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Realism and Worries in Physics Bridging Programs in Kenyan Universities

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ABSTRACT

Physics is commonly related to basis of science and technological development. Kenyan Fundamental Education Curriculum identifies physics as a mandatory subject at forms one and two in secondary schools. It is also as a vital element for an entry to physics, engineering and technological related programs in the middle colleges and Higher Leaning Institutions. Scientist, technologists, and engineers are considered to be role models in their professions to the subsequent age band of scientists, therefore they are required to exhibit advanced ability in physics. Secondary schools' graduates with C+ (plus) in physics at Kenya Certificate of Secondary Education (KCSE), qualifies for university right entry into most science and technology associated programs. Such ceiling qualifications have blocked many of young Kenyans who are interested in such programs. The need for pre-university bridging in physics is high among the KCSE graduates who are willing to join physics related programs. These are openings which Kenyan universities are hunting for. Currently one of the main concerns to Kenyan Commission for University Education (CUE) is commercialization of university education which has been identified to be diluting higher education. Most universities insist in pre-university physics bridging programs for anyone who had attained grades below C+ in physics. Each and every university has its own entry requirement for pre-university physics bridging. Different universities are also at variance in content to be covered and learning durations. The secondary school physics content and that of pre-university bridging are not equivalent quantitatively. This paper describes on intellectual delivery of physics bridging programs in relation to entry prerequisite, content descriptions and period for the program completions among public universities. Eight (8) out of 22 public chattered universities were randomly sampled. Questionnaires, Interviews schedules and document analysis were used to collect data. Quantitative and qualitative approaches were taken on and results analysis done using content and narrative analysis. Results disclosed wide inconsistencies in the organization of university physics bridging programs ranging from entry requirements, program contents and duration.

I. Introduction

Most of science courses take up basic knowledge from subjects that the individual student is assumed to have studied before beginning the course. At the universities, the knowledge cannot be assumed because most students may find it difficult to manage the course work which they have no or little knowledge about (Eisenman, 2009). Such higher learning institutions recommend for a bridging course before an individual begins a course or a program and you have the minimum required knowledge required for it. This also refreshes the learner's mind when he/she is to return back for given further studies (Gutierrez, 2007).

In some universities such as university of Sydney provides scholarships for a number of quality base bridging course to the students who will enroll at the university for an undergraduate program. This is done by looking at certain criteria giving first priority to students with medical disabilities and those who come from remote/rural areas (University of Sydney, 2016).

II. Background of the Study

In Kenya secondary physics syllabus should be covered within four years of secondary school study. The content is distributed from one to four in a hierarchical manner where it begins from known to unknown. Both the physics teacher and the learner must attend all the lesions as stipulated in the syllabus. Duration of each lesson is 40 minutes. Both forms one and two classes must have at least four lessons per week while both forms 3 and 4 must have at least 5 lessons per week (KNEC syllabus, 2013).

There are mechanisms put in place by the Ministry of Education (MoE), Teachers Service Commission (TSC), School Board of Management (BOM) and other stakeholders to closely monitor lesson attendance and timely syllabus completion. Most of the physics contents are supposed to be taught and learnt by practical work (Jansen et, al. 2016). Most of the Physics Laboratories in some these secondary schools are well equipped with basic physics practical apparatus that can support individual and smaller students group work.

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The students are supposed to be in school for a given time in a day within which the students can have time with their teacher for consultations for better understandings and clarity of a given concept where necessary (Suhre et. al, 2013). After completion of the syllabus within the duration stated under closer supervisions of high school physics teachers, exams are set and administered by Kenya National Examination Council (KNEC) Officials. It is the KNEC to declare (from the national and final examination results) the mean grade and grade per subject of the learner and this is what is used to select those who qualify to join universities.

The physics bridging program is encouraged for those who want to join the university and are freshly interested in taking physics programs. Physics is a foundation of science and technological advancement. Scientist, technologists, and engineers are considered to be economic drivers in their professions; as a result they are expected to demonstrate progressive innovation ability in physics (Jansen et. al, 2010). At least grade C+ (plus) at KCSE (whose attainment has not been easy for most students) qualifies an individual for university right admission into most science and technology related university programs. This makes them seek for such programs but first through pre-university physics bridging program in the higher learning institution in which he wants to join (Kanrinus et. al, 2014). The entry qualifications to the physics bridging programs vary from one university to another (from grade D- to grade C-) in physics at Kenya Certificate of Secondary Education.

III. Statement of the Problem

Majority of O-level students are constrained within limited carriers and training programs due to their O-level low achievements in physics. Scientist, technologists, and engineers are thought about to be good examples in their occupations to the young scientists, as a result they are expected to show signs of progress talent in physics. Generally Grade C+ (plus) in physics at Kenya Certificate of Secondary Education (KCSE) is considered to be the least qualification for university direct entry into most physics and technology related programs. This has frustrated the morals of most secondary school graduates and has compelled them to less desirable alternatives. Such upper limits of qualifications have barred many of young scientists who are attracted to such trainings. The call for pre-university bridging in physics is towering along with form four graduates. Because of these opportunities most universities in Kenya are in the run to admit the students. At present to Kenyan Commission for University Education (CUE) is worried about commercialization of university education as one of the threats to water down higher education in Kenya (Brouwer et. al, 2016). The universities offering the program have their different specific admission requirements for pre-university physics bridging. There are variances in outlined content descriptions and learning durations. The Kenya National Examination Council's (KNEC) physics syllabus content and that of pre-university bridging are not equivalent quantitatively. Therefore this study found out the mentioned variations among the Kenyan universities.

IV. Objectives of the Study

i) To compare the Kenyan Secondary School Physics Syllabus with Pre-University Physics Bridging Content.

ii)To identify the variation of entry qualifications to the pre university physics bridging programs in Kenyan Universities

iii) To way Kenyan Secondary School physics Syllabus Coverage duration against Per university Physics bridging Program Coverage durations among Kenyan Universities

V. Research Design

The study applied descriptive survey design which could help the researcher to identify attitude, opinion or behavior of group of respondents on the subject matter. It also allowed the researcher to measure the significance of the results on the overall population (Leu & Byren 2015).

VI. Population, Sampling and Sample Size

A secondary school KNEC physics syllabus was purposively picked from one of the public secondary schools. The study used a sample of 11 out of 36 chartered Kenyan Universities which were identified to be offering pre-university physics bridging programs. The university were sampled by simple random sampling technique. Eleven chairpersons of physics department, 11 university registrars academic affairs, 11 deans of relevant schools/faculties and 11 directors of schools of open learning and continuing Education (SOLACE) were purposively sampled out for the study.

VII. Methodology

The content analysis was done where key items were; the number of topics to be covered, number of lessons allocated for each topic and sub-topic and total number of hours required to finish the syllabus. Face to face interview was administered to both dean faculties/schools and directors SOLACE in their respective offices. The questionnaires were administered to the CODs – Departments of Physics in their respective offices. Document analysis was done in the physics departmental offices

VIII. Results and Discussion

The result obtained from KNEC secondary physics syllabus analysis was recorded in table 1.1. The study identified that there are 41 physics topics to be covered by high school students right from form one to form four. Form four was identified to have 11 topics while forms one, two and three had 10 topics each. Each topic had a recommended number of lessons. The total number of lessons that can enable learners to fully complete the syllabus was found to be 589 each of 40 minutes making a total of 23,560 minutes translating to 392 hours and 40 minutes as can be seen in table 1.1.

The questionnaires, document analysis and interview results indicated that before KCSE graduates join a university to peruse a physics related programs within a maximum of four months where the last two weeks are for the end semester exams. In each week the courses are taught 3 hours translating to a maximum of 42 hours. The course description contains at least 9 physics topics compared to the high school physics syllabus. From document analysis most universities in Kenya commonly provide topics such as Measurements and Units, Linear Motions, Vectors, Force, Work, Energy, Dynamics, Newton's Laws on Motion, Electricity and Magnetism. The number of topics covered at some of the Universities for the Physics bridging was found to be too low (about 24.4%).

For a learner to succeed in physics he needs to be organized, arrange his/her learning materials; lesson notes, stationary items well organized and easily accessible (Wilson et. al, 2016). The learner should apply and follow the subject (topical) objectives while reading. At the same time he/she should be subjected to more practical work.

The study also found out that Physics KCSE qualification entry grade into pre-university physics bridging entry is not uniform for all the universities.

Some universities admits those grade D-(minus), some admits those with grade D (plain), some admits grade D+ (plus) while others admits those with grade C-(minus) as shown in table 1.2. The duration for the study at the university was found to vary with each institution, some universities recommend for three months while some universities recommend for 8 months academic year.

Table 1.1. Kenyan Secondary Physics Syllabus, Topics, Number of Lessons and Contact hours.

Topics	Number of Lessons	Number of Contact Minute
Introduction to Physics and Measurements 1	16	640
Force and Pressure	40	1600
Particulate Nature of Matter	12	480
Thermal Expansion and Heat Transfer	26	1040
Rectilinear Propagation of Light and Reflection at Plane Surface	16	640
Electrostatics I	12	480
Cells and Simple Circuits	12	480
Magnetism and Measurements II	28	1120
Turning Effect of Force and Equilibrium Centre of Gravity	22	880
Reflection at Curved Surfaces	16	640
Magnetic Effect of Electric Current	18	720
Hooke's Law	8	320
Waves and Sound	26	1040
Fluid Flow	14	560
Linear Motion	20	800
Refraction of Light	20	800
Newton's Laws of Motion	15	600
Work, Energy, Power and Machines	20	800
Current Electricity	20	800
Waves II	20	800
Electrostatics II	15	600
Heating Effect of Electric Current and Quantity of Heat	30	1200
Gas Laws	15	600
Thin Lenses	20	800
Uniform Circular Motion	10	400
Floating and Sinking	15	600
Electromagnetic Spectrum	15	600
Electromagnetic Induction and Mains Electricity	30	1200
Cathode Rays and Cathode Ray Tube	10	400
X-rays	8	320
Photoelectric Effect and Radioactivity	30	1200
Electronics	10	400
Total	589	23560
		392 hours 40 minutes

Source: Knec Syllabus, 2014.

Table 1.2. Bridging Subject Entry Grade and Studying durations.

Universities	Bridging Subject Entry Grade	Studying Duration
A	D+	3 Months
B	D	3 Months
C	C-	1 year
D	D+	3 Months
E	C	1 Year
F	D+	3 Months
G	D+	3 Months
H	D+	3 Months
I	D-	1 Year
J	D	4 Months
K	D+	1 Year

IX. Discussion of the Results.

KCSE Syllabus contains 41 topics and the content seems to be more detailed compared to that of bridging physics programs from different universities. The content is taught and learnt under close supervisions by physics teachers, the directors of study, deputy principals and the school principals. This channel of supervisions at times forces the learner to work hard with a lot of self discipline. Learners also learn through practical work, they participate in physics contests; they have field works among other mechanisms that are put in place to promote performance. Internal regular formative evaluations are always done to monitor the learner's progress that can be used to employ necessary early corrective mechanisms (Schmidt et. al, 2015). Some of these formative evaluation tests are joint examinations. This exposes students to varieties of test items from variety of examiners. The schools also make efforts to avail many past joint examination papers; this enables them to dig dipper about physics concepts (Rubie, 2015). At the end of the syllabus students are subjected to national exams (Kenya Certificate of Secondary Education). This makes both teachers and learners to work hard towards achieving the KNEC's objectives because the test items may not be exactly known. Through this the gain more physics knowledge and skills. After this exam the result is used to admit students into physics related programs. If the learner does not attain grade C+ in physics, he/she must undergo pre-university physics bridging program before joining physics based programs.

The content of physics covered at the university contains fewer topics compared to that of KNEC's syllabus. The KNEC syllabus is arranged hierarchically from simple to hardest, from known to unknown. A spiral reaching method is applied in secondary schools where as at the university the approach is linear.

Then every university takes the opportunity to admit the students for physics related program. Direct entry must have scored grade C+ and above (St. John, 2006). Those who fail to get the minimum grade and are interested in perusing physics related programs at the higher learning institution must undertake pre-university physics bridging program. The entry subject grade to the bridging program is not uniform yet the Commission for University Education (CUE) specifies that an individual must have attained grade C (plain) at KCSE in the subject to be bridged.

Entry behavior determines future academic performance of the learner (Strayhorn, 2011). These include pre-requisite knowledge skills and the attitude that the learner already posses that are relevant to the learning tasks or subject matter that may require the learner to demonstrate before beginning a given module. Weak academic background translates to weak future academic achievement in the same subject. Most students who are admitted to a program with low achievement background in the given field tend to perform poorly in that specific area (Wilpole, et. al, 2008). So if a student already has a weak grade in physics, and this was after completing KNEC syllabus, there is a possibility of the student not doing well in the bridging program. This because the selected bridging subjects are not selected based on which topics the students' previous perform at KCSE.

X. Conclusion

1. Secondary physics syllabus was identified to be wider than that of pre-university physics bridging program. Despite all the efforts put in place to ensure that the syllabus is completed in secondary schools, some students some students get the grades that need bridging programs. Some of them can only manage to attain 2 points (D-) in physics after syllabus completion. The pre-university physics syllabus is shorter and it may not be easy to attain even 5 more points ahead of the previous 2 to attain 7; C+ (plus). Therefore the secondary school syllabus contents should be harmonized with that of pre-university physics program' s content so that the bridging process can actually bridge the gap per topic.
2. From the study it was found out that there were variations in the qualifications to pre-university physics bridging programs at KCSE physics results. Most Kenyan universities were identified not to have adhered standard qualifications set by Commission of University Education (CUE). Bridging program should take an individual from one grade to the immediate grade above it. Some universities were found to have been admitting those KCSE graduates with as low as grade D- (minus). This means that a student admitted with grade D- should move to grade D (plain) after the program; this is still below recommended C (plain).
3. In this study, it was noted that the syllabus coverage duration in secondary school has more time compared to that content coverage duration for the pre-university physics. The KCSE physics syllabus require at least 392 hours and 40 minutes while that of pre-university physics bridging program has been taking at most 72 hours (8 Months) in some universities while in other universities it was found that they finish the program within 40 hours (3 Months). This means that if the content could be exactly that of high school then the duration should be harmonized.

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