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Literature Sources:

DOES SPECIALISING IN SCIENCE SIGNIFICANTLY INFLUENCE PROFICIENCY IN PROCESS SKILLS APPROACH TO TEACHING ENVIRONMENTAL SCIENCE BY TRAINEE (PRIMARY) TEACHERS?

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Abstract

The objective of this study was to find out if specialising in science significantly influenced proficiency in process skills approach to teaching of Environmental Science (ES) by trainee primary teachers.

The sample included 123 final year students from three teachers' colleges. Data collection strategies employed include (i) Questionnaires, (ii) A test on integrated process skills (TIPS), and (iii) Analysis of ES lesson observation critiques.

The study established that (i) There was no significant difference in performance between main subject students and non-main subject students, in both TIPS test and teaching of ES (ii) Training appeared not to give main subject students confidence to act as ES resource persons.

Introduction

This article is a follow-up on an earlier article in which we discussed our findings with regards to Primary Teachers' Colleges Science Syllabi Aims Content and Methods as indicators for proficiency in process skills approach to teaching Environmental Science (ES).

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Here we consider superiority in understanding process skills between main subject students and non main subject students. We also look at whether main subject students have enough confidence to act as ES resource persons in schools where they will teach.

The students in the sample were 61 science main subject students and 62 randomly selected applied education students. Both groups were in their third and final year at college.

Implications of Process Skills and Environmental Science Aims to Teaching and Learning

If main subject students have to be resource persons in their schools, they should be taught whatever extra content in a way that will make them more superior in the understanding of both content and the process of science. That way they are likely to be more effective in teaching science than their non science major counterparts. A content oriented course will not enhance their competence in the classroom. In support of the above assertion Penick et al (1988:17) in discussing features which separate least effective from most effective science teachers say:

> Knowing science says little about being able to communicate science ... while strong content preparation may be necessary, it is not sufficient for effective teaching.

If teachers are to be effective resource persons, they should have pedagogics which blend well with main subject content.

Trainee teachers should receive training on how to in-service their colleagues in the schools. Studies by Yager et al (1988) and by Kyle et al (1988) both indicate that whenever teachers are in-serviced they became more effective, and develop in students, positive images of science and scientists. Ross (1990) in a meta-analysis of 112 controlled studies, also found that in-service is more effective when it is organised at local school level by teachers for other teachers. The in-service provided by the main

subject student to his/her colleagues in the school will be cheap and effective.

In this investigation, we sought to determine answers to the following issues:

1) Whether there was any significant difference in the understanding of science process skills between science main subject students and non main subject students.

2) Whether training given to science main subject students gave them confidence to act as resource persons in schools.

Design

The study was limited to three Zimbabwean conventional Primary Teachers Colleges from three urban centres. The sample consisted of all (61) science main subject students (at least 20 per college) in their third year of training as well as 62 randomly selected applied education students also in their third year. Data was collected through:

- Analysis of teaching practice lesson critiques
- Testing the students for proficiency in Integrated Science Process Skills.
- Questionnaires to students.

1. Analysis of Lesson Critiques

Twenty-one critiques of main subject students and twenty-one of non-main subject students who were observed teaching (ES) during year 2 teaching practice were selected and analysed (42 per college). Among other things referred to in the first article, the teaching performance of science main subject students was compared with that of the non-science main subject students, by comparing their scores in teaching (ES). To determine whether there was a significant difference in the performance of the two groups, the student t-test was employed.

2. Test of Integrated Process Skills Proficiency

The test is a combination of items selected from three tests:

i) Test of Integrated Process Skills I (TIPSI) by Dillashaw & Okey (1980).

ii) Test of Integrated Process Skills II (TIPSII) by Burns, Wise and Okey (1985).

iii) The Process of Biological Investigation Test by German (1989).

The test had twenty-two items, which are process skills. Some of the items were repeated to test consistency in the student answering the questions.

The test was chosen because assessing student ability in process skills would be difficult and time consuming if it were to be done through observation of laboratory situations. The fact that it was just a written test and of multiple-choice type, the time needed to get the required data was approximately forty-five minutes only. The test has been used with secondary school students, and it has also been seen to be appropriate for assessing the process skill competence of prospective primary school teachers.

Students wrote the test under examination conditions. The time to complete the test was between forty-five minutes and an hour. For students to be regarded proficient in process skills, they had to score a mark of 70 percent and above. The scripts were also analysed to determine which process skills all the students tended to show weakness and which they showed strengths. The results were then presented as percentages, using simple descriptive statistical methods. Test scores of main subject students were compared against those of non-main subject students. To determine whether a significant difference existed between the two groups, a statistical test, the student t-test was applied.

3. Questionnaires

They were used to find out if main subject students were prepared to be resource persons and whether they were encouraged to take part in the general development and improvement of the teaching of ES wherever they might find themselves teaching.

Results

This section presents findings from:

1. Students' opinions on preparation of science main subject students to be ES resource persons.

2. The performance of the student in the Integrated Process Skills Test.

3. The performance dichotomy in the teaching of ES between main subject and applied education students, if any.

The analysis of the issues is presented in data tables. In the table 'N' represents the total number of respondents to a particular item. Percentages show the proportions of respondents who responded in a particular manner in relation to 'N'. They also show the marks obtained in tests and lesson supervision. For a factor to be considered significant, at least 50 percent of the respondents should mention it. For the purpose of data analysis strongly agree and agree have combined into one category while disagree and strongly disagree have been collapsed into another category. Where applicable, confidence of significance has been enhanced by statistical analysis using the t-test or the chi-square (χ^2) techniques both at the conventional 5 percent significance level.

Main subject students in particular were asked (through the questionnaire) to find out from their opinions if they had been prepared to be resource persons. The findings are presented in Table 1.

Table 1

Preparation of Science Main Subject Students to be EAS Resource Persons

STATEMENT	PERCENTAGE			
	SA	A	DA	SDA
1. I prefer the lecturer to do experiments that I can watch rather than do them myself	3.3	0	18.0	75.4
2. I presented a demonstration lesson in ES or a paper on the teaching of ES while on T.P.	26.1	32.9	27.9	8.2
3. I was in the school science or ES committee of the school I was teaching during T.P.	21.3	26.2	27.9	14.8
4. There was an ES committee at the school I was teaching during T.P.	26.2	21.3	24.6	18.0
5. We were taught how to organise in-service courses or staff development courses or ES in the schools where we will teach	9.8	36.1	34.4	32.9
6. The content in our main subject is closely related to the content in ES.	6.6	36.1	26.2	29.5
7. My first choice of main subject was science	50.8	16.4	19.7	8.9

KEY:

SA - Strongly Agree
A- Agree
DA - Disagree
SDA - Strongly Disagree

The findings here suggested that the students would in-service their colleagues emphasizing the process approach style. This is shown by their own desire to be involved in hands-on learning than watch their teachers do it for them (93.4%). It is also clear that a lot of them were involved in some form of promoting science teaching and learning in the school they taught in during T.P. The fact that a significant number of them (67.2%) had science as their first choice of main subject would suggest that they would enthusiastically promote the growth of ES in their schools. The data, however, suggests that the colleges did not prepare them adequately for the task as shown by 67.3 percent of them in item number 5. Another 55.7 percent indicated that what they spent most of their time doing in main subject did not have close relationship with ES. This was likely to leave them at the same level of competence as their counterparts in applied education, when it comes to ES.

Students' Proficiency in Integrated Process Skills

The data obtained are shown in Table 2.

Table 2

Number and (%) of Students Proficient in Integrated Process Skills (Scoring Above 70%).

Applied Education Students N = 62		Main Subject Students N = 61		Total N = 123	
Number	%	Number	%	Number	%
15	24.12	20	32.8	35	28.5
Mean Score	54.03%	Mean Score	54.06%		
Standard Deviation	21.08	Standard Deviation	21.23		

Only 28.5 percent of the whole sample of 123 students managed to score above 70 percent. This was the level at which a student would be considered to be proficient enough to teach confidently and effectively

using the process approach. While at face value main subject students seemed to have more students who were proficient, statistically there was no significant difference. The chi-squared value calculated is 1.77. This is smaller than the tabulated value of 3.84 at the 5 percent significant level, hence there was no significant difference in the number of the main subject students passing and the applied education students passing.

Despite the fact that main subject students received more tuition in science, they were no better in their process skills proficiency than the applied education students. The t-test value which was obtained in comparing the test results of the two groups is 1.198. Since this is smaller than the tabulated value of 1,97 at the 5 percent conventional significance level, there was no significant difference between the two groups.

The results of the test were further analysed to determine the areas in which both groups showed strengths and weaknesses. Findings are shown in Table 3.

Table 3

Number and (%) of Students Succeeding in a Given Integrated Process Skill

PROCESS SKILL	APPLIED EDUCATION (N = 62)		MAIN SUBJECT STUDENTS (N = 61)		APPLIED AND MAIN (N = 123)	
	Number	%	Number	%	Number	%
Interpretation of Data	23	37.1	35	57.4	58	47.2
Supporting Data	40	64.8	41	67.0	81	65.9
Prediction	32	51.5	25	40.9	57	46.3
Assumption	27	43.6	28	46.9	55	44.7
Evaluation	29	46.8	27	44.3	56	54.5
Designing Investigations	50	80.6	54	88.5	104	84.6
Identifying and Defining Variables	47	75.8	52	85.2	99	80.5
Hypothesis	19	30.6	22	36.1	41	33.3

Both groups had less than 50 percent of the participants showing ability to (1) make assumptions, (2) evaluate, and (3) hypothesize. Furthermore, 62.9 percent of the applied education students failed the test items testing ability to interpret data while 59.1 percent of the main subject students failed the test items testing ability to make predictions. This implied that there will be few teachers in the field with the required skills to guide pupils in the acquisition such of scientific skills.

It should be noted that while this is a 45 minute test, all the six groups had up to an hour to write the test. Given the duration in which they wrote we would like to believe that they had all the time to reflect on each test item increasing their changes of scoring high.

The last issue to be presented is the data obtained from lesson critique analysis. This is shown in Table 4.

Table 4

Lesson Critique Analysis

	FREQUENCY OF ACKNOWLEDGING AND SUGGESTING THE INCLUSION OF PROCESSING SKILLS OR QUESTIONING THEIR ABSENCE IN OBSERVED SCIENCE LESSON			
PROCESS SKILL	APPLIED EDUCATION STUDENTS (N = 63)		MAIN SUBJECT STUDIES (N = 63)	
	Number	%	Number	%
1. Manipulating	24	38.0	16	25.4
2. Observation	24	38.0	24	38.0
3. Classification	9	14.3	1	1.6
4. Measuring	Nil	Nil	Nil	Nil
5. Communication	14	22.0	13	20.6
6. Predicting	Nil	Nil	Nil	Nil
7. Interring	Nil	Nil	1	1.6
8. Experiementation	11	17.5	8	12.7
Cases Where Acknowledgement Exceeds Three Students	2	3.2%	3	4.8%
Mean Score Awarded Per Lesson	59.75		61.54	
Standard Deviation	7.99		8.52	

Here, besides what was discussed in the first article, the other issue which had to be considered was whether main subject students performed better than non-main subject students in the teaching of ES. The t-test was applied. The value obtained i.e. 1.22 was smaller than the table value i.e. 1.97 at the 5 percent significant level. Therefore, there was no significant difference between the performance of the main subject students and the applied education students in the teaching of ES.

Discussion

The purpose of this research article was to find out if specialising in science significantly influenced proficiency in Process Skills Approach to teaching ES by primary school trainee teachers.

Relevant research question will be restated and then discussions pertaining to them made below.

"Do Science Main Subjects Show Superiority in Understanding Process Skills to Non-Main Subject Students?"

The study established that there was no statistical difference in understanding process skills between science main subject students and non-science main subject students. These findings make us pose the question, "Is it necessary to have an academic main subject for students who are being trained to become primary school teachers?" If we consider that these students received six hours per week of science teacher over and above that which they received together with those who did ES only, then the answer would be no. Interestingly, the same lecturers who teach them are the ones who go on to give them extra enrichment in Biology, Chemistry and Physics. If there were different people taking them for main subject, their lack of ability to demonstrate superiority over their counterparts would probably be attributed to variability in approach of the lecturers.

If there was adequate hands-on science in the six hours per week of main subject science, honestly, 67.2 percent of main subject students would not demand more hands-on science as shown in table 3 of our previous article.

It can be argued that even from a purely scientific point of view devoid of ES, the science main subject programmes observed from this study are a failure. This view is based on what Screen (1986), Burns et al (1985), and Frazer (1986) have said and the fact that 67.2 percent of the main subject students failed (as shown in table 2) to achieve the stipulated 70 percent. Another factor which has to be taken cognisance of is the fact that a test that is normally taken in 30 minutes was in this case written over an hour's duration.

Another factor which would run in favour of the main subject students scoring significantly higher than their non-main subject counterparts is that they should be highly motivated. This argument is derived from the fact that a significant 67.2 percent has science main subject as their first choice of a main subject, showing an interest already in science before entering college.

There is need to make a review of the relevance of main subject as it is given today, in the light of the shortcomings revealed by studies such as this one. Teacher's Colleges should not be used as academic institutions to further the interests of students who may want to sit for 'A' level examinations on completing their three years in college. Instead, on completion students should have been thoroughly prepared to be confident and competent practitioners of the primary school curriculum.

"Does Training Give Main Subject Students Enough Confidence to Act as Resource Persons in Schools?"

A very significant number of science main subject students did show their awareness of the importance of school based staff development (80% compared to 50% non-main subject students). However, the majority of them said they did not get training in their colleges to give them confidence to be resource persons. Again, a significant number does feel that there

is no relationship between their main subject content and ES. Penick et al (1988) cited in the literature review contend that content preparation alone is not sufficient for effective teaching. It should therefore be blended well with pedagogics.

The fact that the main subject students are no better in their understanding of process skills than applied education students makes them unsuitable as resource persons. They would really have little to offer if anything to their colleagues in the schools. Some of the in-service courses in the schools may require them to give demonstration lessons. With the data showing their teaching performance to be no better than that of the non-science main subjects, their counterparts will learn very little from them. They (science majors) are bound to produce mediocre lessons which will be resented by their colleagues, and hence stifle the spirit of school-based staff development.

For them to be useful as resource persons, firstly, training in process skills should be improved. Their content would have to be ES oriented. Secondly, there would be need to train them thoroughly in how to manage and conduct school-based in-service courses.

Conclusion

On the basis of their performance on the TIPS test, we conclude that there was no significant difference in understanding of science process skills between main subject and non-main subject students. We also conclude that main subject students lack confidence to act as ES resource persons in schools. This is based on: (i) the main subject students saying that they did not get any training for it; (ii) their performance on the TIPS test which was neither impressive nor better than that of their non-science counterparts and, (iii) that they exhibited a lacklustre performance similar to that of non-majors in the teaching of ES as revealed by lesson critique analyses.

Recommendations

Authors to this article are aware of the limited studies done in this area, especially in Zimbabwe. However, in view of our findings on TIPS performance, lesson critique analyses and reactions of trainees to issues in the questionnaires, we strongly feel the following suggestions should be considered by those concerned with teacher training practices:

Science main subject along academic lines needs to be reviewed. Colleges should consider replacing it with specialisation in the main subject, e.g. ES as it is offered in Zimbabwean primary schools. In this approach, there would be both emphasis on the content of the subject (ES) and the teaching approach which is largely process oriented. Within this approach, students could be offered an opportunity through C.D.S projects to experiment with content and process teaching techniques.

Alternatively, in place of specialisation, the time for main subject could be transferred to applied education areas. This has the advantage in ES especially, of ensuring that all students will have the experience and time for hands-on activity as expected in the teaching of science. There is also more time for syllabus and text analysis as well as reflective training based on peer teaching and micro-teaching.

There would also be need for intensive staff development programmes for lecturers involved in both teaching and T.P. supervising of ES lessons to ensure that they know what is required of them.

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