: Ibadan: Bisi Books.
- Ogunleye, A. O. (1994). *Science Education in Nigeria: Historical Development, Curriculum reform and research* Lagos: Sunshine International Publication.
- Okebukola, P. A. O. (1985). The relative effectiveness of cooperative, competitive and individual, interaction techniques in strengthening students performances in science classes. *Science Education* 69(4), 501-509
- Onwioduokit, F. A. (1998). Tensile strength of local materials used as ropes in Nigeria . *Alberta Science Education Journal*, 30 (2), 28 – 34
- Onwioduokit, F. A. (2000). *Educational Research Methodology, and Statistics* Uyo: Dornand Publishers.