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Laying The Foundation for Software Development Industry in Zimbabwe

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Abstract
This paper analyses the impact of the Zimbabwe education curriculum on the development of home grown software solutions. Interviews and questionnaires were employed as information gathering techniques, to obtain both qualitative and quantitative data. This study reveals that, to a greater extent early exposure to computing studies produces high quality software development programmers. The study further reveals that most computing professionals only learn programming basics at advanced stages of career development. This adversely affects the software development industry in Zimbabwe as it runs short of experts in the field. The paper recommends early introduction to programming concepts in primary and secondary education, which will go a long way in career development and ultimately create opportunities in the software development industry and benefit the Zimbabwe economy at large.

Keywords
Software development, education curriculum, computer programming, experts, technology

I. Introduction

Software is arguably the world's most important industry since it has made possible many new businesses and is responsible for increased efficiencies in most traditional businesses [1]. Computer programmers are directly involved in the development of software packages. Computer programming is considered an important competence for the development of higher-order thinking in addition to algorithmic problem solving skills [2]. However, reports from teachers of programming and results from some empirical studies now suggest that the teaching of programming has created significant difficulties for high school and university students. This has failed to catalyze the development of higher order thinking skills [3]. Development of cognitive ability is a valid predictor of performance in the knowledge domain of computer programming [4]. A sound background in problem solving skills is an important factor if one is to take programming as a career. Papastergiou, [5] found that the gaming approach was both more effective in promoting students' knowledge of computer memory concepts and more motivational than the non-gaming approach. In addition to playing computer games, surfing the net, making a multimedia show and doing other activities using off-the-shelf application packages may be a more educational task that parents may do together with their children [6].

A learning intervention (cMinds) that deploys game-based visual programming towards building analytical, computational and critical thinking skills in primary education [7] has been adopted for classroom use in some countries to enable early development of computer programming concepts. The proposed learning method uses graphical programming, hands on graphical experimentation, solution synthesis and visualization of programming results, to assist children to gain a better understanding of programming concepts and logical operations such as conditionals, loops or switches. Morelli et al. [8] allude that engaging students in building free open source software (FOSS) that serves society is a positive step towards strengthening undergraduate computing education. The software industry in Zimbabwe has remained dormant over the years despite the increasing number of graduates in the field of computer science and information systems. There is an acute shortage of skilled personnel in the software development industry [1]. A limited number of graduates venture into the field of bringing out software solutions. One of the more perplexing conundrums and an area where the answers should be clearer is the challenge of finding enough highly skilled technologists [9]. This is despite the overwhelming number of students graduating each year. A dynamic technology landscape requires programmers and technologists to constantly update their technical and domain skills [10]. Development of career management skills needs to be included in education programs from primary school through to adult career transition programs [11]. In programming courses, teaching students who have varied levels of knowledge, skills and the requisite competencies to perform in real-world software development teams is indeed difficult [12]. Bearing in mind that youths are our future programming experts, youth need to acquire a good foundational set of social and academic skills [13]. Effective mathematics education for young children (approximately ages 3 to 5 years) seems to hold great promise for improving later achievement [14]. There is need therefore to prepare future software developers through problem solving and mathematical skills at early stages in the education cycle.

This paper highlights the important stages and components in introducing computer programming and related skills at early stages in the education system of Zimbabwe for development of future software experts. To the best of our knowledge, research on the impact of the Zimbabwean education curriculum on the development of home-grown software solutions has not been reported.

II. Method

A random sample of two programmers from four software development companies (A, B, C and D) were interviewed, to get an in-depth understanding on the computer programmers view concerning early introduction of programming concepts. Five programmers from each of the software development companies were given a questionnaire. A total of twenty questionnaires were successfully completed for data analysis.

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III. Results

Table 1 shows the demographic data of programmers from the companies. The larger portion of programmers was males (85%) between the ages of 26-30 years. The field of computer programming revealed that it is male dominated with very few women (15%), which agrees with the research done by McDowell et al [15]. The findings allude that women are underrepresented in computer science. The majority (95%) of computer programmers are above the age of 20 years with only 5% below the age of 20 years.

Table 1: Demographic data of programmers

Company	Gender		Age (years)				
	M	F	<20	20-25	26-30	31-40	>40
A	5	0	1	1	1	2	0
B	4	1	0	0	3	2	0
C	4	1	0	1	2	1	1
D	4	1	0	0	3	1	1

The information on academic qualification or level of programmers (Table 2) reveals that most (75%) of the programmers hold a degree while the minority (5%) have a diploma. Only 20% have a masters certification.

Table 2: Data on academic qualifications of programmers

Company	Diploma	Degree	Masters
A	1	3	1
B	0	5	0
C	0	4	1
D	0	3	2

Initial exposure to computer programming concepts is shown in Table 3. The majority (85%) of the programmers were first exposed to programming at tertiary level with 15% being introduced to programming at high school. There was no introduction of computing programming concepts at pre-school and primary school levels. Late exposure to computing facilities can be attributed to lack of resources from government in equipping public schools with computers. There was no competent computer teaching staff deployed in public schools. Interviews revealed that only those who attended high schools of the elite or well equipped schools outside Zimbabwe were exposed to computer programming at relatively early stages of life.

Table 3 : Initial exposure to computer programming

Company	Pre-school	Primary	Secondary	Tertiary
A	0	0	0	5
B	0	0	1	4
C	0	0	2	3
D	0	0	0	5

Table 4 summarises individual programmer ranking within different companies. The ranking was done by assessing the number of software programs that they had successfully developed and were in use by at least one organisation. The majority (55%) ranked themselves as fair programmers with 5% ranking themselves as expert. Most (95%) computer programmers are not experts. Interviews revealed that most of the programmers were trained at tertiary institutes in programmes such as information systems or information technology, which do not major in training programming concepts at greater depth as compared to advanced programmes such as computer engineering and software engineering.

Table 4 : Individual programmer ranking

Company	Fair	Good	Expert
A	0	4	0
B	4	1	0
C	3	1	1
D	3	2	0

Table 5 shows responses to early introduction to computer programming concepts at lower levels (preschool, primary and high school). Early exposure helps in the development of good programmers. The majority (80%) of the respondents strongly agreed that early introduction to computer programming concepts at lower levels helps in the development of good programmers while 15% simply agreed. Only 5% disagreed stating that early introduction has no effect since the concepts can be easily mastered at any stage, instead they advocated that they is need to improve availability and accessibility of learning resources at tertiary institutes.

Table 5: Responses to early introduction to computer

Company	Disagree	Agree	Strongly Agree
A	0	1	4
B	1	1	3
C	0	0	5
D	0	1	4

Causes of retarded development of computer programmers in Zimbabwe

Respondents cited various reasons for slow development of computer programmers in Zimbabwe. The majority of the reasons were curriculum related issues. The respondents noted that programming concepts are developed at later stages (tertiary level) of learning due to lack of resources and qualified staff for computers at both primary and high school levels. The scarcity of teachers leads to exclusion of the subject especially at primary level. At high school where computers are taught the respondents stated that the curriculum mainly focused on theory with limited practical application. There were no final practical examinations to motivate the learners to master programming concepts. Some of the respondents attributed the problem to limited exposure to local software during their learning process. This resulted in lack of motivation in designing individuals' system, instead they developed a bias towards outsourced software. Scarce employment opportunities and poor career guidance in the field was stated as another source of problem.

IV. Conclusion

Zimbabwe still lags behind in the development of computer software programmes. Fewer females take up computer programming as compared to males. There are limited programmers below the age of 20 years. The initial stage of exposure to the field of computer programming is at tertiary level. Expert programmers are limited in Zimbabwe due to late introduction of computer programming

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concepts. Therefore there is need to introduce programming concepts at early stages of school. More efforts should be made to train competent teachers in the field of computers at grassroots level. An appreciation of home grown software should be done at early stages to motivate learners to pursue computer programmes. Companies are investing huge sums of capital on foreign software products which are expensive and at times out of line with the full requirements specification of the software solution's targeted audience. Early incorporation of computer programming concepts in Zimbabwe educational curriculum will go a long way in promoting the development of home grown software solutions.

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References

[1]. G. Booch, Developing the Future. Communications of the ACM, 44, 118-121, 2001.

[2]. G. Fessakis, E. Gouli, E. Mavroudi, Problem Solving by 5-6 Years Old Kindergarten Children in a Computer Programming Environment: A Case Study. Computers & Education, 63, 87-97, 2013.

[3]. D. Sleeman, The Challenges of Teaching Computer Programming. Commun. ACM, 29, 840-841, 1986.

[4]. C.G. Cegielski, D.J. Hall, What Makes A Good Programmer? Communications of the ACM, 49, 73-75, 2006.

[5]. M. Papastergiou, Digital Game-Based Learning in high school Computer Science Education: Impact on Educational Effectiveness and Student Motivation. Computers & Education, 52, 1-12, 2009.

[6]. J.M.C. Lin, S. F. Liu,An Investigation into Parent-Child Collaboration in Learning Computer Programming. International Forum of Educational Technology & Society (IFETS), 15, 162-173, 2012.

[7]. H. Tsalapatas, O. Heidmann, R. Alimisi, E. Houstis, Game-Based Programming Towards Developing Algorithmic Thinking Skills in Primary Education. Scientific Bulletin of the Petru Maior University of Targu Mures, 9, 56-63, 2012.

[8]. R.Morelli, A. Tucker, N. Danner, T.R. De Lanerolle,H.J.C. Ellis, O. Izmirli, D. Krizanc, G. Parker, Revitalizing Computing Education Through Free and Open Source Software for Humanity. Communications of the ACM, 52, 67-75, 2009.

[9]. R.L. Mitchell, Why Good Technologists are Hard to Find. Computer World, 40, 32-32, 2006.

[10]. P.R. Newswire, Infosys Brings World-Renowned Software Career Training to Wayne County Community College District in Detroit. MI-NJ-Infosys, 2012.

[11]. C. Graham, Investing in Early Career General Staff. Journal of Higher Education Policy & Management, 31, 175-183, 2009.

[12]. G.D. Chen, L. Y. LI, C.Y. Wang, A Community of Practice Approach to Learning Programming. Turkish Online Journal of Educational Technology -TOJET, 11, 15-26, 2012.

[13]. K. Hynes, Next Steps for Research and Practice in Career Programming. New Directions for Youth Development, 2012, 107-114, 2012.

[14]. H.P. Ginsburg, J.S. Lee, J.S. Boyd, Giving Child and Youth Development Knowledge Away, 22,2008.

[15]. C. McDowell, L. Werner, H.E. Bullock, J. Fernald, Pair Programming Improves Student Retention, Confidence, and Program Quality. Communications of the Acm, 49, 90-95, 2006.

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