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Evaluation Of Objectives Of Physics Teacher Education In Relation To Pedagogic Skills Of Student Teachers In Public Universities In Kenya

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Abstract: ***Evaluation of the B.Ed (Science) program in public universities has focused on content and little has been reported on the improvements made on objectives of the training programs. Moreover, each university develops its own programs and this has resulted to lack of coordination on the key provisions of the training such as the objectives, yet, secondary school instruction to be conducted by the teachers is common. Further, the reforms have not been informed by research on best practices, moreover, an average low performance of 36.43% in the Kenya Certificate of Secondary Education (KCSE) physics examinations has been recorded in the years 2007 to 2016. This has raised questions on the relevance of objectives of physics teacher education programs to acquisition of pedagogic skills by physics teachers. Findings reveal that there is need for objectives of physics teacher education programs to focus on key content areas in secondary physics, enhance use of formative assessment procedures, focus on 21st century skills, delivery of instruction in a technological setting, and on designing physics instruction for students with diverse needs. The findings may be useful in providing a framework for development of objectives of physics teacher education programs for acquisition of pedagogic skills.***

Key Terms: Pedagogic skills, Public Universities, Students with learning disabilities

I. INTRODUCTION

Physics teacher education is meant to facilitate purposeful learning through the use of appropriate procedures that make graduates not only to secure meaningful employment, but also handle demands of the labour market effectively. Omusewo (2007) notes that teacher training at the universities is an important enterprise because standards of education in any country depend on the quality of the teachers. The design of what knowledge, skills, attitude and behaviour that teachers should be equipped with during training is necessary for the success of an education system. This is because teachers are entrusted with the task of moulding learners to the desired characteristics. Similarly, Etkina (2011) has indicated that learners' acquisition of the key knowledge, attitudes and behaviour that will be active in the society and the economy depends on the ability of the teachers. Similar sentiments are also made by the United Nations Information Communications Technology (UN- ICT, 2013) in a task force report, that training does influence the extent to which teachers can embrace an education system that equip students with the requisite 21st century skills. In discussing how to strengthen the position of physics teacher education in changing times, Hilburn and Ruth (2003) noted the need to enable teachers cultivate skilled and independent-minded members of the society by equipping teachers with the right competencies, values and attitudes. Basing on the foregoing, the success of physics instruction in secondary schools depends on the

training of the teachers as done largely by the universities (McCawley, 2009). Further, objectives of teacher education programs should endeavour to address the objectives of secondary school physics that graduates are expected to achieve while in employment (Hilburn & Ruth, 2003). Apparently, little has been reported on whether the objectives of physics teacher education programs at universities enable student teachers acquire pedagogic skills such as subject matter knowledge, assessment skills, communication skills, skills in use of resource material and skills in use of information technology.

Moreover, Physics teacher competencies have been of concern in many countries, for instance, in the United States of America (USA), physics classrooms do not provide students with the expected benefits (Rogers, 2007). Gibbs and Coffey (2004) have argued that the sudden explosion of physics-based technologies that have created a new paradigm have not yet been absorbed by the USA education system. In Ireland, physics teacher education is practiced within a policy framework that highlights the evolving and dynamic programs for teaching and in the increasingly complex role of teachers today (The Teaching Council, 2011). In reference to this, the policy states:

"The time is now right for a thorough and fresh look at teacher education to ensure that tomorrows teachers are competent to meet the challenges that they face to enable them support their students' learning." (p. 7)

This informed the development of a set of criteria and guidelines which developers of physics teacher education programs are required to observe. In South Africa, Shongwe and Ocholla (2009) revealed that graduates at the University of Zululand suggested that they needed in-depth content imparted during training to enable them to be more confident in teaching. It was also established that most teachers lack awareness of students' forms of learning and thinking in Nigeria, and that most teachers do not carry out innovations of new curricula. This was said to be emanating from objectives of training that were not clearly defined (Omosewo, 2007).

In Kenya, the Europe-Africa Quality Connect evaluation report (EAQC, 2012) has raised concerns over the training programs of physics teachers as the graduates lack the capacity to impact positively on learners' achievement. The report further challenged Universities to work on modalities that would enable graduates to transform secondary school learners from being mere consumers to generators of knowledge. Also, the Teacher Education in Sub-Saharan Africa (TESSA, 2010) formative report raised several issues with the teacher training process in Kenya such as lack of a firm philosophy guiding the teacher training programs. According to Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA, 2009) the initiation of in-service teacher training programs in Kenya was as a mitigation measure to address the existing disconnect between the training of physics teachers and the realities in the working environment (SMASSE, 2007). Despite the concerns raised by the previous reports (EAQC, 2012; TESSA, 2010; SMASSE, 2007; CEMASTEA, 2009) objectives of physics teacher education programs in public universities in Kenya has only experienced improvements guided by the goals of the wider B.Ed (Science) program in line with the mission and vision of the university, in reference to the modes of delivery, clarity, general appropriateness and the extent to which they promote students' engagement. Therefore, public universities have continued to use the same course design and objectives adopted from the university of East Africa in 1970s where little is known on the relevance of the objectives to acquisition of pedagogic skills by the student teachers.

The Kenya National Examinations Council (KNEC) has noted that the performance in physics at KCSE level nationally in the last 10 years is 36.43% which is represented by a letter grade D. This performnce is below an average of 50 out of 100 hence poor. Harley and Simiyu (2012) blames the poor performance on poor pedagogy in secondary school physics instruction while Amadalo, Ocholla and Memba (2012); Wambugu, Changeiywo, and Ndiritu (2013) and Barrack (2014) blames the poor performance on pre-service teacher training that produces incompetent physics teachers who hardly improve their skills during their teaching career. Similarly, Redish (2003) has urged that students who opt for physics have got high academic self efficacy which is a predictor of students academic achievement. In support of Redish sentiments, Ekici (2012) and Tezer (2015) observes that students who have high level of self efficacy are better at overcoming obstacles, have higher target and are more confident and therefore it is expected that students who enrol for physics should attain good performance in KCSE examinations. This poor performance in physics is likely to derail the achievements of the country in future if not addressed promptly (Nui & Wahome, 2006. Further, Igwe (2003) has warned that any nation that does not have a strong scientific and technological base rooted in acquisition of satisfactory physics knowledge and skills normally cannot develop its natural resources and remains permanently impoverished.

RESEARCH QUESTION

What objectives should physics teacher education programs seek to attain in relation to acquisition of pedagogic skills?

II. METHODS EMPLOYED IN THE STUDY

RESEARCH DESIGN

The design of the study was descriptive survey. Williman (2011) has argued that descriptive survey is useful when an accurate and extensive description of an educational practice is to be made and therefore, the design was considered the most appropriate method in this study.

AREA OF STUDY

The research was conducted in six (6) public universities in Kenya namely, The University of Nairobi (UoN), Moi University (MU), Kenyatta University (KU), Egerton University (EU), Maseno University (MSU) and Masinde Muliro University of Science and Technology (MMUST). These universities were established by 2007 and chattered by

the end of 2013 and they were selected for this study because they have collectively graduated 92.30% of physics teachers for secondary schools countrywide in the last 10 years (IUCEA, 2014). Moreover, poor performance in secondary school physics at KCSE level has also been witnessed in the same period of time.

STUDY POPULATION

The study population comprised of 420 physics student teachers, 277 physics heads of subjects in secondary schools where the student teachers were undertaking their teaching practice and 130 physics teacher trainers from the schools of Education, Sciences, computer and Human Resource management.

SAMPLE SIZE AND SAMPLING TECHNIQUES

Purposive sampling technique was used in the study in which the total population sampling strategy was applied to select 351 physics teacher, 225 physics heads of subjects and 108 physics teacher trainers. As Gall and Borg (2007) have noted, purposive sampling enables the researcher to identify respondents who are rich in information and allows them to participate in the study. Each category of the sample was approximately 84% of the population and the remaining 16% were used in the pilot study.

RESEARCH INSTRUMENTS

The study used Questionnaire for Physics Student Teachers, Questionnaire for Physics Heads of Subjects, Questionnaire for Physics Teacher Trainers and Document Analysis Guide. The questionnaire method was used as a primary source of gathering of the data and it enabled the researcher collect both quantitative and qualitative.

VALIDITY OF THE INSTRUMENTS

Face validity of the research instruments was determined by incorporating views of experts in the area of study from Maseno University (MSU), School of Education. Content validity of the instruments was determined through piloting of the research instruments and data collected from the pilot study was evaluated in reference to credibility, relevance and scope in answering the research question.

RELIABILITY OF THE INSTRUMENTS

The reliability of the questionnaires was established by computing a test-retest reliability coefficient. This was done after administering the instruments to the same respondents twice with an interval of two weeks (Hinton-Bayre, 2010). Pearson product moment correlation (*r*) was used to determine the correlation coefficients where the *r* values ranged from +0.74 to +0.81. This made the instruments to be judged as reliable for use as the *r* values for the instruments were above the recommended threshold of 0.70 (Brink, 2003

III. RESULTS

Objectives of Physics Teacher Education Programs	Overall Mean Score out of 5
Objective on subject matter knowledge	3.27
Objectives on acquisition of assessment skills	3.52
Objectives on acquisition of communication skills	3.03
Objectives on acquisition of skills in use of resource material	3.74
Objectives on acquisition of skills in use of information technology	2.98

Table 1: Relevance Of Objectives In Physics Teacher Education Programs To Acquisition Of Pedagogic Skill (Physics Student Teachers, N =351)

Improvements to be made on Physics Teacher Education program	Frequency, *f* (%)
Emphasis to be made on 21st century skills	43 (19.1)
Objectives to focus on ethical issues and building of good morals	36 (16.0)

Table 2: Improvements that should be made on Objectives of Physics Teacher Education Programs (Physics Heads of Subject, n =225)

Qualitative data was also scrutinised and one of the suggestions made by physics heads of subjects on improvements that should be made on objectives of physics teacher education was as follow:

HoS 126: "Physics is a practical subject but it is rare to see teaching practice teachers conduct hands on activities with the students so objectives of physics teacher education should look into that."

More data on objectives of secondary school physics was equally sought for through analysis of the Kenya Institute of Curriculum Development (KICD) physics teaching syllabus. It was revealed that objectives of secondary physics of resource material were based on use of inquiry based learning processes. Noticeable were a few class projects mentioned at the end of some topics although with little guidance of how they were to be developed or even assessed. Also, the KICD physics teaching syllabus revealed that there was little mentioned in the objective of secondary school physics on the use of information technology in physics instruction and assessment. Similarly, analysis of the Teachers Performance Appraisal and Development Tool (TPAD) revealed that physics teachers are expected to acquire and demonstrate a sense of honesty and high integrity in all aspects of the profession and life in general and also, physics teachers are required demonstrate understanding of children rights, learner safety and protection measures and equally exhibit strong interpersonal skills.

IV. DISCUSSION

Khan (2014) in outlining the importance of objectives of teacher education emphasised on the need for teacher training to produce professional teachers who have the critical

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knowledge combined with practical skills, competences and commitment required to meet the needs and expectations of stakeholders. Further, objectives of physics teacher education programs should focus more on imparting adequate knowledge of the subject matter and enable student teachers engage more with content in secondary school physics. More importantly, Etkina (2010) has recommended that teachers should be able to balance declarative knowledge with procedural knowledge, expository teaching with inquiry based learning and balance depth of content with breadth of coverage, and therefore, objectives of physics teacher education programs should outline how the balancing can be achieved.

The findings of the current research on the need to emphasise processes of formative assessment in the objectives of physics teacher education programs are similar to those of the Assessment Reform Group (2002) of Cambridge University School of Education. The reform group established that assessment should focus on how students learn, provide constructive guidance about how to improve and more so recognise the full range of learners' activities. The reform group concluded that principles underpinning effective assessment practices needs to be included in the objectives of teacher training programs. Formative assessment yields information that is interpreted in relation to the progress of students towards the goals of a particular section of work, and also, steps that follow formative assessment dependents on achievements and challenges encountered during instruction. It is therefore important that activities that comprise formative assessment are part of the objectives of physics teacher education programs in order guide strategies to be use in physics teacher education programs. Therefore there is need to enhance the competency of physics teachers to enable them conduct and give valid judgement of the achievement of the learners and at the same time, integrate both formative and summative assessment processes in objectives of physics teacher education programs.

In agreement with the foregoing, Brekelmans, Brok, Tartwik, & Wubbels (2005). have emphasised that strong written and oral skills, strong interpersonal skills that include co-teaching, team teaching, guidance and counselling, collaboration alongside problem solving skills are among the key skills employers desire of teachers. Moreover, Gragert (2001) has urged that objectives of teacher education programs to include aspects of global awareness such as the need to learn and work with individuals from diverse cultures, religions, ideologies and lifestyles in an environment of openness and mutual respect, as this will enable student teachers integrate more effectively in the school system.Similar assertions are made by Trilling and Fadel (2009) and the Pacific Policy Research Centre (2010) who identifies some of the 21st century skills for teachers in the global economy as effective communication, strong ethical grounding and high productivity. They further argued that teachers need to articulate thoughts and ideas more clearly, listen effectively, work effectively with diverse teams and be open minded to varying ideas and values. Good communication skills is arguably one of the work related skills employers desire of teachers (Brekelmans *et al*., 2005; Wiema, 2007) and includes verbal communication, non verbal communication, classroom organisation, classroom management and integration in the school system. Etkina (2010) has equally recommended that objectives of physics teacher education programs should include the 21st century knowledge and skills, and focus on development of long-term value system that is pervasive, consistent and predictable.

Resource material in teaching of secondary school physics include objects that are commercially acquired or improvised by the teacher to make abstraction more concrete and practical to the learners (Okwelle, 2014). Also, resource material in physics instruction has been categorised into three broad groups as first, projected and electronic material such as radio, slide, overhead projectors and computer instruction system. The second group comprise of non projected material that include printed or textual, charts and chalkboards while the third category is made up of manipulative material that the learner handles skilfully and expertly to bring the desired changes such as laboratory apparatus and equipment (Okeke & Okeye, 2013). From the findings of the current research it is necessary that objectives of physics teacher education programs on use of resource material are enhanced in order to mitigate the impending challenges that student teachers experience with management of hands-on-activities in physics instruction.

The findings of this research on little focus on use of information technology in secondary school physics instruction are partly similar to those of a study done by Montebon (2015) that aimed to develop objectives for a contextualised student teacher enhancement program in the Philippine's Normal University. Findings of the research done by Montebon indicated that one of the areas in which pre-service teacher required enhancement was in the use of information technology in teaching and evaluation. The study further revealed that the integration of computer assisted instruction in physics classrooms by the student teachers from the Normal University was poor (*MS* = 2.83) and it was recommended that the objectives of physics teacher education programs should seek to enhance acquisition of skills in use of information technology. Hitherto that, according to Zahra and Ali (2014), Information technology is used to enhance learning and it is important that teachers be comfortable using it to ensure that students get its full advantage. It is important that physics teachers are trained on how to plan, create and deliver instruction within a technological setting. Further, Zahra and Ali argued that as much as training in technology more often appears to focus on technological knowledge and skills, it leaves teachers with difficulty in applying it in their students' learning. It is therefore necessary that the interaction between technology, pedagogy and content is outlined in the objectives of physics teacher education programs as means to effective use of information technology in secondary school physics instructions.

V. CONCLUSIONS

OBJECTIVES OF PHYSICS TEACHER EDUCATION PROGRAMS FOR ACQUISITION OF SUBJECT MATTER KNOWLEDGE

- ✓ Emphasis to be placed on content that is relevant to trainees' future work as secondary school physics teachers
- ✓ Optional courses in physics to be offered to allow specialisation
- ✓ Need to integrate project work in development of physics knowledge
- ✓ Address applications of physics knowledge and emerging issues in physics
- ✓ Seek to produce physics teachers who can participate in development of physics knowledge and contribute towards research in physics.

OBJECTIVES OF PHYSICS TEACHER EDUCATION PROGRAMS FOR ACQUISITION OF ASSESSMENT SKILLS

- ✓ Objectives of physics teacher education programs should align the training programs to specific assessment frameworks.
- ✓ Seek to prepare teachers for assessment in secondary school physics with emphasis of the use of project work, laboratory reports and on the use of portfolio analysis.

OBJECTIVES SHOULD FOCUS ON FORMATIVE ASSESSMENT STRATEGIES IN PHYSICS INSTRUCTION

- ✓ Allow the use of a variety of assessment techniques in physics teacher education.
- ✓ Focus on development of assessment items and rubrics necessary in assessment of secondary school physics.

OBJECTIVES OF PHYSICS TEACHER EDUCATION PROGRAMS FOR ACQUISITION OF COMMUNICATION SKILLS

- ✓ Focus on developing trainees understanding of the complexity of teaching physics.
- ✓ To instil professionalism and develop the trainees ability to work in a collaborative environment.
- ✓ Instil skills and attitude necessary to manage learners from varied religious, social and cultural backgrounds, and also meet instructional needs of students with varied learning abilities.
- ✓ Inculcate 21st century skills and processes necessary for effective management secondary school physics curriculum and physics instruction.
- ✓ Focus on developing teachers who are of high moral standing, high integrity and of good problem solving abilities.

OBJECTIVES OF PHYSICS TEACHER EDUCATION PROGRAMS FOR ACQUISITION SKILLS IN USE OF RESOURCE MATERIAL

- ✓ Align programs to use of resource materials in delivery of physics content.
- ✓ Aim to enhance knowledge and skills in designing and use of resource material especially apparatus and equipment to facilitate content delivery at all level of secondary school physics syllabus
- ✓ Seek to equip trainees with knowledge necessary for effective management of resources in physics instruction.
- ✓ Inculcate skills in construction of scientific devises and also in improvisation of common laboratory apparatus.
- ✓ Emphasis the use of inquiry based learning techniques especially the use of project work and experimentation.

OBJECTIVES OF PHYSICS TEACHER EDUCATION PROGRAMS FOR ACQUISITION OF SKILLS IN USE OF INFORMATION TECHNOLOGY

- ✓ Align the training program to use of information technology in delivery of subject matter knowledge with emphasis on the use of computer software, simulations, projected content and web technologies.
- ✓ Training should enable teachers integrate information technology at all levels of content delivery in secondary school physics instruction.
- ✓ Focus on preparing teachers to use information technology effectively in assessment of secondary school physics.

VI. IMPLICATIONS

The framework outlined in the current study would enable public universities in Kenya to enhance the objectives of physics teacher education programs for acquisition of pedagogic skills by the student teachers.

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