Deficiencies of Competency Based Education and Training in Higher Education Institutions in Kenya

Cleophas Ondieki[1]*, **Prof. Gerald N. Kimani[2], Prof. Edward K. Tanui[3]**
[1]PhD. Candidate, Maasai Mara University, Kenya
[2]School of Education, University of Nairobi, Kenya
[3]School of Education, Maasai Mara University, Kenya

Abstract: Competency Based Education and Training (CBET) is a poorly understood concept in Kenya's institutions of higher education. The matter is one of serious concern since a fast-emerging trend in global academic circles is the implementation of this curriculum platform. The basic education sector of Kenya had CBET launched in Grades One, Two, and Three in 2018. The activity signified the change from the outgoing 8-4-4 setup to the new 2-6-3-3 system of education. Despite the landmark event there appears to be minimal endeavors towards adopting CBET in universities in Kenya. A summary of CBET's development and spread was provided. An investigation pertaining to generic attributes of the educational platform was among objectives of a tracer study which focused on the University of Nairobi's alumni of the 2007 to 2011 period who underwent the Bachelor of Science in Electrical and Electronic Engineering curriculum. Using a case study design a sample of 265 respondents was accessed from a population of 417 graduates. Purposely sampled employers were also involved. Those targeted were 30 and of these 28 actively participated in the study. In addition 5 out of 48 academic and technical staff of Electrical and Information Engineering Department answered questionnaires. Questionnaires were self-administered to the respondents at their place of work. For respondents who were distantly placed, questionnaires were emailed followed with telephone discussions. Alumni showed an unsatisfactory comprehension of CBET in core aspects of engineering. They, however, indicated awareness of generic attributes essential for job performance. The challenge was a knowledge and skills deficiency in these since most of the attributes were excluded from the curriculum. A major significance of the study was therefore the need for a CBET policy at the University. This will improve graduates' employability and also as a preparation for the onset of the new education framework in higher institutions of learning.

Keywords: Competency-based education and training; tracer study; engineering curriculum; education framework; graduates' employability, 2-6-3-3 educational system, University of Nairobi.

INTRODUCTION

A competency based curriculum, according to the International Bureau of Education 2017, is one that emphasizes the complex outcomes of a learning process rather than mainly focusing on what learners are expected to learn about in terms of traditionally-defined subject content. The current paper is anchored on a research of Bachelor of Science in Electrical and Electronic Engineering graduates of the University of Nairobi who completed their studies between 2007 and 2011.

Objective of the Study

One of objectives which guided the study was:

To investigate the generic competencies required at work by the Bachelor of Science in Electrical and Electronic Engineering graduates of the University of Nairobi.

LITERATURE REVIEW

Competency Based Education originated in the USA due to perceptions that educational standards were declining leading to social, economic and political consequences. When on October 4, 1957, the former Soviet Union succeeded in launching the first artificial satellite, known as 'Sputnik I', into orbit around the earth, America was left deeply shocked [1]. It was considered that an unsatisfactory educational system had contributed to poor technology in comparison to that of the Soviet Union. Curriculum reforms and increased federal capitation for education intensified. Progress in the area of primary and vocational teacher education, besides vocational education itself,

introduced the first official application of Competence-Based Education (CBE) in 1967 in the USA [2]. Its qualities included specified competences to be learned, the modulation of instruction, the use of feedback, and the personalization of instruction [3]. The popularity of CBE characteristics spread to higher educational institutions in the USA from the 1970s. Western Governors University is the most prominent having begun accepting students in 1999. Its curriculum includes a fully online CBE system geared primarily but not exclusively to working adults [4].

From the USA the CBE concept spread to some countries in Europe [5] where it was also known as Competency-Based Training (CBT). Recessionary economic conditions and high rate of unemployment particularly among the youth necessitated educational reforms in which the curriculum was considered theory-based [6]. Germany was among countries which accepted competency-based ideas for vocational training in the early 1970s [7]. A decade later the need to address unemployment and prepare the youth for employment made the potential of CBE for technical education acceptable in the United Kingdom [8, 2, 9]. Australia is another country whose introduction of CBET was also associated with low level skills of the workforce [10].

Roots of Ethiopia's CBT stretch back to the 1940s when four technical institutes were opened in Addis Ababa [11]. These and others which followed were providers of technical, vocational, education and training (TVET) disciplines to meet the middle level human power demand of industry service sector and commercial agriculture. In South Africa in 1995 an indigenization of CBT led to the creation of the National Qualifications Framework [12]. The first three polytechnics in Ghana were established in 1963 to contribute to the development of human resources. Subsequent evaluations revealed skills deficiencies leading to the introduction of an industry-driven Competency-Based Training [6]. Namibia's National Qualifications Authority Act of 1996 was a formal acceptance of Competency-Based Education and Training in the country. The economic development target of the CBET model was a big factor in that country's paradigm shift [5]. The poor quality and effectiveness of the educational system in Mozambique made the development and implementation of a competence-based curriculum in the Faculty of Education, Eduardo Mondlane University, imperative as an educational intervention [13]. Subsequent evaluation showed that improvements were being achieved in the training of competent professionals [14].

Kenya, Uganda, Tanzania, Rwanda and Burundi are members of the East African Community which upon establishment in 2000 began encouraging partners to reform and unify the educational system. There was need to coordinate their human resource

development policies and programmes besides encouraging and supporting the mobility of students, teachers and workers within the region. This culminated in the blueprint *A Framework on Harmonization of Curricula*, *Structure and Examinations in the East African Community* [15]. Thereafter, and in quick succession, curricula were simultaneously published for primary education and secondary teacher education-diploma [16, 17]. Both anchored on the theme of competence which was explained further through descriptors that detailed learning outcomes. The document, a qualifications framework, covered the entire educational spectrum [18]. Competences for bachelors' degree included skills for communications and critical thinking. Direction from the East African Community and other considerations positively impacted on member states to incorporate competency in national curricula.

A Competence-Based Curriculum was introduced in Rwanda to cover preprimary, primary and secondary levels of education [19]. The action was motivated by a quest to build a knowledge-based economy, with particular emphasis on science and technology as an engine of development. Tanzania has had CBET in primary and secondary schools from the early 2000s [20]. Several higher education institutions also offer CBET targeting courses in pedagogy. Those prominent are the Open University of Tanzania [21], the University of Dar es Salaam [22] and the Sokoine University of Agriculture [23]. A few universities in Uganda are also CBET compliant in some of their courses. For instance, Makerere University is at the centre of a consortium approach to competency-based undergraduate medical education [24]. Its partners in Uganda are: the Kampala International University; Mbarara University of Science and Technology; Gulu; and, the African Centre for Global Health and Social Transformation. The Johns Hopkins University, Baltimore, USA, is in the consortium, too.

Both external and internal factors influenced Kenya's abandonment of the existing educational structure of 8-4-4 (eight years of primary education followed by four years of secondary and four years of university education) and the adoption of the competence-based system. According to the revamped curriculum [25] basic education, which was launched early in 2018, is slated to have two years of pre-primary, six years of primary, six years of secondary and three years of tertiary education (2-6-6-3). The United Nations Educational Scientific and Cultural Organization (UNESCO) was among the exterior elements that impacted positively towards the competency-based platforms [26, 27]. Domestic considerations for the new curriculum included *Kenya Vision 2030* [28] with a concept of having a globally competitive quality education, training and research for the country's sustainable development. *The Constitution of Kenya* [29] also highlighted the status of education as

a right of every child. A competency-based curriculum was among key recommendations contained in *Sessional Paper No. 14 of 2012* [30]. All these trends were happening against a background of a perceived old curriculum. The one which had ushered in the 8-4-4 in 1985 was, despite several reviews, regarded as unfit for purpose [31]. Developments arising from the foregoing account culminated in the launch of a new curriculum with a competency-based approach [25]. Core competencies in Kenya's basic education curriculum are seven: communication and collaboration; critical thinking and problem solving; creativity and imagination; citizenship; self-efficacy; digital literacy; and, learning to learn.

From the foregoing literature review it is evident that CBET is steadily being established in many countries globally. The initiative has also been taken in Kenya and appropriately from the basic education level. Benefits, notably in expanding employment opportunities, are perceived to be many and so every available chance should be taken at all sectors of curricula. A matter of concern, however, is that in Kenya's higher education institutions the concept appears remote. Discussions among education scholars or lay people have been extremely limited [32]. The scenario has been apparently static notwithstanding the raising up of the matter in government blueprints regarding universities and employment competencies. The challenge of mismatch between skills acquired by university graduates and demands of industry was identified over a decade ago [33]. The issue was also rephrased as one of the need for relevant skills and competencies [34].

Another report stated that there was a need to equip students academically in such a manner that they emerged from university as graduates who exhibited quality, stability, confidence, and entrepreneurship [33]. *Sessional Paper* No. *14 of 2012* [30] already cited, described the Government's policy to improve collaboration between industry, professional bodies and universities in determining competences of the graduates. Among recommendations of the Sessional Paper was the creation of a qualifications framework. Subsequently *The Kenya National Qualifications Framework Act, 2014*, came into being [35]. The objectives of this Act included the development of a system of competence, life-long learning and attainment of national qualifications. Against this background the current paper sought to unravel the status of CBET at the University of Nairobi's Department of Electrical and Information Engineering.

METHODOLOGY
Research design
The study adopted case study survey design to collect data once across all the study participants. The design was suitable for the study because according to Bryman [36], case study design entails the detailed and intensive analysis of a single case or programme. In the study, the researcher investigated Bachelor of Science Electrical and Electronic Engineering graduates of the University of Nairobi. Kothari [37] further explains that surveys are concerned with describing, recording, analyzing and interpreting conditions that exist or existed; and are usually appropriate in case of social and behavioral sciences. Data were collected through questionnaires that were largely adapted from the work of Schomburg [38] on tracer studies. Cronbach alpha was used to test reliability of the questionnaires.

Target Population and Sample Size
A population of 417 engineering students who graduated between 2007 and 2011 was obtained from the University of Nairobi graduation handbooks. Their contacts were provided by the Department of Electrical and Information Engineering. The study further targeted 30 employers and 48 academic and technical staff in the Department of Electrical and Electronic Engineering. A sample size of 300 Engineering graduates was determined using Yamane's [39] formula. However, the accessible sample, using snowball sampling method, was 262 alumni.

RESULTS
Out of the accessible 262 alumni, 251(95.8%) filled out the questionnaires. In addition, 20(66.6%) of the employers completed the instruments. However, a very low response rate of 5(10.4%) was achieved with the academic and technical staff. The response rate achieved was nevertheless considered adequate for data analysis. More males (88.4%) than females (11.6) were in the electrical and electronic engineering profession. Most of the engineers were youthful with age ranges between 26 and 30 years (26.0%) and 31 to 35 years (63.0%).

Generic Competencies required at Work by BSc. Electrical and Electronic Engineering Graduates
One of the objectives sought to investigate the generic competencies required at work by graduates of the University of Nairobi in Bachelor of Science in Electrical and Electronic Engineering. The question asked was: To what extent are the following abilities and attitudes expected from you in your current job? The generic competencies or soft skills were: willingness to learn; ability to solve problems; reflective capability; communication skills; loyalty to the company and its objectives; reliability; ability to work under pressure; sense of responsibility; economics (project management); leadership qualities; entrepreneurial skills; and, role modeling. Responses were gauged against a five-point scale ranging from: 1= very high extent; 2=high extent; 3=average; 4=poor; and, 5=not at all important. Results availed were as displayed in Table-1.

Table-1: Attributes expected in Current Employment (2007-2011)

Abilities and attitudes	Frequency	Rating percent
Willingness to learn	214	81.0
Ability to solve problems	214	81.0
Reliability	200	75.0
Ability to work under pressure	195	74.0
Sense of responsibility	195	74.0
Communication skills	188	71.0
Loyalty to company and its objectives	188	71.0
Reflective capability	167	63.0
Leadership qualities	168	63.0
Role model	158	60.0
Economics (Project Management)	148	56.0
Entrepreneurial skills	106	40.0

Table-1 illustrates respondents' identification of the top five essential attributes: willingness to learn (81.0%); ability to solve problems (81.0%); reliability (75.0%); ability to work under pressure (74.0%); and sense of responsibility (74.0%). Qualities that were favored, although not so highly ranked were reflective capability and leadership qualities (both 63.0%), role model (60.0%), economics meaning project management (56.0%) and, entrepreneurial skills (40.0%). It should be noted that only skills in communication and project management were in the University's common undergraduate courses. The deficit was evident.

DISCUSSIONS

From the respondents' views generic competencies were extremely vital for employment as per discussions below in respect of each quality that was interrogated. Attributes have been made imperative by what Abdulwahed and Hasna [40] analysed to be four drivers of focus on skills development in engineering education. These are: industrial needs; emerging roles and responsibilities; complex and advanced working environment; and, needs of knowledge-based economies and knowledge-based societies. All four variables either individually or collectively impinge on the change in engineering education.

Willingness to Learn

Alumni accorded an 81.0% rating for willingness to learn and in the process singled it out as the most desirable employment characteristic. It appears the curriculum laid more emphasis on technical or hard skills than the soft skills such as this one. This finding was consistent with the study of Iqbal and Zenchenkov [41] who reported that locally educated graduates in Saudi Arabia faced employment challenges due to unsatisfactory learning potentialities and other soft skills.

Ability to Solve Problems

Capacity to get solutions to challenges at work was identified as a top most attribute of employment by University of Nairobi respondents who gave the characteristic an 81.0% rating. A study by Wellman [42] had also shown that employability attributes required of new and early career marketing graduates was problem solving. Corresponding results were availed from a research by Aigbavboa and Aliu [43] relating to graduates in the construction industry. Problem solving skills were ranked fourth most valuable.

Reliability

As a profession serving society in very critical spheres engineers should be distinguished by principles of reliability and trustworthiness. Fortunately, practitioners including respondents who were interviewed, are aware of these precepts associated with reliability. It was rated as the third most important competency, with a score of 75.0% from alumni. The finding likewise compared favourably with that of Wickramasinghe and Perera [44] conducted among computer science graduates in Sri Lanka. Through synthetization of literature Andrews and Higson [45] also deduced that reliability was a competency integral to graduate employability.

Ability to Work under Pressure

The capacity to complete tasks according to strict deadlines implies the ability to work under pressure. It involves dealing with constraints which are often outside one's control examples being resource or time limitations, the difficulty of the task or having insufficient knowledge required to conclude the assignment, or unforeseen changes or problems [46]. Engineers accorded the attribute a rating of 75.0% in employment expectation. This outcome reflected Roux's study [47] on employability generic competencies required for entry-level marketing jobs in selected sectors in South Africa. The ability to work under pressure was the third highly ranked skill by respondents.

Sense of Responsibility

Engineering is considered as a profession that relates to the development and application of technical, scientific and mathematical knowledge for specific purposes [48]. The implication of this is that engineering drives social, economic and human development and underpins knowledge of societies and infrastructures. Consequently, in the execution of their duties engineers are expected to do so with a sense of responsibility to the general public [50]. Respondents of the current research likewise confirmed so in their rating of 74.0% for the quality. The finding was consistent with, among others, Stappenbelt's [50] study of personal ethical perceptions of engineering students in Australia.

Communication Skills

Research alumni awarded a rating of 71.0% to the attribute in the list of those expected in employment. A tracer study of the Universitas Kristen Indonesia [51] similarly revealed that communication skills were indispensable. The same quality was likewise very much commended in the USA [52]. In Kenya several blueprints have also underscored the essential part of communication in professional activities [33, 35, 53, 30, 54]. Besides this the Institution of Engineers of Kenya [55] always emphasizes the attribute during its biannual professional interview preparation seminars for newly graduated engineers. Concerted efforts should therefore be applied for purposes of upgrading communication skills. At the University of Nairobi currently the subject is one of the ten common undergraduate courses, which, moreover, is delivered during a single semester. Clearly, the attention rendered is very inadequate.

Loyalty to Company and its Objectives

Another set of hallmarks expected in employment which electrical and electronic engineering graduates identified, with a 71.0% rating, was about loyalty to company and its objectives. Loyalty is closely associated with ethics, a quality which Passow [56] pinpointed as among competencies undergraduate engineering programmes should emphasize. A joint syllabus research involving European and American universities correspondingly revealed the premium of undergraduate training in professional ethics among other soft skills [57].

Reflective Capability

Reflective capability implies competency to examine the past in order to scrutinize successes and failures with the intention of developing future strategies, approaches and tactics [58]. Participants also mentioned the role in employment of reflective capability awarding the element a ranking of 63.0%. Competency in the characteristic represents the link between technology and the ethical components normally of teaching [59] but also of professions which imbibe pedagogy. Engineers in their various roles are occasionally expected to explain issues to others. Characteristics of reflective capability then prove necessary. The same virtues, recognized as deficiencies of new graduates, are accordingly stressed by the Institution of Engineers of Kenya [55] during its seminars.

While graduate attributes in the University of Nairobi portray deficiencies including those of reflective capacities studies elsewhere depict a growing trend towards a curriculum coverage. A case in point was the survey done by Shekar [60] on first year Bachelor of Engineering students of Massey University. Focus was on an Engineering Practice: Global Perspectives course based on social and humanitarian engineering. From findings it was concluded that respondents had assimilated the concept. Matters involving engineering method of problem solving and design requirements for social engineering projects were appreciated as were roles and responsibilities of engineers.

From Deakin University came a research assessment of an online student portfolio for the development of engineering graduate attributes [61]. Respondents were final-year students who were interrogated on professional practice issues. In portfolio system students are engaged in activities that facilitate their comprehension and development of professional skills and in the process create a portfolio [62]. By its nature a portfolio is a reflective exercise that aids students to self-assess their output and to reflect on underlying matters of their programme. It contains work history records, continuing professional progress and a reflective view of how competence standards have been attained. Findings of the Deakin University study showed that students appreciated the online portfolio, and demonstrated that it had assisted them to value the skills and knowledge they had developed in their undergraduate studies.

Leadership Qualities

Acquisition of a bachelor's degree places the holder on the threshold of rising to the professional and managerial cadres regardless of social background [63]. Indicators of a leader, according to Farr and Brazil [64], are risk taker, decision maker, big thinker, good communicator, team builder, ethical and courageous, masters change, uses power wisely, and chooses a mission of relevance. These and other characteristics are further enshrined in various accords [65] and engineering codes of conduct [66, 55]. The vocation of leadership is also individually beneficial particularly in terms of promotion and associated emoluments [67]. It could be one reason why responding alumni of the University of Nairobi gave the attribute a percentage rating of 63.0.

This perception corresponds with the findings of Barbosa *et al.,* [68] from their investigation of

Economics and Management graduate students of the University of Minho in Braga, Portugal. Alumni rated leadership qualities sixth out of the ten most relevant transferable skills for employment. A study in the University Centre of Merida, at the University of Extremadura, Spain, which focused on graduates of Bachelor in Engineering for Industrial Design and Product Development, Bachelor in Engineering in Geomatics, Bachelor in Computer Engineering and IT and Bachelor in Telematic Engineering reflected similar perceptions [69]. Paucity of leadership skills was the third most serious work-related deficiency reported by respondents.

Role Model

Current research alumni indicated with a rating of 60.0% that role model attributes were anticipated in their workstations. Career theory, according to Gibson [70], proposes the importance of role models as helping to counsel individual development. Moreover, role models are also considered critical to career development. Newly qualified engineers themselves derive examples from registered professional engineers found in almost every country. The National Society of Professional Engineers in the USA [71] and Kenya's professional engineers [55, 66] are among numerous illustrations. Through the excellency of their services members champion the safety, health, property and welfare of the public.

A contemporary emergence in the arena of role models in engineering is the creation of Global Engineers [72]. These are professionals with expertise in an increasingly complex and globalized society. Attributes of a global engineer include capability of performing leadership roles in interdisciplinary work environments and ability to apply technical skills in a global context. Another characteristic is competency in exploring complex societal issues. Several researches have also been undertaken in respect of role model impact and gender. Sonnert *et al.,* [73] made a study of student and faculty participation in biology, physical sciences, and engineering for 499 universities in the USA. The period covered was between 1984 and 2000. A key finding was that the percentages of women among undergraduate science/engineering majors and degree recipients was associated with percentages of women among the faculty in those fields. It was therefore concluded that the effects of 'role models' from faculty were strong for the participation and performance of women in science and engineering. One implication from these findings is that the matter of role model should be in a university curriculum.

Economics (Project Management)

Project management, as defined by the Project Management Institute [74], is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements/goals. Competency in this field is one of the cornerstones of an engineer and consequently it is an item in the curriculum [75]. In the University of Nairobi's Bachelor of Engineering in Electrical and Electronic Engineering discipline project management is offered during the fifth and final year as an item under management for engineers. Respondents awarded it a rating of 56.0% as an attribute expected in their employment. Out of the twelve assessed elements of distinction it was the second last ranked. The low perception was probably because graduate engineers may not have been interrogated in an extensive usage of knowledge and skills with bearings on project management.

Studies elsewhere have also shown the significance of project management programmes in engineering education. A tracer study of engineering graduates of Lyceum of the Philippines University-Batangas revealed that engineering management was the third ranked professional subject alumni found to be most relevant for job placement [76]. In a research that concentrated on project-based learning in the Industrial Engineering and Management course of University of Minho responding first year students confirmed that the experience refined their academic abilities [77].

Entrepreneurial Skills

Entrepreneurial skills had a rating of 40.0% from alumni. The apparent negative perception could have been an issue of personality rather than the university environment. A similar case was reported by Sesen [78] in a research that involved business administration, health sciences and law students from two Turkish universities. Individual entrepreneurial self-efficacy determined entrepreneurial intentions of students but not curricula surroundings. Academicians elsewhere, however, indicated that there were other issues besides personality which influenced entrepreneurship. According to Taha *et al.,* [79] factors included entrepreneurship training and education, government support program, collaboration of government-university-industry, and participation of micro, small and medium enterprises; Khuong [80] considered prior entrepreneurial experience and external environment; and Ambad [81] emphasized perceived behavioural control and relational support.

Although lowly assessed by the University of Nairobi respondents a deficiency in entrepreneurial competencies can be a serious handicap. Studies elsewhere, however, showed that comprehension of business was greatly valued by respective alumni. Warsame [52] in the USA found that engineering business was a core professional ability. Cases were reported of engineers who explained that they were unexpectedly required to develop business resumes for small and/or large projects, and prepare decision support packages. Perceived unsatisfactory performance indicated a deficiency in that category. In Australia Male *et al.,* [82] were confronted by alumni who stated

that had they been taught business attributes their careers would have been better.

FACILITATING COMPETENCY BASED EDUCATION AND TRAINING

Studies have revealed that the deficiencies discussed above and others can be reduced through several platforms. Work Integrated Learning (WIL) is one of the approaches and its definitions, according to Edwards *et al.,* [83] include: purposeful links to curriculum and specifically designed assessment; integrating theory with the practice of work; engagement with industry and community partners; and, planned, authentic activities. A close variant is project-based learning which augments student participation in both active and self-learning processes [84]. Findings from a number of thesis have also underlined comprehensive benefits of WIL. Thonglek's [85] investigation of chemical engineering schools in Thailand and Australia demonstrated that WIL helped students improve their learning and graduate attributes including ethics through engagements with professionals. A study of WIL in civil engineering at further education colleges, Western Cape Province, in the Republic of South Africa established that links between the two sectors enhanced the preparation of students for the workplace [86].

Researches of corresponding case studies were reported from, among others, Rangel *et al.,* [87]. An example was made of the implementation of integrated project delivery methodology to the project based learning in civil engineering education. Participants were students of the Integrated Master in Civil Engineering programme in Spain's University of Porto. Students' ability to acquire knowledge became evident. Another illustration applied to the diploma and Bachelor of Technology degree in the University of South Africa [88]. Work Integrated Learning methods were successfully implemented as per guidelines of the engineering accrediting body, the Engineering Council of South Africa. Two other representative cases are: Development of a competency-based work-integrated learning programme to facilitate science, engineering and technology retention in South Africa as a developing country [89]; and Competency-based educational model in a chemical engineering school in Spain [90].

Facilitation through curriculum changes are also vital. Stupans [91] proposed a Competency Outcomes and Performance Assessment Model which delineated four variables: essential competencies and outcomes; indicators defining relevant competencies; methodologies for learning competencies; and, documenting achieved competencies. Two pertinent illustrations were then made relating to pharmacy: curriculum design to promote outcomes around communication; and, curriculum design to promote outcomes around accountability. Mishra [92] outlined similar recommendations with a bearing on competency-based curriculum design and development, competency-based curriculum implementation and competency-based performance assessment, evaluation and monitoring system. A list of strategies for competence-based curriculum development was also made by Mulder [93].

COMPETENCY BASED EDUCATION AND TRAINING CHALLENGES

Among challenges confronting CBET is a lack of trained lecturers in imparting knowledge-based teaching and learning [92, 94, 5, 95]. This should not come as a surprise since this concept of pedagogy is relatively recent as discussed in the early part of this article. Training should zero in on the development of teacher innovation competence [96]. Besides, the number of lecturers is insufficient particularly in engineering disciplines and also because allocations are hardly based on Full Time Staff Establishment. It is a framework for calculating the number of lecturers needed to teach a particular program [97]. Basic variables are student staff ratio, course hours, class size, and mode of teaching. Weak preparation of teaching-learning materials, too, pose a challenge in CBET [11]. Moreover, lack of other facilities and resources is not an infrequent feature among institutions [98]. The new teaching/learning paradigm remains considerably a misunderstood concept not only by the general public but also by students, lecturers [99] and a broad spectrum of staff in higher educational institutions.

CONCLUSION

It is apparent that globally there is a growing paradigm shift towards Competency Based Education and Training. The spread of the concept to Kenya has witnessed its launch at the basic education level and within a few years higher educational institutions will embrace it too. In the meantime, however, the CBET core and generic knowledge and skills for engineering have not been adequately emphasized. This is despite the fact that the curriculum platform is anchored on a firm foundation regarding labour market and occupational analysis. Academic outcomes are consequently applicable for personal, career, community and sector progress in addition to appropriate job placements.

RECOMMENDATIONS

Matters regarding the facilitation of CBET should be emphasized and implemented. A CBET policy covering curriculum and availability of resources both material and human are among these. There is also the need to strengthen links between universities and industries so as to bolster Work Integrated Learning/Project-Based Learning. An exposition of competencies through the national qualifications framework will assist in pedagogy and consequently in assimilation. Marketing CBET through seminars, workshops, print and electronic media will also be crucial.

REFERENCES

1. Hodge S. The Origins of Competency-Based Training. Australian journal of adult learning. 2007 Jul;47(2):179-209.
2. Harris R, Hobart B, Lundberg D. Competency-based education and training: Between a rock and a whirlpool. Macmillan Education AU; 1995.
3. Tuxworth E. Competence based education and training: background and origins. In Competency based education and training 2005 Oct 18 (pp. 18-31). Routledge.
4. Nodine TR. How did we get here? A brief history of competency-based higher education in the United States. The Journal of Competency-Based Education. 2016 Apr;1(1):5-11.
   5. Engelbrecht FD. *A framework for the design and implementation of competency-based teacher education programmes at the University of Namibia* (Doctoral dissertation, Stellenbosch: University of Stellenbosch).
6. Boahin P. Competency-Based Training (CBT) in higher education: towards an implementation in Ghanaian polytechnics. 2014.
7. Mulder M, Weigel T, Collins K. The concept of competence in the development of vocational education and training in selected EU member states: a critical analysis. Journal of Vocational Education & Training. 2007 Mar 1;59(1):67-88.
8. Thompson PJ. Competence-based learning and qualifications in the UK. Accounting education. 1995 Mar 1;4(1):5-15.
9. Burke JW, editor. Competency based education and training. Psychology Press; 1989.
10. Smith E. A Study of the Penetration of Competency-based Training in Australia. Research in Post-Compulsory Education. 1996 Jan 1;1(2):169-85.
11. Dadi L. Effectiveness of Competency-Based TVET Curriculum in Ethiopia: the Case of TVET Institutes of Oromo Regional State. Doctoral dissertation. Addis Ababa University; 2014.
12. Parker B, Walters S. Competency based training and national qualifications frameworks: Insights from South Africa. Asia Pacific Education Review. 2008 Feb 1;9(1):70-9.
13. Kouwenhoven GW. Designing for competence in Mozambique: Towards a competence-based curriculum for the Faculty of Education of the Eduardo Mondlane University, 2003.
14. Van der Linden J, Mendonca M. From competence-based teaching to competence based learning: The case of generic competencies in the faculty of education at the Eduardo Mondlane University in Mozambique. Perspectives in Education. 2006 Sep 1;24(3):37-51.
15. East African Community (EAC). *A Framework on Harmonization of Curricula, Structure and Examinations in the East African Community*. Arusha. EAC; 2012.
16. East African Community (EAC). *Draft Harmonised Curriculum Structures and Framework for the East African Community: Primary Education*. Arusha. EAC; 2014.
17. East African Community (EAC). *Draft Harmonised Curriculum Structures and Framework for the East African Community: Secondary Teacher Education*. Arusha. EAC; 2014.
18. East African Community (EAC). *East African Qualifications Framework for Higher Education.* Arusha. EAC; 2014.
19. Ministry of Education. *Competence-Based Curriculum: Curriculum for Sustainable Development*. Kigali. Ministry of Education; 2015.
20. Rutayuga AB. *The emerging Tanzanian concept of competence: conditions for successful implementation and future development* (Doctoral dissertation, Institute of Education, University of London).
21. Chogugudza P, Mtitu E. Enhancing Open Distance Learning through Competency-Based Approaches: A Case of the Open University of Tanzania. Journal of Issues and Practice in Education, 2016: 8(1); 173-188.
22. Paulo A. Pre-Service Teacher's Preparedness to Implement Competence-Based Curriculum in Secondary Schools in Tanzania, 2014.
23. Makunja G. Adopting competence-based curriculum to improve quality of secondary education in Tanzania:"is it a dream or reality"?. 2015.
24. Kiguli S, Mubuuke R, Baingana R, Kijjambu S, Maling S, Waako P, Obua C, Ovuga E, Kaawa-Mafigiri D, Nshaho J, Kiguli-Malwadde E. A consortium approach to competency-based undergraduate medical education in Uganda: process, opportunities and challenges. Education for Health. 2014 May 1;27(2):163.
25. Republic of Kenya. *Basic Education Curriculum Framework*. Nairobi. Kenya Institute of Curriculum Development; 2017.
26. UNESCO. *Global Education for All Meeting*. Paris. UNESCO; 2014.
27. UNESCO. *World Education Forum 2015 Final Report*. Paris. UNESCO; 2015.
28. Republic of Kenya. *Vision 2030*. Nairobi. Government Printer; 2007.
29. Republic of Kenya. *The Constitution of Kenya*. Nairobi. Government Printer; 2010.
30. Republic of Kenya. *Sessional Paper No. 14 (2012). Reforming Education and Training in Kenya*. Nairobi. Government Printer; 2012.
31. Kabita DN, Ji L. The why, what and how of competency-based curriculum reforms: the Kenyan experience. Current and Critical Issues in Curriculum, Learning and Assessment.
32. Bunyi G. 'Competency-Based Education in Kenya: Contending with the Imperatives for Successful

Implementation'. Second Inetrnational Conference on Education, 18th-20th May, 2015. Nairobi. Kenyatta University.

33. Republic of Kenya. *Sessional Paper No. 1 of 2005 on a Policy Framework for Education, Training and Research: Meeting the Challenges of Education, Training and Research in Kenya in the 21st Century*. Nairobi. Ministry of Education, Science and Technology; 2005.

34. Republic of Kenya. *National Information & Communications Technology Policy*. Nairobi. Ministry of Information & Communications; 2006.

35. Republic of Kenya. *The Kenya National Qualifications Framework Act, 2014.* Nairobi. Government Printer; 2014.

36. Bryman A. *Social Research Methods*.4th Edition. Oxford. Oxford University Press, 2016.

37. Kothari CR. *Research Methodology*. Delhi. New Age International Publishers, 2004.

38. Schomburg H. *Handbook for Graduate Tracer Studies*. Kassel University of Kassel. Centre for Research in Higher Education and Work, 2003.

39. Yamane T. *Statistics, An Introductory Analysis* 2nd Edition. New York. Harper and Row; 1967.

40. Abdulwahed M, Hasna MO. Engineering and Technology Talent for Innovation and Knowledge-Based Economies; 2017.

41. Iqbal A, Zenchenkov M. Market Tested Business Education: Corporate Sector Perceptions of Saudi Graduates Competencies. Asia-Pacific Journal of Cooperative Education. 2014;15(2):91-106.

42. Wellman N. The employability attributes required of new marketing graduates. Marketing Intelligence & Planning. 2010 Oct 26;28(7):908-30.

43. Aigbavboa C, Aliu J. Requisite skills for graduate success: perceptions of the Nigerian construction industry, 2017.

44. Wickramasinghe V, Perera L. Graduates', university lecturers' and employers' perceptions towards employability skills. Education+ Training. 2010 Apr 27;52(3):226-44.

45. Andrews J, Higson H. Graduate employability,'soft skills' versus 'hard'business knowledge: A European study. Higher education in Europe. 2008 Dec 1;33(4):411-22.

46. University of Leeds Careers Centre. Employability skills: Working under pressure. Leeds. University of Leeds Accessed on 1/7/2018 from http://careerweb.leeds.ac.uk/info/4/make_yourself_employable/202/employability_skills/13

47. Roux T, De Jager J. Employability Attributes required for Entry-Level Marketing Jobs in Selected Sectors in South Africa. In9th Annual Conference of the EuroMed Academy of Business 2016 Sep 14.

48. UNESCO. *UNESCO Report*: *Engineering-Issues, Challenges and Opportunities for Development.* Produced in conjunction with: World Federation of Engineering; International Council of Academies of Engineering and Technological Sciences; International Federation of Consulting Engineers. Paris. UNESCO; 2010.

49. Adamson G. Ethics and Engineering: A Matter of Trust-Improving Our 'Engineering-Crazed' Image. IEEE Technology and Society Magazine, 2015-2016.

50. Stappenbelt B. Ethics in Engineering: Student Perceptions and their Professional Identity Development. Journal of Technology and Science Education, 2013; 3(1), 3-10.

51. Sitepu IV. *Competencies of higher education graduates: A case of universitas Kristen Indonesia* (Doctoral dissertation, Faculty of Social Sciences, University of Kassel). 2011.

52. Warsame AF. The Gap Between Engineering Education and Postgraduate Preparedness. 2017.

53. Republic of Kenya. The National Strategy for University Education 2007-2015: Investing in the Future of University Education. Nairobi. Ministry of Education, 2007.

54. Republic of Kenya. *The Kenya National ICT Master Plan 2014-2017.* Nairobi. Ministry of Information, Communications and Technology; 2014.

55. Institution of Engineers of Kenya. *The Constitution of the Institution of Engineers of Kenya*. Nairobi. The Institution of Engineers of Kenya; 2016.

56. Passow HJ. What Competencies Should Undergraduate Engineering Programs Emphasize? A Dilemma of Curricular Design that Practitioners' Opinions Can Inform. 2008.

57. Bankel J, Berggren KF, Blom K, Crawley EF, Wiklund I, Östlund S. The CDIO syllabus: a comparative study of expected student proficiency. European Journal of Engineering Education. 2003 Sep 1;28(3):297-315.

58. Helyer R. Learning through reflection: the critical role of reflection in work-based learning (WBL). Journal of Work-Applied Management. 2015 Oct 6;7(1):15-27.

59. Elena S. Reflective capability–a specific goal of a Teachers Professional Ethics Course. Procedia-Social and Behavioral Sciences. 2011 Jan 1;11:145-9.

60. Shekar A. Global perspectives: First-year engineering students' views on social engineering projects. International Journal of Mechanical Engineering Education. 2015 Apr;43(2):102-9.

61. Palmer S, Holt D, Hall W, Ferguson C. An evaluation of an online student portfolio for the development of engineering graduate attributes. Computer applications in engineering education. 2011 Sep;19(3):447-56.

62. Campbell MI, Schmidt KJ. Polaris: An undergraduate online portfolio system that encourages personal reflection and career planning. International Journal of Engineering Education. 2005 Dec 5;21(5):931.

63. Tholen G. Graduate Work: Skills, Credentials, Careers, and Labour Markets. Oxford University Press; 2017.
64. Farr JV, Brazil DM. Leadership skills development for engineers. Engineering Management Journal. 2009 Mar 1;21(1):3-8.
65. Accord W. Graduate attributes and professional competencies. Version. 2013 Jun;3:21.
66. Republic of Kenya. *The Engineers Act, 2011*. Nairobi. Government Printer; 2012.
67. Russell JS, Yao JT. Education conference delivers initiatives. Journal of Management in Engineering. 1996 Nov;12(6):17-26.
68. Barbosa I, Freire C, Santos MP. The Transferable Skills Development Programme of a Portuguese Economics and Management Faculty: The Perceptions of Graduate Students. InCompetencies and (Global) Talent Management 2017 (pp. 25-47). Springer, Cham.
69. Hernandez-Linarez R, Agudo JE, Rico M, Sanchez H. Transversal Competencies of University Students of Engineering. Croatian Journal of Education, 2015: 17(2); 383-409.
70. Gibson CB, Birkinshaw J. The antecedents, consequences, and mediating role of organizational ambidexterity. Academy of management Journal. 2004 Apr 1;47(2):209-26.
71. National Society of Professional Engineers. NSPE Code of Conduct; 2007.
72. Lam JW, Mah FJ, Miller PB, Meikleham A. Developing Role Models for Engineering and Sustainable Development: Engineers Without Borders' Global Engineering Certificate. InNew Developments in Engineering Education for Sustainable Development 2016 (pp. 139-149). Springer, Cham.
73. Sonnert G, Fox MF, Adkins K. Undergraduate women in science and engineering: Effects of faculty, fields, and institutions over time. Social Science Quarterly. 2007 Dec;88(5):1333-56.
74. Project Management Institute (). A guide to project management body of knowledge (PMBOK Guide). Newton Squire, Pennsylvania: Project Management Institute; 2008. OCLC World Cat Permalink.
75. Macías-Guarasa J, Montero JM, San-Segundo R, Araujo Á, Nieto-Taladriz O. A project-based learning approach to design electronic systems curricula. IEEE Transactions on Education. 2006 Aug;49(3):389-97.
76. Dotong CI, Chavez NH, Camello NC, De Castro EL, Prenda MT, Laguador JM. Tracer Study of Engineering Graduates of One Higher Education Institution In The Philippines For Academic Year 2009-2012. European Journal of Engineering and Technology Vol. 2016;4(4).
77. Fernandes S, Mesquita D, Flores MA, Lima RM. Engaging students in learning: findings from a study of project-led education. European Journal of Engineering Education. 2014 Jan 2;39(1):55-67.
78. Sesen H. Personality or environment? A comprehensive study on the entrepreneurial intentions of university students. Education+ Training. 2013 Sep 6;55(7):624-40.
79. Taha, K. A. S., Ramlan, S. N. & Noor, I. M. (2017). The Factors Affecting Entrepreneurial Intentions of University Students in Malaysia. International Journal of Business and Technopreneurship, June 2017: 7 (2), 189-202.
80. Khuong MN, An NH. The factors affecting entrepreneurial intention of the students of Vietnam national university—a mediation analysis of perception toward entrepreneurship. Journal of Economics, Business and Management. 2016 Feb 1;4(2):104-11.
81. Ambad SN, Damit DH. Determinants of entrepreneurial intention among undergraduate students in Malaysia. Procedia Economics and Finance. 2016 Jan 1;37:108-14.
82. Ambad SN, Damit DH. Determinants of entrepreneurial intention among undergraduate students in Malaysia. Procedia Economics and Finance. 2016 Jan 1;37:108-14.
83. Edwards D, Perkins K, Pearce J, Hong J. Work integrated learning in STEM in Australian universities. Canberra: Office of Chief Scientist & Australian Council for Educational Research. 2015 Jun:1-20.
84. Pereira MA, Barreto MA, Pazeti M. Application of Project-Based Learning in the first year of an Industrial Engineering Program: lessons learned and challenges. Production. 2017;27(SPE).
85. Thonglek S. Maximising stakeholders' benefits of work integrated learning programs: schools of chemical engineering; 2015.
86. Bronkhorst JV. *Work-integrated learning in Civil Engineering: an activity theoretical study* (Doctoral dissertation, Cape Peninsula University of Technology). 2013.
87. Rangel B, Guimaraes AS, Sa AV, Alves FB. Integrated design concept in civil engineering education. International Journal of Engineering Education. 2016 Jan 1;32(3):1279-88.
88. Nickola G, Swart J. Work integrated learning in electrical engineering at a distance education institution: Opportunities and challenges. In25th Annual Conference of the Australasian Association for Engineering Education: Engineering the Knowledge Economy: Collaboration, Engagement & Employability 2014 (p. 90). School of Engineering & Advanced Technology, Massey University.
89. Bonnet P. Development of a competency based work-integrated learning program to facilitate science, engineering and technology retention in South Africa as a developing country. InNZACE 2009 Conference Proceedings 2009.
90. Witt H, Alabart JR, Giralt F, Herrero J, Vernis L, Medir M. A competency-based educational model in a chemical engineering school. International

Journal of Engineering Education. 2006 Mar;22(2):218.

91. Stupans I. A Curriculum Challenge—The Need for Outcome (Competence) Descriptors. Pharmacy. 2017 Feb 17;5(1):7.

92. Mishra A. Challenges in quality improvement of engineering education in India. International Journal of Social Sciences, 2017; 3(1): 254-260.

93. Mulder M. Competence-based Education and Training—About Frequently Asked Questions. The Journal of Agricultural Education and Extension. 2012 Aug 1;18(4):319-27.

94. Kiran RS, Valli PM, Chandulal JA. Competency based training and development for engineering students. International Journal of Engineering Research and Applications. 2011;1(2):246-50.

95. Kagaari JR, Munene JC. Engineering lecturers' competencies and organisational citizenship behaviour (OCB) at Kyambogo University. Journal of European Industrial Training. 2007 Nov 6;31(9):706-26.

96. Wilson Kasule G, Wesselink R, Noroozi O, Mulder M. The current status of teaching staff innovation competence in Ugandan universities: perceptions of managers, teachers, and students. Journal of Higher Education Policy and Management. 2015 May 4;37(3):330-43.

97. Aduol FW. A model for estimating student unit cost and staffing requirements for university academic programmes with reference to Kenyan public universities. Higher education policy. 2001 Jun 1;14(2):117-40.

98. Tambwe MA. Challenges facing implementation of Competency-Based Education and Training (CBET) system in Tanzanian Technical Institutions. Education Research Journal, November 2017: 7(11): 277-283.

99. Henry JA, Edwards BJ, Crotty B. Why do medical graduates choose rural careers?. Rural and remote health. 2009 Feb 1;9(1083):1-3.