

学位論文の要旨 (論文の内容の要旨)
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論 文 題 目

Dissertation title: An Investigation of Primary School Teachers' Conceptual and Operational Understanding of Science Process Skills in Zambia

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Introduction: As a developing nation, Zambia has been improving the quality of science education through broader educational goals. Through the ministry of education, the country focuses on equipping "learners with fundamental scientific knowledge, process skills and values that are essential to contribute to the attainment of vision 2030" (Ngandu & Kaulu, 2020, p. 204). The current curriculum emphasizes the learners' acquisition of Science Process Skills (Banda, 2013). However, learners in Zambia display "weaknesses in questions involving science process skills in science subjects' practical activities" (ECZ, 2016; 2017 in Ngandu & Kaulu, 2020, p.204). The problem has been credited "to weaknesses such as lack of process skills experimentation ability and weakness in expressing ideas when writing answers to examination questions" (Ogunleye, 2012, p.4). The learners' inadequate skills acquisition and development could be due to their teachers' insufficient conceptual and operational understanding of the scientific skills. One study reveals that Zambian primary school teachers displayed an inadequate understanding of the assessment of Basic Science Process Skills (BSPS); this is a concern that calls for an investigation (Mushani, 2021c).

Main Purpose

The study intended to examine the trend of Zambian primary school teachers' conceptual and operational understanding of Science Process Skills (SPS) and study the patterns of Zambian primary school teachers' conceptual and operational understanding of Science Process Skills (SPS) concerning five selected variables, with regards to previous research studies.

Method: The method section of this study involved two stages: (A) Systematic literature review by qualitative research design for research questions one (1) and two (2). Research question one (1) focused on integrated analysis of previous research studies on the trends in research on SPS from developed and developing countries focusing from three perspectives: (i) Science Curriculum, (ii) Teacher education and (iii) 21st Century Learning. Likewise, research question two (2) used a systematic literature review through an integrative review of the literature using four (4) key search terms, Science Process Skills, Understanding, 21st Century Learning, and Africa. (B) Descriptive and Correlation method by quantitative research design was for research question three (3). This stage was centred on the positivism paradigm using Association Quantitative research method design. This design "relies on the hypothetical deductive method to verify a priori hypotheses that are often stated quantitatively where functional relationships can be derived between casual and explanatory factors (independent variables) and outcomes (dependent variables)" (Park et al., 2020, p.690). The stage was sub conducted into two, i.e., (i) primary school teachers' conceptual understanding of science process skills and (ii) primary school teachers' operational understanding of these skills.

The researcher obtained study data from existing literature on science process skills education and two surveys administered two times. The survey instruments are composed of the Teachers' Conceptual Understanding of Science Process Skills Test (TCUSPST) and Teachers' Operational Understanding of Science Process Skills Test (TOUSPST). The items used in both tests were adapted from the 5th Edition of Learning and Assessing Science Process Skills Book (Rezba Richard J, 2007) and (Molefe, 2016).

Part A covered the respondents' demographic information, including gender, teaching experience, teaching qualification, and teaching grade level. Part B comprised the standardized questions regarding the conceptual and operational understanding of science process skills as the dependent variables analyzed statistically across five independent variables: gender, teaching experience, teaching qualification, teaching grade level and teachers' facilitation of SPS.

Results: Findings on research question one showed that "the representation rate of SPS is inconsistent with each other" Duruk et al., 2017, p.124) in science curriculum documents and the curriculum implementation at all science education levels. Not many studies on SPS education concerning 21st Century Learning have been done in advanced and emerging countries. SPS development is needed by considering more vital treatment programs for pre-service and in-service teachers. Teacher educators play an indispensable role instructionally in pre-service education. Their training influences the development of students' SPS. Teachers' understanding of SPS facilitates students to study science out of SPS usage in the science education practice. Findings on research question two include the crucial necessity to grow the workforce with systematic understanding and competencies essential for trade advancement in Africa. Despite being in the 21st Century, the African continent records poor socio-economic conditions due to nominal economic growth—demand for quality science education for Africa.

The findings for research question three are in two segments: results under teachers' conceptual understanding of SPS and those under the operational understanding of SPS. Respondents' conceptual understanding of SPS showed no significant difference across gender, but a substantial difference across teaching qualification variable was noted. Despite reaching statistical significance, the actual mean difference between the teaching qualification categories for respondents' conceptual understanding of SPS was relatively small ($\eta^2 = 0.2$). As for the teaching grade-level variable, a nonoccurrence pattern is realized in respondents' conceptual understanding of SPS. Lastly, respondents' conceptual understanding across the teacher SPS facilitation level variable reflects a series of records that repeats plainly.

Findings under respondents' operational understanding of SPS across gender was substantial, with a medium effect size found ($d=0.6$). There is no significant difference ($p>0.05$) in teachers' operational understanding of SPS across teaching experience and qualification variables. As for the teaching grade-level variable, a nonoccurrence pattern is realized in teachers' operational understanding of SPS. Lastly, participants' operational understanding across the teacher SPS facilitation level variable reflects previous research findings that repeat identifiably.

Conclusion: This study's findings concerning respondents' conceptual understanding and their operational understanding of SPS are general directions. This study displays various patterns for respondents' conceptual and operational understanding of SPS across the five independent variables. There was a non-repeated occurrence across the gender variable, while their conceptual understanding of these skills showed a repeated occurrence. A non-repeated occurrence was observed from the teaching experience variable, while the teaching qualification variable displayed a repeated occurrence for both respondents' conceptual and operational understanding of SPS. As for the teaching grade-level variable, the unreported occurrence was shown for the respondents' conceptual and operational understanding of SPS. Finally, the respondents' perspective and perception of their facilitation of the SPS variable bears a repeated occurrence. Respondents' operational understanding of SPS is relatively above average; thus, it can be deemed as reasonable to confirm the findings from previous studies such as Hafizan et al. (2012). Zambian primary school teachers involved (regardless of their gender, teaching experience, teaching qualification, teaching grade level) have a low conceptual understanding of SPS. Previous studies recounted that educators with an inadequate conceptual understanding of SPS could not apply efficient instruction and associate education approaches in their teaching space (Mushani, 2021b).

The necessity for teachers' understanding of SPS's peak and the didactic importance of these abilities should be overvalued. Outstanding teachers' interpretation of SPS along with its application in science education can influence prospective fiscal personnel and investigators in Zambia and Africa in general, where the usage of scientific information is yet modest. The teacher training system in Zambia should have a clear content outline concerning SPS education to enhance the effective acquisition and development of these skills by in-service and pre-service teachers in the various teacher training institutions. Curriculum developers and implementors should consider quality and efficient SPS facilitation at each primary school grade level. Finally, a strong linkage among the curriculum developers, curriculum implementers, Examination bodies, and teacher training institutions will help promote quality SPS education through teaching and learning activities to achieve the country's educational goals and Vision.