Methods to be Emphasised in Physics Teacher Education for Acquisition of Pedagogic Skills Needed for Inclusive Instruction

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Abstract:- **A variety of teaching methods are used in teacher education in public universities and they are discussed in relation pedagogy in secondary schools. Existing literature indicates a high likelihood that teachers will replicate these teaching methods in secondary school instruction; yet little is known about the methods that should be emphasised for acquisition of pedagogic skills by physics student teachers. As much as calls are made for more effective secondary school physics instruction, it is critical that such instruction use methods that address varied learning needs. In this study, questionnaires and document analysis guide were used to collect quantitative data which was them analysed by use of frequencies and percentages and also, qualitative data which was analysed by creating thematic categories and reported as verbatim excerpts. The study revealed that methods of teaching that should be emphasised in physics teacher education for acquisition of pedagogic skills are interactive lecture, experimentation, use of information technology, project work and use of models that cater for students with learning disabilities. The findings may be useful to public universities in Kenya to enhance the use of teaching methods that should be emphasised for acquisition of pedagogic skills needed for inclusive secondary school physics instruction.**

Key words: **- Inclusive instruction, Methods of teaching, Pedagogic skills, Public Universities, Learning disabilities.**

I. INTRODUCTION

Inclusive instruction involves the development and design of activities for teaching and learning in ways such that all students learn and participate equally in mainstream classrooms irrespective of their varied learning needs [18]. In the current era of increasing awareness of inclusion practices in science classrooms as a step towards achieving the objective of general education for all, it is necessary that physics teachers plan and support every student to learn. The role of universities in training physics teachers for inclusive instruction cannot be overemphasised as university 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. Reference [30] shows 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, [9] 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 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. Moreover, the [29] has urged that training should enable teachers to engage with students, use teaching strategies and resource material that are appropriate to their needs and that can promote learning.

In discussing how to strengthen the position of teacher education in changing times, [13] 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. Such teachers are able to stir up their students' mind other than stamp the teacher's mind upon students, enable students to see through their own eyes rather than coax students to see through the teachers' eyes and also inspire curiosity in students to make students want to go out into the world and search for truth other than give students definite amount of knowledge [11]. Teachers should understand the learning needs of students with special educational needs in mainstream classrooms such as impairments in perceiving, phonological processing, memory, language processing, planning, vision, attention and decision making [18]. And also, avoid prejudices around such students with learning disabilities. Basing on the foregoing, the success of secondary education and depends on the training of the teachers as done largely by the universities [17].

In Kenya, the Europe-Africa Quality Connect evaluation report has raised concerns over the training programs of physics teachers as the graduates lack the capacity to impact positively on learners' enrolment in physics. A follow up situational analysis report revealed that the practice of students-centred teaching and improvisation has been inadequately entrenched in physics instruction [7]. Similarly, [1] noted that employers feel that graduates from the school system do not have the soft skills that are crucial for moulding productive human resource. This is especially

for secondary school physics whose knowledge and processes form the foundation for majority of the careers. Poor approaches to teaching secondary school physics is blamed on the training process of physics teachers at the universities where graduates fail to implement relevant strategies that are necessary to facilitate instruction [27]. Moreover, [1] have urged that a necessary teacher competency especially in science is to have an understanding of the learning process and that teachers are expected to create learning environments in which students can master concepts. Methods of teaching in teacher education should therefore enable physics teachers cater for diverse needs of students in the classrooms. And as [18] have observed, the ultimate task of enabling inclusion of students with learning disabilities in physics seems to fall mainly in the hands of inexperience teachers who lack deeper understanding and knowledge of the characteristic of diverse learners.

Reference [3] indicate that the only element of teacher preparation that can predict how new teachers will actually teach is the experience with instruction in the first year of their teaching. The inadequacies exhibited by the physics teachers are therefore associated with the weak links between the pre-service physics teacher training process and the requirements for effective secondary school physics instruction [21]. Furthermore, the Teacher Education in Sub-Saharan Africa (TESSA) formative report raised concerns on the missing guidelines on methods of teaching to be utilised during the training process to address diverse needs in classrooms. Despite the concerns raised by the previous reports and researchers [7], [27], teacher education in public universities has only witnessed improvements on the scope of content and the goals of the programs evaluated in reference to the modes of delivery, clarity and the extent to which they promote students' engagement [14]. Moreover, universities have largely continued to use the same methods of teaching adopted from the university of East Africa in 1970s. This is at the backdrop of low enrolment of approximately 25% of the total candidature annually in physics for the last 10 years in the Kenya Certificate of Secondary Education (KCSE) physics examinations.

Research Questions

1. What are the methods of teaching that should be emphasised in physics teacher education for acquisition of pedagogic skills needed for inclusive instruction?
2. What improvements should be made on methods of teaching in physics teacher education for acquisition of pedagogic skills needed for inclusive instruction?

II. METHODS EMPLOYED IN THE STUDY

1. Research Design

The design of the study was descriptive survey because it determines and reports the way things are and attempts to describe such things as intents, values, behaviour and characteristics possessed by individuals and groups [15]. Furthermore, [17] recommends the foregoing approach since it gives room for interrogation of number of research questions thereby providing a holistic interpretation of a process.

2. 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 [14]. Moreover, low enrolment in secondary school physics at KCSE level has also been witnessed in the same period of time.

3. Participants

The study population comprised of 420 physics student teachers who were undertaking teaching practice in the year 2016 from 6 public universities in Kenya. As [28] have argued, students on field attachment are better placed to give an account of the training because they are able to interpret it in the context of the demands of the job environment. Also, the study population included 277 physics heads of subject in secondary schools where the student teachers were undertaking their teaching practice and 130 physics teacher trainers from public Universities, specifically drawn from the departments of pedagogy and content equally took part in the study.

4. Sample Size and Sampling Techniques

Purposive sampling was used in the study in which the total population of 351 physics teacher, 225 physics heads of subject and 108 physics teacher trainers were selected to participate in the study. This is because [10] have noted that the use of total population in purposive sampling is a technique where the entire population that meets the criteria of specific skills set or experience desired are included in the study.

5. Instruments for Data Collection

The study used Questionnaire for Physics Student Teachers, Questionnaire for Secondary School 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 data. Documentary analysis focussed on documents that were deemed relevant in the current study.

6. Validity and reliability of the Instruments

Face validity of the instruments was determined before the commencement of the actual research through improvement on each of the items on the data collecting instruments by incorporating views of experts in the area of study from Maseno University School of Education. Also, 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 to the research question. 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 [15]. The respondents included 67 physics student teachers from one of the universities, 38 physics heads of subjects in secondary schools where the student teachers undertook their teaching practice and 22 physics teacher trainers from the university selected for piloting. The sample for piloting formed approximately 16% which is above the 10% minimum advanced by [10]. 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 instruments were above the recommended threshold of 0.70 by [15].

III. RESULTS, DISCUSSIONS AND CONCLUSION

1. Results

Table I: Methods of teaching that should be emphasised in Physics Teacher Education for Acquisition of Pedagogic Skills needed for Inclusive Instruction (Physics Student Teachers, *n* = 351; Physics Heads of Subjects, *n* = 225)

No	Methods of Teaching	*f*	Percent (%)
1	Interactive lecture	360	62.5
2	Experimentation	335	58.2
3	Use of IT in teaching	330	57.3
4	Project work	294	51.0
5	Use of models to cater for students with learning disabilities	235	40.8
6	Peer teaching	193	33.5
7	Students demonstration	154	26.7
8	Use of charts and Tables	141	24.5
9	Lecture method	62	10.8
10	Teacher demonstration	61	10.6

Table II: Gaps in Methods of Teaching in Physics Teacher Education in Relation to Acquisition of Pedagogic Skills needed for Inclusive Instruction (Physics Student Teachers, *n* = 351)

No.	Gaps in Methods of Teaching in Training Programs	Frequency (*f*)	Percent (%)
1	Over use of lecture method	74	21.1
2	Challenges with assisting slow learners	51	14.5
3	Challenges with handling delinquent students	48	13.7

Table III: Improvements that should be made on Methods of Teaching in Physics Teacher Education for Acquisition of Pedagogic Skills needed for Inclusive Instruction (Physics Teacher Trainers, *n* = 108)

No.	Suggestions for improvement	Frequency (*f*)	Percent (%)
1	Need to enhance student centred approaches	52	48.1
2	Need to reinforce formative assessment	24	22.2
3	Need to integrate technology in lesson presentation	41	38.0

Qualitative data was also scrutinised and for following remarks on improvements that should be made on methods of teaching in physics teacher education were noted:

Student teacher 81: "We should be allowed to ask many questions. We always follow the procedures given in practicals so as to clear the courses on time"

Student teacher 228: "It is important that I am taught how to mark practical work of learners."

A critical analysis of documentary evidence was also conducted and it was noted no guidelines on the use of methods of teaching was specified in both the Kenya Institute of Curriculum Development (KICD) physics teaching syllabus, and the Kenya National Examination Council (KNEC) syllabus. Rather, teaching approaches are listed at the end of the syllabus layout to be used at the discretion of the teachers.

2. Discussions

The finding of the current study are similar to those of a study conducted by [22] that aimed at developing science education pedagogies in Selangor Malaysia in which simulations, demonstrations, experiments, projects work and field studies were used by trainee teachers as teaching strategies. It was revealed that inquiry based strategies were able to stimulate excitement among students and were highly recommended in physics classroom. Moreover, [22] have noted that prior to real teaching experiences, the pre-service teachers should be exposed to inquiry- based methods at college level. This is because pre-service teachers who are taught using inquiry based methods are more likely to develop hands on activities in their teaching [29]. More so, such teachers are more likely to link science experiments to everyday life. Hands on activities in physics classrooms can be enhanced when interactive lecture technique, experimentation and use of project work are emphasise in physics teacher education programs. In the studies conducted by [6], [26] and [9], it was concluded that student-centred teaching is yet to be made a habit by new teachers. Further, many teachers experience difficulty implementing it despite being taught of their importance. Similar findings were made in a study conducted

by [16] that there was need to shift education from the approaches that focus on transmission of content to those that address the needs of students and also develop cognitive and social skills of the students. Moreover, [9] recommends that physics teacher preparation should enable pre-service teachers to learn content through the pedagogy that the teachers are to use in secondary instructing

On the other hand the findings of the current research on interactive lecture being the method of teaching that should be emphasised in physics teacher education differs from that of a study by [22]who established that experimentation is key in physics instruction. In the current study, the over use of lecture method identified in physics teacher education may have created a need to improve and enrich lecture method whenever it is used. Moreover, student teachers are conscious of the role of inquiry based teaching strategies such as experimentation, project work, use of models to cater for students with learning disabilities and also, the use of information technology in physics teacher education. Experiments encourage students to learn physics by providing students with opportunities to manipulate objects, test hypothesis and collaboratively work together. While supporting the central role of experimentation in physics classrooms [8] argued that the use of a blended combination of physical manipulative and visual manipulative processes enhanced student conceptual understanding in the major domains of physics knowledge.

In support of the need to intensify use of experimentation in teacher training and in secondary school physics instruction, [21] advocated for the use of instructional models and methods that promote the understanding of physics, anchored on innovation and use of technology such as active learning, discussion methods, inquiry based learning, demonstrations, collaborative learning, role play and use of project work. Similarly, [30] in developing the code of professional conduct for teaching, advocated for support structures for teachers in inclusion of students with varied learning needs in physics classroom. Similar recommendations are made by [23] that physics teachers should be made aware of the need for inclusion in science classroom, understand criteria for creating inclusive environments, use of interactive presentations and teachers should also be guided on the choice of various accessible experiments to be used. Moreover, [18] advocates for teacher education to draw on the universal design to learning model that emphasis use of multiply representation, engagement and assessment to enrich physics instruction for diverse learning.

The policy framework for education for all Kenyans by 2015 envisage rising 100% transition rate from primary school to secondary schools. The desire to provide education for all Kenyans may see increase in numbers of students with learning disabilities in the mainstream physics classrooms. As Rich and Brigham (2006) have observed that widespread inclusion practices will always lead to a large percentage of students with documented learning disabilities getting to science classrooms. These students may be deficient in certain aspects of learning such as organisation, reading, writing and memory. However, [18] have further recommended that regardless of race, gender or disability, students should have an opportunity to learn and understand the essential content in physics. This can only be made possible when teachers are conscious to the existence of students with learning disabilities and understand the need to utilise diverse strategies that offer multiply representation of physics content. At Illinois state university, an increase in the number of students with documented learning disabilities led to the review of methods of teaching in science teacher education. The review equally purposed to equip student teachers with knowledge and skills in the school laws, characterize appropriate safely procedures, explain issues related to diversity, inclusion of disabled and gifted students and also, to distinguish between ethical and unethical behaviour. Physics education program in Kenyan public universities should equally seek to equip trainees with methods of teaching that address needs of students with learning disabilities. Further, integration of such strategies in delivery of the physics content requires to be focussed on during the training process of physics teachers.

In a separate research conducted by [2], it was established that Information Technology equipment such as the computers are largely used as objects in computer lessons in many schools. Furthermore, teachers who have undertaken courses in software packages are unable to integrate or meaningfully insert the knowledge in their daily teaching. Concerns that had been earlier on raised by [19] that pre-service teachers learn about teaching outside both the subject matter and technology hence technology remains unconnected with the subject matter. This calls for a shift in teacher education programs towards embracing and developing the desired Technological Pedagogical Content Knowledge (TPCK). As [19] has equally urged that TPCK should include the use of knowledge in the curriculum and curriculum material that integrates technology with learning of the subject matter. Further, [31] has reported that teacher education may either assume a leadership role in the transformation of education, or be left behind in the swirl of rapid technological change. Most importantly, web technologies and collaborative computer based learning environments can be embraced in physics teacher education programs and [5] have noted that web technologies enable users to produce and share content in new ways and in real time. Web technologies also enable users to become creative and engage in practices that challenge traditional relationships between teachers and students, specifically in providing information and content for learning [25]. While [32] have indicated that computer based learning environments can work to stimulate student learning, enhance the process of inquiry and can impact desirably on effective problem solving, critical thinking and information handling abilities. Benefits of computer based learning cannot be underestimated and therefore, it is necessary that physics teacher education

programs integrate relevant web technologies and computer based learning models to enable student teacher practice use similar models in secondary school physics.

Teacher trainees need opportunities to practice effective technology integration strategies in methods courses and field experiences [32]. Technology training directly affects pre-service teachers' self-efficacy and value beliefs, which in turn influence their student –centred technology use. Despite the abstract nature of physics, its teaching is to bring about scientific thinking in students, a mindset that requires students to test out through experimentation. Through the use of information technology, the teaching and learning of physics is interesting and it offers a great variety of opportunities for modelling concepts and processes. Also, information technology provides a bridge between students' prior knowledge and learning of new physical concepts and it helps students develop scientific understanding [25]. Further, although computers can be used for many purposes, the most prevalent use of computers in schools is of word processing that is made up of Microsoft word; slide show programs such as Microsoft power point; spread sheet programs such as Microsoft excel and web page programs that includes Microsoft front page. Therefore, the use of word processing programs should be included in physics teacher education programs alongside the use of other appropriate computer software in delivery of physics content. And as [24] have asserted, the effectiveness of computer technology depends not only on the way in which computers and software are used, but also on the interaction of the students as they learn content with use of technology.

3. Conclusion

Methods of teaching that should be emphasised in physics teacher education for acquisition of pedagogic skills needed for inclusive instruction are; Interactive lecture, experimentation, use of Information Technology in teaching, use of Project work and the use of models that cater for students with learning disabilities. Moreover, improvements that should be made on methods of teaching in physics teacher education for acquisition of pedagogic skills for inclusive instruction are to enhance use of student centred approaches alongside associated assessment strategies and integrate use of information technology in lesson presentation.

4. Implication

Public universities in Kenya to enhance the use of methods of teaching that should be emphasised for acquisition of pedagogic skills needed for inclusive instruction in secondary school physics.

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