



EXPLORING THE PROSPECT OF INTRODUCING COMPUTER PROGRAMMING IN BASIC SCHOOLS

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Abstract

This research was conducted to assess the feasibility of adding computer coding to the Basic level curricular of the Ghanaian Education System. The problem this study attempts to address is to pre-test the chances of this policy pronouncement not joining the growing trend of wasted effort in our national developmental drive due to lack of fundamental inputs. Two Districts of comparatively different standing in developmental status were purposively selected for the study. The study employed the mixed method design. Findings disclosed that the JHS students' have good knowledge in ICT and Mathematics, which are critical for effective computer coding. All the sampled schools had a number of "RLG Laptops" but most of them were not functioning. Other logistics such as computer laboratories, projectors, printers and textbooks were rarely found. Aside the scarcity of these key logistics, the quality of the human resource (teachers) has impacted negatively on the program implementation. We observed that the students were good enough, and can cope with the program. The study recommended that adequate logistics and relevant human resource should be provided. To get it right from the start, we recommend that Ghana Education Services should be mandated to engage Computer Science Graduates for the program. Furthermore, Teacher Training Colleges should introduce the skills of teaching computer programming as a course so that the trained and licensed teachers can eventually teach ICT and coding. Lastly, Government should sufficiently finance GES to equip the various institutions to combat the logistics deficiency to enhance the success of the program.

Keywords: Basic Education, Programming Language, Coding, ICT Logistics

Introduction

The development of a nation depends largely on its educational system. As defined by Dewey (2007), education is a process of experience, which means helping an individual's inner growth (skill) without being restricted by age. In Ghana, the Ministry of Education working through Ghana Education Service is responsible for the administration and coordination of Ghana's Education. The Educational System is in three different phases; the basic education (pre-primary, primary and junior high school), senior high education (senior high school, vocational and technical

education) and the tertiary education (universities, polytechnics and colleges).

In 2011, the Ministry of Education launched a project with the theme "ICT as a tool for Development at the Basic Level Education". Basic education curriculum of Ghana was developed by the Ministry of Education and the Curriculum Research and Development Division of the Ghana Education Service. The curriculum was developed based on the objective model of curriculum development and this has resulted into over-prominence on knowing basic facts, principles, and procedures instead of higher reasoning

abilities such as creativity, application, critical-thinking etc. The then Minister of Education, Mould-Iddrisu (2011) in addressing this launching indicated that “equipping teachers and children with the complexities of ICT were the surest ways to expose children to the larger world, and also ICTs excite and stimulate the minds of children and hopefully this will drive them to compete with young minds from other parts of the world”. This resulted in the introduction of ICT as a subject in the Junior High Schools.

During the, Girls in ICT Day Celebrations in 2018, the Minister of Communications Hon. Ursula Owusu-Ekuful speaking on the theme “Expand horizons, change attitudes” announced that the Ministry of Communication in collaboration with the Ministry of Education are reviewing the curriculum of Ghana’s basic education with the intention of introducing coding as a subject at the basic level of Ghana’s education (Owusu-Ekuful, 2018). Code in computing can be seen as a mode of existence of software which has a textual and processual dimension (Hiller, 2015). According to Knuth (1984) and Vee (2013), code can be regarded as a new semiotics with its own literacy. The act of composing codes to derive a software or program is referred to as coding. The motive of this amendment by the Ministries of Education and Communications is to improve and promote software and website development among Ghanaian students (Owusu-Ekuful, 2018). She further avers that “Government will be renovating and re-equipping computer information centres with internet connectivity so that students can learn off school hours”. This will address the logistics inadequacy of the programme.

This paper assesses the feasibility of adding coding/programming as a subject at the basic education level curriculum. For the specific objectives, pupils’ performance in Mathematics and ICT, as well as the availability of teaching and learning logistics were assessed. Human resource challenge under the programme implementation was also assessed. As asserted by Feurzeig, Papert & Lawler (2010), the rationale for assessing the pupils’ Maths and ICT performance was to test their ability to apply some basic mathematical concepts in problem solutions.

Review of Relevant Literature

Educational Policies

Buckland (2000) advocated that the concept of basic education is to expand the dimension of the right to education for lifelong learning. It creates the opportunity to provide the right channel for children to continue to higher levels of learning and for those who cannot, it gives them the opportunity to acquire work-related skills (Oduro, 2000).

Before Ghana’s Independence in 1957, the education policy titled “Accelerated Development Plan on Education” was launched with the aim of using education as a vehicle for accelerating the implementation of government development policies and programs (Agyeman, D. K., Baku, J. J., Gbadamosi, R., Addabor, E., Adoo-Adeku, K., Cudjoe, M., Essuman, A. A., Gala, E. E. K., and Pomary, C., 2000). The Education Act of 1961 provided for a free and compulsory basic education for all children who have attained the school going age and hence must all be enrolled (Kadingdi, 2004).

The Five Year Development plan of 1975-1980, declared a New Structure and Content of Education (NSCE) which sought to replace the four-year Middle School with three years Junior Secondary School (JSS) system. Pilot Junior Secondary Schools were therefore established and vocational programs introduced into the Continuation Middle Schools (Akyeampong, K., Djangmah, J., Oduro, A., Seidu, A., & Hunt, F., 2007). The JSS system reduced the years spent and enriched the curricular with more practical content. Due to political unrest during this period, the NSCE was not fully implemented (Oduro, 2000). The educational system was reviewed again in 1987 which completely abolished the Middle School system and replaced it with the Junior Secondary School. The curriculum was modified and updated such that all students who could not continue after the JSS will possess basic skills and knowledge level that can be used in the world of work (Akyeampong, 2009). The vision of this reform was to make basic education accessible to all children. Hence, the declaration of a free eleven-year compulsory basic education in Ghana’s educational reform of 2007. These consist of two years of kindergarten, six years of primary education and three years of junior secondary education. The curriculum

was therefore redesigned to make it more practical and skill oriented.

Definitions of ICT

Information and Communication Technology (ICT) involves the communication and accessing of information using technology. Carroll (2017) citing Bigelow in the 1800s, defined technology to involve the principles, processes and nomenclatures of the more conspicuous arts, particularly those which involve applications of science, and which may be considered useful, by promoting the benefits of the society together with emoluments of those who pursue them. Many authors writing about ICT describe it to involve the use of science and mathematical theories to communicate and access information worldwide. ICT is therefore viewed as a tool that can be used to process, avail and access information and communication services or products of which these services product may include software and hardware (Rodriguez & Wilson 2000; Bakkabulinda 2007; Opira, 2010). ICT has significantly contributed to the concept of globalization and its numerous economic merits of access to all parts of the world, competition, unlimited market, and many more.

ICT for Accelerated Development (ICT4AD) Policy (2003)

This was the initial effort intended to deploy, exploit and develop ICT to accelerate the socio-economic development of Ghana and had the mission to “*transform Ghana into an information-rich knowledge based and technology driven high income economy and society*” (ICT4AD, 2003:21). This was passed in 2003 into law and it is still under implementation at various phases. The 2009 review of the ICT for Accelerated Development (ICT4AD) Policy focused on the use of ICT to curb the growing unemployment rate in the country by enriching the training of students with practical skills. Graduate unemployment will cease if this policy objective is achieved (Cobbinah, 2015).

Overview of Coding and Programming

Computer coding is defined by different authors to include: Knuth (1984) and Vee (2013) as “... a new

semiotics with its own literacy”; Marino (2006) as “a sign system with its own rhetoric and cultural embeddedness”; and Hiller, (2015) as “a mode of existence of software which has a textual and processual dimension”.

The act of composing codes to derive a software or program is referred to as coding. Software is developed using a particular programming language. Programming language is a language used to write computer programs, which involves a computer performing some kind of computations (Association of Computing Machinery Special Interest Group Programming Languages (ACM SIGPLAN), 2003). Such computer programs perform some form of algorithms and possibly control external devices such as printers, disk devices, robots and so on (Dean, 2002). A Programming language allows humans to communicate to machines whereas natural language is used for interaction between people. There are several programming languages with different modes and order of composing (e.g. C, C++, Java, Visual Basic, FORTRAN etc) (White, 2004).

ICT and Pupils’ Educational Development

Computer coding and programming is the universal language of the planet. People who know how to code will be able to communicate across countries and cultures, be innovative and solve problems more efficiently without barriers to impede their success. It empowers critical thinking of its users especially among the youth (Porter, 2016). As indicated by Owusu-Ekuful (2017), the introduction of coding at the lower levels of education seeks to empower students at these early stages to contribute to the development of applications that can help provide solutions to the country’s ICT needs. This will also arouse the interest of students in ICT. The children’s early accessibility to computers can expose them to global issues and generate a lot of innovative ways of doing things as well as challenge them to contribute their quota to the solutions of these challenges. Akyeampong (2009) concluded that when computer studies is introduced at the basic level, all students who may not continue after the JHS will possess certain level of skills and knowledge that can be used in the world of work.

Policy redirection or modification is not a new thing such that one may see it as a risky experimentation in the educational system. Adding ICT into basic schools' curricula is common in the developed world and also among some neighbouring African countries. For instance, in 2014, programming was introduced in England for children from the age of five and in 2015, Australia followed by adding coding to the new digital technologies curriculum for children across all levels (University of Adelaide, 2015). A USA based educational support organisation "code.org", in its 2017 annual report indicated increasing involvement of schools, teachers and individual students in the access and diversity in computer science as part of primary and secondary education.

Under the School Education Gateway 2015 report, it was indicated that in 2014, 20 European Ministries of Education had computer programming and coding already in the curricula of their basic schools. Many more including Bulgaria, Estonia, Greece, Ireland, Italy, Lithuania, Poland, Portugal are planning to integrate coding into their basic education curricula in the future. Many more authors have appreciated the need to include computer coding into the curricula of basic schools (Uyanga, 2006; Hill, C., Dwyer, H. A., Martinez T., Harlow, D., & Franklin D., 2015; U.S. Congress Office of Technological Assessment, 1995). Ghana's plan to introduce programming in its lower level education system is therefore not an isolated case. We simply explored the prospect of the program especially in the deprived northern part of the country.

Methodology of the Study

The research design adopted for the study was the Mixed Method under the Multiple Methods Choices (Curran & Blackburn, 2001; Tashakkori & Teddlie, 2003). The sample frame limited the potential respondents to heads of the schools, tutors of ICT and students. A case study approach was applied and two District Education Directorates namely Kassena Nankana East Municipality and the Talensi District Directorates of the Upper East Region were purposively selected as case areas for the study. These Districts were selected purposively due to the wide developmental gap between them. The former is a well-developed District with all categories of educational institutions including a state owned

University Campus. The latter is a relatively new and struggling District with one Senior High School as its highest educational institution. Four schools were randomly sampled from each Directorate. Thirty students were also randomly selected from each school. All the Head teachers and ICT tutors of these schools were added to the sample. A total of 268 respondents were involved in the study made up of 240 students, 20 ICT tutors and eight head teachers.

Questionnaires were administered to the students and ICT tutors while the head teachers were interviewed to validate the teachers' claim of being ICT trained or untrained, logistics and conducive space for ICT practicals among others. BECE results of ICT and Mathematics for 2015, 2016 and 2017 formed the key secondary data obtained from the head teachers' offices. Data analysis was mainly descriptive and predictive using Excel 2010 package. Close ended questions were tallied and frequency distribution tables generated which were used to produce charts. Similarly, open ended questions and interview responses were categorised, summarised and discussed. A further analysis of the challenges was done using a problem tree to pictorially present or evaluate how the perceived problem relates to its causes and effects.

Results Presentation and Discussion

Demographic Characteristics of Respondents

This has been sub-divided into students, ICT teachers and Heads of Schools.

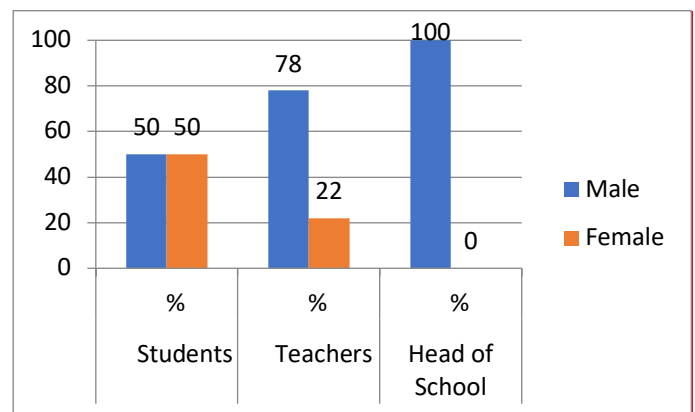


Figure 1: Distribution of respondents with respect to gender

The gender distribution as in Figure 1 shows that all the heads of the sampled schools were males. The ICT teachers were also male dominant while the student respondents were gender balanced. This was considered to provide gender equality and conclude as to whether the performances of males and females in the considered discipline depicts any significant difference, and calls for any attention. The male domination among the ICT teachers may imply that females are not too interested in teaching ICT. It could also be attributed to the fact that most of the schools were in rural communities.

Students Performance in Mathematics and ICT

The rationale for this assessment was to test the pupils’ ability to apply basic mathematical concepts in some problem solutions. Analysis under this part of the study relied on the West African Examinations Council (WAEC) grading system for second cycle institutions’ examinations. These indicators were A, B, C, D and E. Students. A grade of 1 is represented with **A** and described as *Excellent performance*, Students with grades 2 or 3, are represented with **B** and described as *Good performance*, Students with grades 4, 5 or 6, are represented with **C** and described as *Average performance*, Students with grade 7, are represented

with **D** and described as *Below-Average performance*. Finally, Students with grades 8 or 9 are represented with **E** and described as *Bad performance*. This analysis was to determine the relationship between the proportion of students scoring grades A, B and C as compared to those with D and E in order to draw a conclusion on the potential of the students to confront the programming skill.

Performance in Mathematics

Findings from Figure 2 indicated that, only 1.6% had an excellent grade in mathematics. The modal performance (54%), were those with grade C. About 8% completed with a bad performance. The scores demonstrate a normal distribution curve with the median also being the modal class. More than three quarters of the sampled students are knowledgeable enough in mathematics and have the potential to easily adapt to coding and programming as far as their thinking abilities are concerned. This confirms Hoyles, Noss and Adamson’s (2002) and Feurzeig, Papert and Lawler’s (2010) assertions that one needs to understand basic mathematical concepts to appreciate programming as a discipline and also to enhance the individual’s problem solving skills.

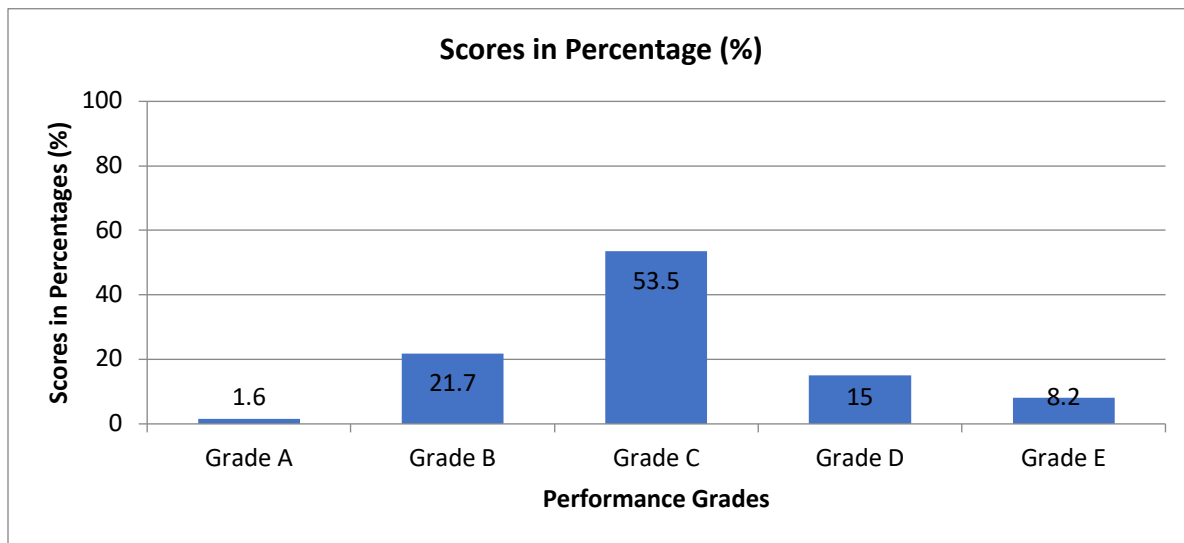


Figure 2: Students performance in mathematics

Performance in ICT

Like in mathematics, their performance in ICT as in Figure 3 exhibits a normal distribution curve with grade C being the median and modal class. An aggregate of 78% exhibited good knowledge in ICT. This means majority of the students are positively oriented and interested in ICT which is a good indicator for the introduction of coding and programming.

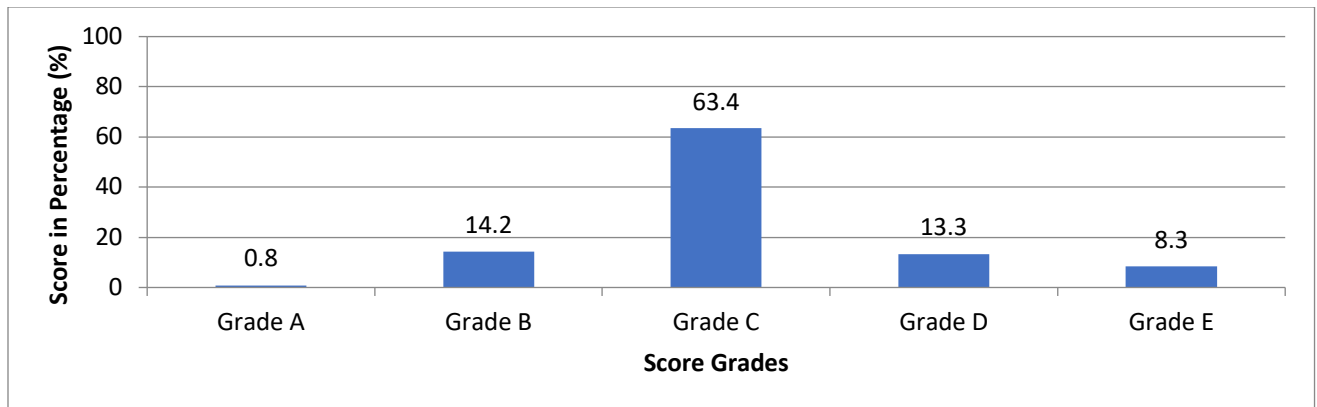


Figure 3: Students performance in ICT

Availability of Logistics

The current state of logistics in the various schools that supported the implementation of the project is woefully inadequate. Five (5) different items are considered in this case i.e. computer lab, active computers, printer, projector and ICT textbooks.

Computer Laboratories

In Figure 4, 50% of the sampled schools had specially allocated rooms as computer laboratories where the students go for ICT practical lessons. The remaining 50% did not have any such facilities. This implies that those schools without a computer laboratory will have to be carrying their computers and all accessories that need to have been placed in the computer room, from their place of storage to the classrooms during classes' hours. This exposes them to the risk of early spoilage. Although a Committee on the Development in the learning of Science set up in 2000 recommended proper furnishing of

laboratories (including computers) as a necessity to enhance the teaching and learning of science, most of these laboratories were not furnished.

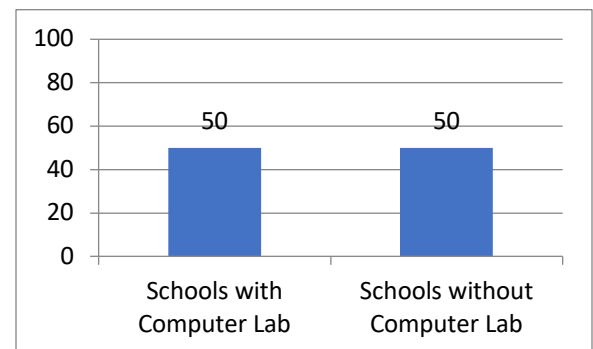


Figure 4: Response on Computer laboratory availability

Active Computers Availability

Active computers here refer to working or functioning computers at the schools. This is to analyse the accessibility of computers by the students and the load placed on them.

Table 1: Response on Active Computers availability

Sampled Schools	Students per Class	Active Computers	Accessibility ratio
KNM- J.H.S. "A"	46	5	9.20
KNM- J.H.S "B"	32	3	10.67
KNM- J.H.S "C"	37	1	37.00
KNM- J.H.S "D"	23	3	7.67
TDA - J.H.S. "A"	52	4	13.00
TDA - J.H.S. "B"	42	16	2.63
TDA - J.H.S. "C"	48	8	6.00
TDA - J.H.S. "D"	38	3	12.67
Total	318	43	7.40

From Table 1, it is evident that all the schools were supplied with a number of computers to support the teaching of ICT program. Although not sufficient even at the time, most schools did not have the capacity to properly maintain these computers. Except JHS "B" and "C" in the Talensi District where there were 16 and eight active computers respectively, all the other sampled schools had less than six computers. Although the average class size is within the standard size between 45 and 50 students per class, the average accessibility to the Computers is seven students to a computer. To effectively implement Coding which demands more access time to the computer than the existing ICT, there will be the need to increase the number of computers.

Availability of Printers

This could serve as an alternative approach in presenting teaching notes to students especially where there are fewer computers to serve a large student's population. The students can source e-documents and have them printed.

Table 2: Response to availability of printing machine(s)

Category	Frequency	Percentage (%)
Schools with Printers	4	50
Schools without Printers	4	50
Total	8	100%

Findings as per Table 2, indicates that 50% of the schools considered in the study have active and working printers which are used to print out examination papers as well as other teaching and learning materials that the teachers deem useful to the students. Some of the remaining 50% had printers but they were either without toner or have developed a minor problem and nobody was available to service/repair them.

Further discussions revealed that the schools having the printers benefited from gifts and support from philanthropists whilst those not having are expecting government to provide. Others levied their Parent Teacher Associations to procure their printers and even extra computers. The schools that did not have printers levy their students to pay for the printing of their examination questions.

Availability of Projector(s)

Like the printers, these could also serve as an alternative approach in presenting teaching notes to students especially where there are fewer computers to serve the students at large. It can aid students to visually appreciate most of the computer peripherals and components that are not readily available at the centre.

Table 3: Response on availability of projector

Category	Frequency	Percentage (%)
Schools with Projector	3	37.5
Schools without a Projector	5	62.5
Total	8	100%

Findings from Table 3 indicated that only 37.5% had projectors. Majority of the schools 62.5% do not have a projector. The heads and ICT teachers admitted that projecting lessons can positively influence the students' interest and enthusiasm in ICT and even other lessons, but they did not have the funds to procure any. Some of the schools lacked furniture for the children and so indicated such as their priority. One of the three schools that had projectors were not connected to the National Electricity Grid. The ICT teacher offered his personal generator to power the equipment during class periods to present his lessons. The children contributed to purchase fuel for the generator.

Availability of ICT textbooks

Findings from the sampled schools in the two District Directorates indicated that there were no ICT textbooks. All the schools interviewed disclosed that the government had not provided ICT textbooks to their schools since the integration of the subject into the education system. Teachers of ICT buy their own textbooks in order to teach. Meanwhile, most of these books in the open market are not in line with the GES syllabus. This has partly affected the performances of the students in their BECE.

Human Resource Challenge on the program

This subsection assesses the human resource requirement for the successful implementation of the program. Most of the teachers currently teaching ICT in the schools are either professionally trained teachers with little computer knowledge or specialised computer science graduates/professional who are not trained teachers.

Table 4 portrayed that 85% of the ICT teachers at the sampled schools are trained teachers who graduated from recognized teacher training institutions across the country. The 15% non-trained teachers are ICT specialists who graduated from the university (10%) and IPMC (5%). Included in the 85% trained teachers are two ICT specialists who advanced their studies into the University to read Computer Science after the teacher training.

The rest of the ICT teachers acquired their ICT knowledge through short courses and informal tutelages from friends. Nonetheless, as trained teachers they are able to handle the ICT learning and teaching environment, manage large class sizes and longer duration of classes' hours, assist stressful and tired students to relax and understand or at least appreciate the lessons they deliver as advocated by Jenkins (2001).

The absence of ICT in the Teacher Training Colleges' curriculum is a drawback on most of the trained teachers' limited knowledge in ICT. The high rate of non-ICT specialists teaching ICT at the Basic Education level is a threat that can increase the rate at which students fail the subject in the BECE (Kinnunen & Malmi, 2006). It can also negatively affect the educational policy direction to introduce programming at the basic schools.

Table 4: Distribution of teachers' responses on Questionnaires

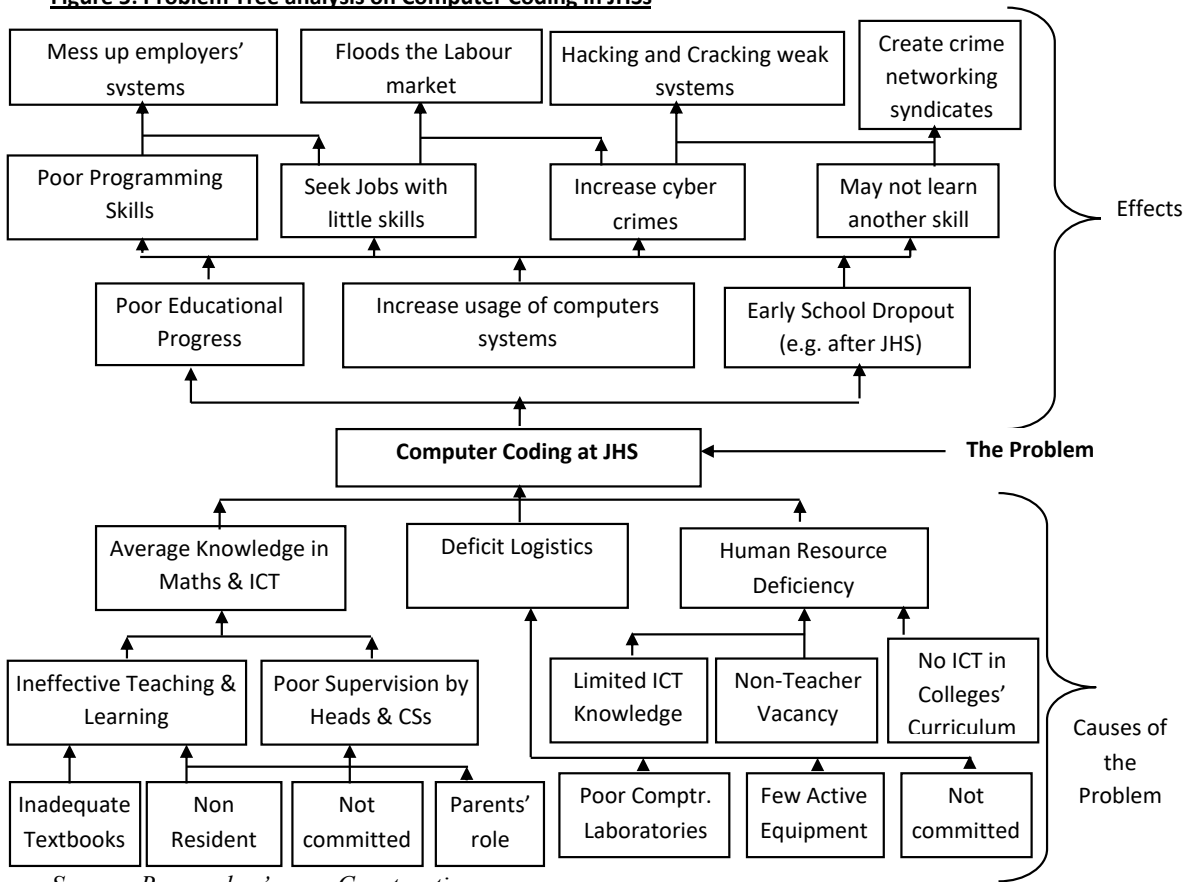
s/no	Questions	Response	KNM %	TD %	KNM Freq.	TD Freq.	Total	Per cent
1	Are you a trained teacher?	YES	100%	73%	9	8	17	85%
		NO	0%	27%	0	3	3	15%
	TOTAL		100%	100%	9	11	20	100%
2	Are you an ICT specialist?	YES	11%	36%	1	4	5	25%
		NO	89%	64%	8	7	15	75%
	TOTAL		100%	100%	9	11	20	100%
3	Learnt your ICT from Training college?	YES	0%	0%	0	0	0	0%
		NO	100%	100%	1	4	5	100%
	TOTAL		100%	100%	1	4	5	100%
4	Do you have any considerable knowledge in ICT?	Nil	44%	9%	4	1	5	25%
		Fair	44%	55%	4	6	10	50%
		Good	12%	36%	1	4	5	25%
		TOTAL		100%	100%	9	11	20
5	Did you learn coding at the college	YES	0%	0%	0	0	0	0%
		NO	100%	100%	9	11	20	100%
	TOTAL		100%	100%	9	11	20	100%
6	Do you have any considerable knowledge in coding?	Nil	89%	64%	8	7	15	75%
		Fair	0%	18%	0	2	2	10%
		Good	11%	18%	1	2	3	15%
		TOTAL		100%	100%	9	11	20

The teachers, who had no knowledge of ICT and yet are teaching the subject, indicated that they volunteered to teach ICT due to the unavailability of trained teachers in that field. This depicts an alarming challenge that may confront an effective integration of coding as a subject into Ghana's Basic Education. As advocated by Trigwell, Prosser and Waterhouse (1999), students learn deep when taught deep and learn surface when taught on the surface, students may suffer to sharpen their thinking skills due to limitation of the instructors'/tutors' knowledge in the subject. Notwithstanding this, the head teachers were okay to have some volunteers helping in teaching the new subject. The head teacher of TDA-JHS C of the Talensi District confirmed the volunteerism of non-ICT teachers and said "I was highly relieved when one of the existing teachers expressed interest to take responsibility of the ICT lessons. I gave him all the text books and my official motor bike to help him be punctual at school." It is clear that the existing ICT teachers are largely without the requisite knowledge in the field. If the trend is not checked, introducing Coding/Computer Programming for this calibre of teachers to teach will cause serious havoc which may not be easy to correct.

Problem Tree Analysis of the Challenges

As much as the prospect of introducing computer programming is assessed to be a possibility with a bright future, it could also be looked at as a problem in disguise. Computer knowledge is one of the terrains where people can easily make quick money in this 21st century. Anyone with such knowledge at a very tender age may end up being a great asset to society or a liability. These issues are presented in figure 5, using Problem Tree Analysis. The problems associated with the introduction of computer coding at the Junior High school level is caused by three key factors namely the students' knowledge level in Mathematics and ICT, the availability of logistics and the capacity of the human resource to effectively teach the program.

Figure 5: Problem Tree analysis on Computer Coding in JHSs



Source: Researcher's own Construction

Factors causing Coding in JHS to be a problem

Average performance of Students in Maths and ICT

The students' knowledge level in mathematics at that foundation stage was found to be at an average level. Being one of the core subjects that drive one's skills and novelty in programming, if the students' knowledge base is not above average, they risk being inefficient programmers. The possible factors generating the churning out of BECE graduates with majority scoring average grade include ineffective teaching and learning, and poor supervision by heads of schools and circuit supervisors.

The first could be attributed to inadequate text books or libraries for the students to read more on what they have been taught. Most of the schools had no accommodation facilities for the teachers so they live in nearby towns and commute daily to school. Thus, the students have no teacher to consult after school hours. In fact, most of the teachers close from school before the normal closing hours. Heads and circuit

supervisors in the public sector schools are not so aggressive in the discharge of their supervisory roles and have thus given uncommitted teachers room not to perform their duties towards the students and society as a whole diligently.

Most parents in our rural areas are not able to support their children to study at home. They load the children with domestic activities and they become tired to be able to study in the evenings. Weak School Management Committees are not able to stop the inappropriate actions and inactions of both the teachers and students at school.

None availability of logistics in reasonable quantities at the various schools is also an active ingredient that fuels the poor performance of the students especially in ICT. This situation can equally frustrate the coding program if this deficiency is not properly addressed.

The last but equally critical potential cause of the program failing is the quality of the human resource in the GES system. The basic school teachers churned out from the Teacher Training Colleges have no computer knowledge except those who purposively pursued it outside the curricular. The computer science graduates from the universities are also mostly not trained teachers under the GES system and are not enrolled to teach at the basic school level.

Effects of Coding in JHSs

Like the causes, three direct key effects are perceived to be generated by the introduction of coding at the JHS level amidst the existing challenges. These include: churning out shallow minded and less skilful programmers; the dropouts at that level will flood the job market with their skills; and inevitably, computer usage will increase significantly with its associated crimes. Those who will be lucky to get jobs may mess up the systems of the employers. Others may form a syndicate to explore weak systems for cybercrime. Nonetheless some will obviously excel to become efficient and talented programmers.

Conclusion and Recommendations

The dominantly average performance of the JHS students in Maths and ICT coupled with the inadequate logistics are a challenge to the success of the early introduction of programming in the education system. Nonetheless, it is likely to boost the employable skills of JHS leavers who may not be able to further their education to the SHS or its equivalent.

The study recommends that the policy to introduce coding should go alongside with the recruitment of Computer Science Graduates as teachers to teach the computer related courses within the immediate and short time period. GES should modify the teacher development programs to churn out professionals in the area of computer science to permanently teach the program.

It is further recommended that ICT logistics should be provided or upgraded in the junior high schools to enhance the programme implementation. It is also recommended that the servicing of the equipment be decentralised and appointment of service providers

made on short term contract basis, and renewable subject to satisfactory performance.

Finally, it is recommended that short courses be organised for the ICT teachers and other teachers interested to equip them with the needed skills and to keep them abreast with technological innovations. Motivate teachers to advance in the field of ICT.

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