SCIENCE LITERACY AND SCIENCE PROCESS SKILLS AS DETERMINANTS OF PRE-SERVICE SCIENCE TEACHERS' EFFICACY BELIEFS

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Abstract
The behaviour of teachers in the achievement of educational goals has invisible complement known as teacher beliefs. In science education, the teachers' beliefs are not left out in leading the students to have a strong belief of succeeding in scientific processes which include; observing qualities, measuring quantities, sorting/classifying, inferring, predicting, experimenting and communicating. These skills involve a system known as science literacy which is now a well-recognized global educational slogan and contemporary educational goal. The study employs the descriptive survey research design to investigate science literacy and science process skills as determinants of pre-service science teachers' efficacy beliefs. The study sample involved an intact class of pre-service science teachers in a college of education, in south-western, Nigeria. The study answered two research questions in which science literacy and science process skills determined the efficacy beliefs of pre-service teachers. The data analyzed revealed significant relationship among the three variables. The study was concluded on the need for pre-service teachers' access to sources of positive experiences in teacher education. Intervention programmes in teacher training were also suggested for further studies to alleviate teacher efficacy beliefs.

Keywords: Science literacy, Science process skills, Teachers' efficacy beliefs, Teacher training, Intervention programs

Introduction

The entire edifice of education is constructed on the foundation that teaching can contribute to accelerated and accomplished learning. Hence, the overall process of education certainly involves several players which include; educational administrators, policy makers, curriculum planners, teacher trainers and teachers among others. However, the player who has a direct contact or bearing on shaping and reshaping the desired learning outcomes is the classroom teachers. These classroom teachers have been described by Kumaravadivelu (2003) to be an artist, architect, scientist, psychologist, manager, mentor, controller, counsellor, sage on stage, guide on the side and lots more.

Teachers are important in the realization of any educational goals and this is particularly true about science and technology which remains the yardstick for the development of nations all over the world. Therefore, science teaching and learning should help the future leaders to master scientific knowledge and as well practice science process skills in their daily activities. Consequently, according to Gbolagade (2009), the importance of science teachers in the implementation of science curriculum at all levels of education is acknowledged worldwide. Therefore, the training of science and technology teachers should be constantly reviewed in order for the teachers to be relevant because there is a rapid change in the advancement of science and technology according to Ige and Ogunseemi (2016).

Science literacy plays an important role in human daily lives. Promotion of science literacy has been recognized as a major goal of science education in the world according to Zembylas (2002). Meanwhile, Hazen (2002) makes distinction between being able to do science and being able to use science. He stated that science literacy is a mixed concept; history and philosophy that help one understand the scientific issues of our time. Hence, scientific literacy has been recognized as an important characteristic that every citizen in a modern society should possess. In this respect, science education which includes 21st century skills are critical for developing student's scientific literacy, which in turn will give rise to scientifically literate citizens in future.

Furthermore, science teachers according to Ozdemir (2010), are important to the achievement of scientific literacy at all levels of education because of their roles in preparing scientifically literate individuals. However, Sultan, Henson and Harvey jnr. (2018) in a study found that pre-service science teachers showed high teacher efficacy beliefs, moderate literacy and low science process skills. The previous study suggests preservice training with corresponding understanding of scientific ideas, content knowledge and science process skills because teacher efficacy belief is not enough to impart knowledge most especially in science.

Morris and Lummis (2018) showed in a study that many pre-service science teachers feel uncomfortable to teach due to low teacher efficacy belief, a situation which was as a result of their experience during training. Learners are heavily influenced by their teachers according to Hodges, Wright and McTigue (2019) and so, the higher the teachers' efficacy belief, the more they tend to impact learners. Therefore, science teachers' efficacy belief is proportional to what they know about science. However, Joseph (2010) has linked science teacher efficacy belief to pedagogical preparation and content knowledge which by implication is a challenge to teacher training programmes that refuse to make provision for teacher efficacy.

Pre-service science teacher's process skills according to Akpan (2010) are an aspect to be given considerable attention during the training period. This however, does not require total deviation from what is in practice presently, but

merely involves making the science process more explicit in lessons. This is of necessity as they are being trained to teach others later. Science and technology contributes to learners' success which agrees with the submission of Opara (2011) that science and technology help the learner to describe objects and events, ask questions, construct meaning, test and verify phenomenon and as well communicate the result to others.

Scientific process skills as shown in Turiman, Omar, MohdDaud and Osman (2011) can be divided into two, namely; the basic science process skills and integrated science process skills. Basic science process skills include; observation, classification, measurement, using numbers, making inferences, prediction, communication and using the relation of space and time. Integrated science process skills consist of interpretation of data, operational definition, controlling variables, making hypotheses and experimentation. Science process skills according to Miller (2002) should be utilized by teachers in the delivery of teaching the facts of science effectively. This is because science is not just of knowledge but it is a way to systematically understand the environment and the world at large.

Consequent upon the previous assertions, the teacher knowledge base for effective science teaching is very important in that they are to help the learners completely to understand the content and the basic philosophy of science. However, Erdem and Demire (2007) shared that pre-service science teachers' efficacy belief is important to their efficiency in the delivery of science and technological concepts in the classroom. It is the primary aim of any teacher education programme according to Onocha (2013) to produce teachers who can start their career with sufficient efficacy as they are trained to become professional teachers. According to Aydin and Boz (2010), teachers' efficacy beliefs predict their motivation and choice to ascertain their actions in the classroom.

Also, Joseph (2010) has identified teacher efficacy belief as a significant indicator of effective teachers and so, teachers with high efficacy belief are confident about specific task that may influence their actions in the classroom. This is in line with d'Alessio (2018), who argued that teachers' efficacy belief about their effectiveness in the classroom influences what and how they teach, so teacher training programmes should work to cultivate strong teacher efficacy beliefs in future teachers. This has long been emphasized by Dahor, Dahar, Dahar and Faiz (2011) that there is the need for teacher training programmes that will produce sound and effective scientifically literate teachers.

Therefore, this study investigated science literacy and science process skills as determinants of pre-service science teachers' efficacy belief.

Research Questions

4. Are there any significant effects of Science Literacy on Pre-Service Science Teachers' efficacy beliefs?
5. Are there any significant effects of Science Process Skills on Pre-Service Science Teachers' efficacy beliefs?

Methodology

Descriptive survey design was adopted for this study. The design is on relative elements of the population with common attributes which are chosen with a view to representing the entire population data collection by self-report questionnaire containing two sections. Section A comprises Bio-Data of the respondents as well as their subject combinations. While section B has two (2) parts seeking for information on

1) Science literacy of pre-service science teachers in relation to teacher efficacy belief

2.) Science process skills of pre-service science teachers in relation to teacher efficacy belief

Each part contains 20 questions with 10 positive scoring of strongly agree = 4, agree = 3, disagree = 2, strongly disagree =1, while the remaining 10 have reverse scoring such as strongly disagree = 4, disagree= 3, agree= 2 and strongly agree =1respectively. The instrument was subjected to a content validity with the help of experts in measurement and evaluation in the college. The questionnaire was administered on 50 non-participating pre-service science teachers in the College of Education, Ikere-Ekiti, Nigeria in order to determine the reliability of the instrument. It has a reliability coefficient of 0.85, which was considered reliable for the study.

Participants were an intact class of NCE part III pre-service science teachers from the school of science, College of Education, Ikere-Ekiti, Nigeria. However, the population is a total of two hundred and sixty-nine (269) pre-service science teachers made up of (119) males and one hundred (150) females representing different combinations in the school of science. The purpose of their selection was based on their enrolment in the teaching practice which is their real teaching experience outside the school for the 2018/2019 session. The administration of the questionnaire took about 25-30 minutes during the teaching practice orientation for the 2018/2019 session where the participants were given the self-report questionnaire to complete.

Data Analysis

The data collected were subjected to Mean and Standard deviation, Pearson's correlation coefficients and analysis of variance (ANOVA) to check whether;

a) Science literacy affects science teacher efficacy beliefs
b) Science process skills have affect science teacher efficacy beliefs

Results

Table 1: Analysis of variance (ANOVA) showing the effects of science literacy on pre-service science teacher efficacy beliefs

Sources of Variance	Sum of squares	Df	Mean Square	F-Cal	F-Crit	P.
Between group variance	935.518	11	125.047	21.235	1.83	<
Within group Variance	17704.267	257	68.888			0.05
Total Variance	18639.784	268				

F=21.235, df 11/268; p=0.003<0.05

Table 1 shows that F-calculated value (21.235) is greater than F-critical value (3.0) at 0.05 level of significant. (F value (11/268) = 21.2358, Pro= 0.003 < 0.05). Indicating that science literacy affects pre-service science teacher efficacy beliefs.

Table 2 Analysis of variance (ANOVA) showing the effects of science process skills on pre-service science teacher efficacy beliefs

Sources of Variance	Sum of squares	Df	Mean Square	F-Cal	F-Crit	P.
Between group variance	1161.449	1	145.586	55.836	1.83	< 0.05
Within group Variance	485.993	257	1.891			
Total Varianc	1647.442	268				

F=55.836, df 11/268; p=0.000<0.05

Table 2 shows that F-calculated value (55.83) is greater than F-critical value (1.83) at 0.05 level of significant. (F value (11/268) = 55.836, Pro= 0.000 < 0.05), Indicating that science process skills affects pre-service science teacher efficacy belief

Discussion

The result of this study indicated that science literacy of pre-service science teachers affects their efficacy beliefs. Hazen (2002) makes a distinction between being able to do science and being able to use science. He stated that science literacy is a mixed concept; history and philosophy that help one understand the scientific issues of our time. It also agrees with d'Alessio (2018) that teacher efficacy belief about their effectiveness influences what to teach and how they teach in the classroom. Learners are heavily influenced by their teachers according to Hodges, Wright and McTigue (2019) and so, the higher the teachers' efficacy belief, the more they tend to impact learners. In other words, science literacy of science teachers will inform their efficacy belief, because a teacher that is not versatile in science concepts with its corresponding knowledge may not be able to impact knowledge to students effectively. Therefore, science teachers' efficacy belief is proportional to what they know or don't know about science.

The result also showed that science process skills of pre-service teachers affect their efficacy beliefs. This is in line with Aydin and Boz (2010), that teacher efficacy beliefs predict their motivation and choice to ascertain their actions in the classroom. The result is a reflection of the conclusion of Sultan, Henson and Harvey jnr. (2018) the preservice science teachers training with corresponding understanding of scientific ideas, content knowledge and science process skills will determine their efficacy belief to impart knowledge in science classroom. Also, this result is not different from Morris' and Lummis' (2018) that many pre-service science teachers feel uncomfortable to teach due to low teacher efficacy belief, a situation which may be due to what they know or do not know about science.

Conclusion

Science teachers are important to the achievement of scientific literacy at all levels of education because of their roles in preparing scientifically literate individuals. Science literacy of science teachers will improve their efficacy belief, because a teacher that is not versatile in science concepts with its corresponding knowledge may not be able to impact knowledge to students effectively.

Recommendations

1. There is the need for teacher training programmes that will produce sound and effective scientifically literate teachers.
2. This study suggests a teacher training programme that will link science teacher efficacy belief to pedagogical preparation and content knowledge which, by implication is a challenge to teacher training programmes that refuse to make provision for teacher efficacy.

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