PHYSICS STUDENT TEACHERS' CONCEPTIONS AND PERFORMANCE IN BASIC ELECTRONICS AT THE UNIVERSITY OF ZAMBIA

By

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A Thesis submitted to the University of Zambia in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Science Education (Physics Education)

THE UNIVERSITY OF ZAMBIA
LUSAKA
2015

I, Goodwell Kaulu, declare that this Thesis

(a) Represents my own work;

(b) Has not previously been submitted for a degree of this or another University; and

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APPROVAL

This Thesis of **Goodwell Kaulu** has been approved as fulfilling the requirements for the award of the Degree of Doctor of Philosophy in Science Education (Physics Education) by the University of Zambia.

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2. Internal Examiners

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ABSTRACT

This study investigated the conceptions and performance of student teachers of physics in basic electronics. The objectives were to: determine the misconceptions student teachers of physics have about basic electronics as they finish their teacher training programme, determine the correlation between these misconceptions and performance of physics student teachers in basic electronics content, establish ways in which misconceptions affect physics student teachers' teaching of basic electronics in senior secondary schools and investigate the effect of the 'BE' Education resource on physics student teachers' misconceptions and performance in basic electronics when used as a supplement to traditional instruction.

A *mixed-methods approach* was employed to investigate the issues involved. Consequently, the *concurrent nested strategy* was used to mix qualitative and quantitative methods, with the latter methods being dominant and thus guiding the study. The basic correlation research design and the true experimental design of the type pre-test-post-test control group were used for data collection. Data were captured using: a questionnaire, test on basic electronics, observation schedule and a likert scale. Quantitative data were analysed using descriptive and inferential statistics while qualitative data were analysed using the constant comparative method.

The study revealed several misconceptions held by student teachers of physics in basic electronics, the common ones being that: Cathode rays are electromagnetic waves that travel at the speed of light (38%), Half Wave Rectification results in an output which is partly DC and partly AC (38%) and that a Capacitor discharges completely when it is disconnected from a circuit (33%). Secondly, the study revealed, a correlation of - 0.8 (significant at 0.01, df = 58, 2-tailed) between physics student teachers' misconceptions and their performance in basic electronics content. Thirdly, the study revealed that misconceptions negatively affected teaching by physics student teachers in terms of: formulation of lesson objectives, lesson introduction, lesson development, use of resources, use of questioning technique and other teaching strategies, attention to individual needs, summarizing of the work done, evaluation of the work done and giving of class notes. Lastly, the study revealed that the 'BE' Education resource (with the learner centred teaching approach imbedded in it), minimised the misconceptions held by student teachers of physics and simultaneously enhanced their academic performance on basic electronics. The findings implied that pedagogical strategies used by physics educators should help identify and minimise learner misconceptions in order to help steer the student teachers in a direction that will lead to academic growth.

From the results it was concluded that student teachers of physics in Zambia have several misconceptions about basic electronics which affect their ability to demonstrate high level understanding of this section of physics and to teach basic electronics at senior secondary school effectively. In view of these findings, the study recommended that:

- The Department of physics at UNZA should identify physics student teachers' misconceptions in Electronics at every level and take appropriate measures to alter or dislodge them.
- Physics education courses at UNZA should not only focus on pedagogical strategies but also relevant physics content to enhance physics student teachers' understanding of fundamental physics concepts.
- Further research should be done to investigate the effect of the 'BE' Education resource on performance of physics student teachers in basic electronics.

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DEDICATION

This Thesis is dedicated to my late father Mr. Jonas Kafimbwa and my late mother Janet Menso Kaulu, who together worked hard to make me what I am, though both did not live long enough to see the results of their efforts. It is further dedicated to my wife Maurine and my children: Byrne, Janet, Einstein and Paul, who were so patient and always encouraged me to work hard, regardless of any situation the family went through during the study.

ACKNOWLEDGEMENTS

Nobody can finish this kind of work alone. In view of this, I would like to thank a number of people who contributed to my work.

- Firstly, my heartfelt appreciation goes to the Principal Supervisor, Dr. S. Hatwaambo, and the Co- Supervisor, Dr. M. Tabakamulamu for their constructive criticisms and scholarly feedback throughout the study. Their splendiferous guidance shaped the outcome of this Thesis.
- Second, I wish to offer my sincere thanks and gratitude to all the staff in the Department of Mathematics and Science Education, University of Zambia, particularly Dr. P. Shanyinde, Dr. S. Mbewe, Dr.K. Nachiyunde and Dr. P.P Nalube for the support they rendered to me throughout the study. Without them, this work would not have been a reality.
- Thanks also go to other colleagues in the School of Education, University of Zambia, namely: Dr. E. Munsaka, Dr. D. Ndhlovu, Dr. D. Banda and Dr. K. Kalimaposo for their encouragement and positive contribution to my work.

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ACRONYMS

PCP .....Personal Construct Psychology
CDC……..…Curriculum Development Centre
ECZ…….Examinations Council of Zambia
MSE……Mathematics and Science Education
TER…….Traditional education resource
TI…….Traditional instruction
BE……Basic Electronics
STE……..School Teaching Experience