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Determining the Employability Skills in Polytechnic Curriculum in Ghana

Sarah Dsane-Nsor[1,*], Akyene Tetteh[2], S. Dzisi[1], S. A. Appiah[1]

[1]Computer Science Department, Koforidua Technical University, P. O. Box KF 981, Koforidua, Ghana
[2]Department of Management Studies, University of Mines and Technology, P.O. Box 237, Tarkwa, Ghana
*Corresponding author: saransor@outlook.com

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Abstract Polytechnics worldwide have the mandate to produce the manpower needs of most industry and also to make students entrepreneurial, equipped with the needed skills to be self-reliant through technical and vocational education and training for sustainable development. The development of curriculum for all the HND programmes seems to be retarding and requires immediate attention to make them relevant and industry-friendly. This paper seeks to review the computer science curriculum of polytechnics in Ghana to determine if students are adequately being prepared with employability skills to build human capital, create jobs and raise labor productivity. An analytical review of computer science curriculum of seven polytechnics was used. The finding shows that the computer science curriculum was skewed more toward theoretical and technical skills with very minimal hands-on industry training due to lack of infrastructure, human resource, lack of collaboration between lecturers and industry, among others in most polytechnics. In conclusion this paper recommends a round table discussion between stakeholders such as NAPTEX (and other regulatory bodies), industry players and polytechnics (lecturers) in the design and implementation (course delivery) of the computer science curriculum to ensure employability of HND graduates.

Keywords: *Ghana, polytechnics, employability skills, computer science curriculum*

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1. Introduction

In recent times, national attention has focus on education with employability skills leading to increasing emphasis on curriculum redesign that favors technical vocational education and training (TVET) courses at the tertiary level, especially polytechnics. The government of Ghana in their quest to provide hands-on training to fuel the engine of growth in industry have upgraded some polytechnics into technical universities to enhance the middle man power development [1]. However, transforming polytechnics into technical universities does not ensure polytechnic graduate have the requisite skills to be employed by industry. Hence the need to breach the gap between curriculum and employable skills.

The polytechnic system in Ghana have gone through several changes over the past six decades, from the inception of technical institutes (since 1950), through polytechnic system (1992 till date) and subsequently technical universities (2016). These changes are aimed at improving the polytechnic system to produce the right caliber of graduates for the industry. By their mandate Polytechnics are responsible for training scientific and technical graduates to feed the middle level manpower needs for the development of the country [2]. Polytechnic have a distinct role to play in nurturing middle level technical graduates who are awarded Higher National Diplomas (HND) and their curriculum is devoted to hands-on training. For the efficient running of programmes in the polytechnics, the National Accreditation Board (NAB) was mandated under NAB Law, 1993 (PNDCL 317) to ensure that polytechnics meet or satisfy academic requirements [3].

The National Board for Professional and Technician Examinations (NABPTEX) was also established by the National Board for Professional and Technician Examinations Act, 1994 (Act 492), to ensure compliance of TVET institutions to standards for skills and syllabus competencies. Thus, the ultimate purpose of teaching and learning in the TVET institutions (in the Polytechnics) is the transfer of employable skill for the changing working world (industry) [4].

Studies have emphasized the relevance of graduates from higher education institutions possessing employability skills and able to apply those skills and technical knowledge learned to the workforce [5]. The employability skill of graduates in the polytechnics are linked to the curriculum and its design [6]. However, the development of curriculum for all the HND programmes in Ghana appears to be lagging behind and requires

immediate attention to make them relevant and industry-friendly". Raising the need to examine the curriculum of HND programmes in Ghana's Polytechnics in relation to their capacity to transfer employable skills to grandaunts. This paper seeks to review the computer science curriculum of some polytechnics in Ghana to determine if students are adequately being prepared with employability skills [7].

Employability skills is define as the transferable skills needed by an individual to make them employable along with good technical understanding and subject knowledge In other words employability skills encompasses a blend of transferable skills, technical skills, and subject knowledge to make an individual employable [8]. Similarly for RTI International employability skills involves a set skills that can be categorized as effective relationships skills (interpersonal skills and personal qualities), workplace skill (includes resource management, information use, communication skills, system thinking, and technology use) and applied knowledge skills (applied academic skills and critical thinking skills) [9].

Combining the perspectives of STEMNET and RTI international, this study has designed an employability framework shown in Table 1. to review the computer science curricular of polytechnics in Ghana.

Table 1. Employability Skills

Category	Set of skills and Attributes
Transferable Skills	Interpersonal Skills (IS) Leadership Skills (LS) Organizational Skills (OS) Moral Studies (MS) Team Work (TW) Communication Skills (CS) Lifelong learning (LL)
Technical Skills	Resource Management (RM) ICT, Computer Skills (ICT) Programming Skills (PR) System Thinking (ST)
Subject Knowledge	Application of Mathematical Procedures (MP) Application of Scientific Principles and Procedures (SP) Problem Solving (PS) Analytical Skills (AS) Critical Thinking (CT) Initiative (I)

2. Methodology

There are ten polytechnics in Ghana, one in each region of Ghana and seven of which have computer science department. Out of the seven computer science departments only three run service courses for other departments. The remaining four run accredited information technology (IT) programmes such as computer science, network management, information communication technology (ICT) among others full time course for the award of HND certificates. Out of these the curricular of two polytechnics were considered. The curricular were compared and the courses were extracted. An analytical review of the computer science curriculum was carried out. The audit reveal that some courses were however mounted under different names but the synopsis (course description) revealed that the course content were the same, thus the synopsis aided in stream lining the selected courses. The extracted curriculum was subjected to analysis using Ms Excel 2013. The analysis sought to determine which employability skills the various courses impacted and also the mode of delivery for the courses.

3. Results

The HND computer science curricular, covers a three year period, with a total of six semester having an average of six courses per semester. The analysis of the employability skills enshrined in the computer science curriculum was carried out, by identifying each course with the type of skill, mode of delivery and assigned credit hours as shown in the summary Table 2.

As indicated earlier, Polytechnic have a distinct role to play in nurturing middle level technical graduates who are awarded HND and their curriculum is devoted to hands on training (Polytechnic Law, PNDCL 321, 1992).

Table 2 contains a total of 47 extracted courses the curricular of two polytechnics and these were subjected to analysis. Out of a total of 133 credit hours, 68 hours is dedicated for Theory, 55 hours for Theory/Practical and only 10 credit for only Practical.

Table 2. Summary Analysis Table

No.	Course title	Credit	Delivery mode	Skill category
1	Algebra	3	Theory	Subject Knowledge
2	Probability and Statistics	3	Theory	Subject Knowledge
3	Introduction to Programming (C++)	3	Theory/Practical	Technical Skills
4	Internet Technology	3	Theory/Practical	Technical Skills
5	Communication Skills I	2	Theory	Transferable Skills
6	African Studies	2	Theory	Transferable Skills
7	Calculus	3	Theory	Subject Knowledge
8	Digital Electronics	3	Theory	Technical Skills
9	Computer Hardware	3	Theory/Practical	Technical Skills
10	Object Oriented Programming with C++	3	Theory/Practical	Technical Skills
11	Legal and Ethical Issues	3	Theory	Transferable Skills
12	Communication Skills II	2	Theory	Transferable Skills
13	Industrial Attachment I	2	Practical	Transferable Skills
14	Database Concepts and Technology	3	Theory/Practical	Technical Skills
15	Web – Based Concepts and Technology	3	Theory	Technical Skills
16	Programming using Visual Basic	3	Theory/Practical	Technical Skills
17	Data Communication and Networks I	3	Theory/Practical	Technical Skills
18	Data Structures and Algorithms	3	Theory	Technical Skills

No.	Course title	Credit	Delivery mode	Skill category
19	Introduction to Microprocessors	3	Theory	Technical Skills
20	Operating Systems	3	Theory	Technical Skills
21	System Analysis and Design	3	Theory	Technical Skills
22	Research Methods	3	Theory	Technical Skills
23	Data Communication and Networks II	3	Theory/Practical	Technical Skills
24	Software Engineering	3	Theory	Technical Skills
25	Industrial Attachment II	2	Practical	Transferable Skills
26	Operations Research	3	Theory	Subject Knowledge
27	Programming using Java I	3	Theory/Practical	Technical Skills
28	Web Programming and Administration	3	Theory/Practical	Technical Skills
29	Database Management Systems (Oracle)	3	Theory/Practical	Technical Skills
30	Management	2	Theory	Transferable Skills
31	Linux	3	Theory/Practical	Technical Skills
32	Project I	3	Practical	Technical Skills
33	Entrepreneurship I	2	Theory/Practical	Transferable Skills
34	Computer Security	3	Theory/Practical	Technical Skills
35	Information Systems	3	Theory	Technical Skills
36	Artificial Intelligence	3	Theory	Technical Skills
37	Mobile Service System Design	3	Theory/Practical	Technical Skills
38	Computer Organization and Architecture	3	Theory	Technical Skills
39	Project II	3	Practical	Technical Skills
40	Entrepreneurship II	2	Theory/Practical	Transferable Skills
41	Discrete Mathematics and Applications	3	Theory	Subject Knowledge
42	Distributed Computing	3	Theory	Technical Skills
43	Computer Networking	3	Theory/Practical	Technical Skills
44	Human Computer Interaction	3	Theory/Practical	Technical Skills
45	IT Project Management	3	Theory	Technical Skills
46	Introductory Math for Computer Science	3	Theory	Technical Skills
47	Programming using Java II	3	Theory/Practical	Technical Skills
	Total	**133**		

Again, Figure 1. show the distribution of the curriculum in terms of course delivery mode, it is evident that 51% of courses in the curriculum are theory base, 9% are practical (hands-on) and 40% combined both theory and practical. Furthermore, Figure 2 shows the course distribution that makes up the curriculum by the category of employability skills they are intended to inculcate into the student. Figure 2 shows that after the student has pursued the three year course he/she is likely to gain 71%, 18%, and 11% of technical skills, transferable skills and subject knowledge respectively.

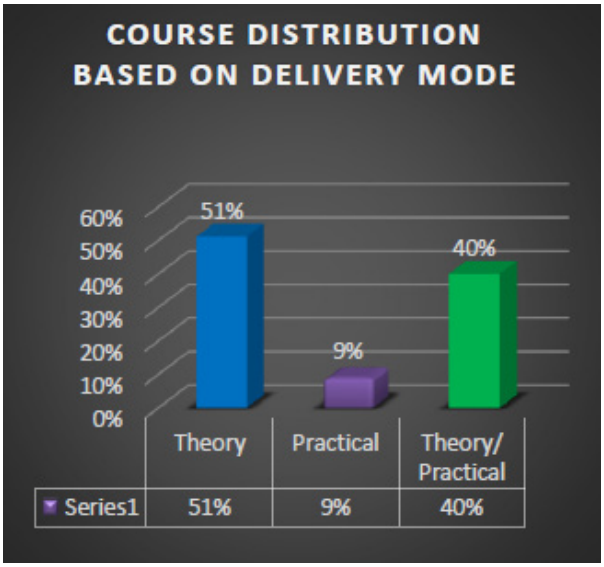

Figure 1. Course Distribution Based on Delivery Mode

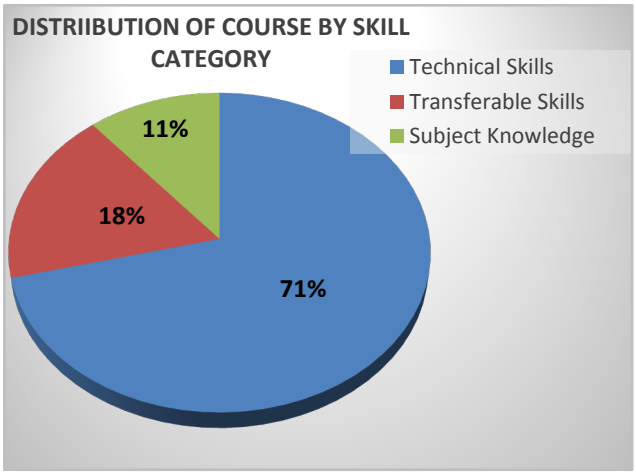

Figure 2. Course Distribution by Skill Category

This paper defines Technical skills as specific skill sets needed to perform a task in a particular field (workforce). Out of the total of 47 courses reviewed, 32 of them have direct attributes of technical skills, whiles 5 and 8 constitutes transferable and subject knowledge respectively. Technical skills courses (102 credit), 44% (15 courses) of them are theory base (45 credit), while 17 courses are a combination of theory/practical course is 50% (51 credit), and 6% are practical oriented with 4 credit hours. However out of the 54 credit practical and theory/practical courses, 6 credit involved students' independent study, which are project 1 (3 credit) and project 2 (3 credit).

Transferable skills are generic attributes and skill sets that enables an individual to interact effectively

(i.e. technically, non-technically) both verbal and non-verbal, coupled with the right workforce attitude. Meaning courses that are categorized under transferable skills are supposed to inculcate skills in the student as shown in Figure 2. 18% of the courses in the curriculum are categorized as transferable skills. These include; African Studies (for moral study and lifelong-learning), legal and ethical issues (for moral studies, organizational skills), industrial attachment I & II (for interpersonal skills, organizational skills, team work, and life-long learning) and entrepreneurship I & II (for leadership skills and creativity). Management (for leadership skills, organizational skills, interpersonal skills). Communication skills (for technical, non-technical, verbal and non-verbal use of information).

It is crucial for graduates to be able to apply the knowledge skill and competences learnt to the workforce [2]. The subject knowledge courses that are integrated in the computer science curriculum has the element of application of mathematical procedures, problem solving, analytical skill, critical thinking, initiative and a bit of scientific principles and procedures.

4. Discussions

From the analysis we identified that practical training of the students per the curricular is solely based on industrial attachment (internship). Subsequently, they gain additional experience while doing the project work which constitutes 6 credit hours out of the 10 credit hours. This may not provide enough hands-on training and exposure needed to enhance the employability skills of the students.

This trend is a deviation from the mandate of the polytechnic since a greater percentage of the courses in the curriculum are more theory inclined than the intended hands on training. This goes to emphasis that the polytechnics instead of producing graduates who are technically and practically competent, would end up producing the same types of graduates as the degree awarding (tradition universities) programmes. As there is no fair balance of employability skills in the curricular.

There is a clear tilt towards the technical skills and theory rather than practical, hands-on training as expected of TVET institutions especially at the tertiary level. Only 45 credit of practical base courses are taught in the polytechnic. For computer science students this (45 credit out of a total of 133 credit) is inadequate to produce competent computer science graduates with the requisite technical knowledge needed. Thus, poor practical orientation as revealed by the curriculum may lead to poor understanding of technology no matter how effective the instructional methodology by employed the lecturer.

HND Computer science student are expected to apply certain skills competencies to the workforce, key among them is how they apply programming, mathematical, computation and scientific knowledge to problem solving in work place. The application of these competencies can be enhanced by providing more practical based courses rather than abstract (Theory). Moreover, as the saying goes “experience is the best teacher” however courses such as industrial attachment, internship, industrial trips and projects provides student with an opportunity to interact directly with real life situations, applications and the appropriate skills to problem solving and innovation, as this provides good understanding to the course.

5. Conclusion

Indeed, there appear to be components of employability skills (transferable, technical and subject knowledge) in the computer science curriculum of the polytechnics in Ghana. The audit revealed that the skills acquired by students are more technical and theoretical in nature. Other factors contributing to this problem are the lack of infrastructure, human resource, collaboration between educators and industry players, among others. This may lead to a proficiency gap hence the sharp deviation from the polytechnic’s core mandate of providing hand on technical training to feed the industry. The computer science curriculum is relevant even now however, the curricular needs a fair balance of employability skills to be integrated in the curricular to ensure that HND computer science graduates become relevant and industry friendly.

There is a need for regulatory bodies and stakeholder to take a second look at the design of the polytechnic curriculum in line with their mandate, by integrating a fair balance of employability skills (i.e. transferable, technical and subject knowledge) into the curriculum. In terms of the 71% technical skills of the computer science within the curriculum the proportion for practical skills should be 65% and 35% theoretical skill.

We propose that a policy be put in place for the computer science curriculum to be redesigned approximately every three years with collaboration from industry players, educators and regulatory bodies such as NAB among others to ensure that; emerging computer technologies and trends are incorporated in the curriculum and graduates are spot on, because of the changes in the labor market. Other school activities that are not captured in the curricular but are sources for enhancing employability skills are industrial trips and workshops for both tutors and students, and these must be encouraged.

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