

Causes of Failure of University Students in Computer Programming Courses : The Case of Wachemo University

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ABSTRACT

Computer programming courses are among the important components of the curriculum to be studied, not only in the school of Computing and Informatics, but also in most of the field including Natural Sciences, Mathematics, and Engineering Science departments. In this research, a study was conducted to investigate and explore the views of students for the failure and difficulties they faced in learning fundamental programming courses. There are many factors that influence the high rate of failure of students in computer programming courses. This paper focuses on the teaching and learning methodologies and strategies that are implemented in teaching of programming courses. This is a major factor for consideration; hence an investigation into the causes of failure of students in computer programming courses from the learner perspective with regard to the teaching methodology used by teachers to teach these courses is relevant and very important concept. Computer programming courses form part of the core concentration areas for students especially studying in school of computing and informatics as an undergraduate degree program. Computer programming students are expected to prove capabilities in the principles of programming and logic that are being taught in the course; even though some of these concepts are highly intellectual and multifaceted. Their opinions to the usefulness of the teaching methods being implemented in computer programming courses were required for. The needs and concerns about the teaching and learning methods are highlighted in the survey and discussed thereby leading to the making of suggestions about the ways to improve the teaching and learning methods that are used in computer programming courses in order to advance understanding of computer programming, when studied by students thereby minimizing failure rates of those students.

Keywords : Failure, Computer Programming, School of Computing and Informatics.

I. INTRODUCTION

This study deals with causes of failure of students in computer programming courses in Wachemo University. The problem is what are courses that affect academic performance of Wachemo University students. Every educational institutions have no worth without student. Students are most essential assets for any educational institute. The social and economic development of the country is directly

linked with student academic performance [1][2]. The students' performance (academic achievement) plays an important role in producing the best quality graduates who will become great leader and manpower for the country thus responsible for the country's economic and social development. Computer programming is a science and it requires the individuals' skill and ability to interpret challenges into tangible solutions. Computing and Informatics students are required to take several programming

courses as structured in the curriculum. In their early years of studies they are required to study programming. The science of Computer programming includes knowledge of programming tools and languages, problem solving skills, and effective strategies for program design and implementation [3]. Computer programming is one of the computing and informatics courses in education institutions. It is an essential skill that must be mastered by anyone interested in studying of any field from the school of computing and informatics. Normally, in teaching computer programming, students will first be introduced to the concept of programming and data structure where they are taught on how to analyze problems, use specific techniques to represent the problem solution and validate the solution [4]. Computer programming courses are a part of many Universities' curriculums and among the most important subjects for computing and informatics school students in Wachemo University. In the case of Wachemo University, computer programming using C++ is first taught at the second semester and many other programming courses will follow sequentially based on the designed and organized curriculum for the fields. This paper studies the causes of student failure in computer programming courses of six hundred (600) students taking the course in undergraduate programmes at Wachemo University, from 2016-2018 academic years excluding vocational times. The purpose of the study was to understand why so many students' fail in computer programming course, and do not pass on to the next semesters or for the remaining years to take other advance programming courses. The school first year students face a wide variety of challenges [5]. Not only must they contend with the pressures of commencing tertiary education, with all the issues associated with adjusting from high school to university study, they also are challenged with immersing themselves into a discipline in which they may not have had any prior formal education and for which they must essentially learn a new language, computer programming

language [6]. The level of misunderstanding in the minds of these students is noticeable when some of the fundamental concepts are taught in class. High rate of failure in computer programming occurs during the early years of their studies and this has been the tendency over the years and this make computer programming courses look difficult in Wachemo University. The challenging nature of the course boils down to the fact that a strong practical component is required for the working environment. Therefore, hands on experience are needed even if one chooses not build a total career out of it.

To effectively communicate with the software development team, a fair understanding of computer programming is required. Computer programming is among the most challenging subjects in computing and informatics school's curriculum, and the one that many students find difficult to grasp, hence it is very important to select an appropriate teaching and learning strategy that will provide students with the most efficient learning environment [7]. Several research works has looked at the major causes of failure by students in programming. According to [8], [9] as cited by [7], researchers agree to the fact that learning to program presents a challenge for many students, and that many of them find programming concepts difficult to grasp.

II. STATEMENT OF PROBLEM

The goal of teaching computer programming is to develop in students the competencies required of a professional software developer. New computer programmers suffer from a wide range of difficulties [10][11]. Students' difficulty in computer programming is not unique to only computing and informatics schools of Wachemo University but extends across other Science and Engineering field students too'. Research works conducted about failures in computer programming courses have most often focused on the failure or the weakness of the

student to understand the concepts in detail what it mean [12]. Many of these students find computer programming to be hard and disheartening especially when they are beginners and even when they take advanced programming language courses. Since computer programming is the basic skill required for computer programmers, the negative impact of these basic introductory courses may have harmful consequences in the learners' attitude towards the field [4]. I have identified several problems that leads the students to fail in computer programming courses are listed as follows:

- ✓ Weaker student admitted to computing and informatics school (i.e they did not have the know how about computer in previous grades)
- ✓ Lack of problem solving skills (i.e they did not have ability for solving problems)
- ✓ Lack of analytical thinking skills (i.e they did not understand problems analytically)
- ✓ Lack of logical and reasoning skills (i.e logical reasoning is mandatory in order to solve problems)
- ✓ Lack of computer programming planning
- ✓ Lack of programming conceptual understanding (i.e they did not have clear concept for computer programming problems)
- ✓ Lack of algorithmic skills (i.e programming requires step wise problem solving technique)
- ✓ The conceptual difficulty of various elements of the curriculum (i.e the designed curricula contain difficult concepts)

Considering the challenges that computer programming represents to the students [13][5], I can assume that finding and implementing an appropriate teaching strategy will be one of the crucial factors in students' success in mastering the course content [7]. The method and strategy adapted by teachers contribute to the failure rate of students in computer programming. Therefore, the problem that has not been critically looked at is the teaching

methodology employed by teachers of computer programming courses offered at the undergraduate level. The style adopted in teaching can affect the learners' performance.

III. OBJECTIVES OF THE STUDY

The main objective of this study is to explore the teaching methods implemented by teachers of computer programming in Wachemo University especially in school of computing and informatics. In order to evaluate the teaching methodologies and technics, an investigation was conducted to identify the best teaching practices that would enhance the teaching of computer programming courses and reduce the fear factor of students and also to improve the teaching environment in order to create a serene atmosphere for learning.

IV. USED METHODOLOGY FOR THE STUDY

PARTICIPANTS

The investigation was done by collecting data from students taking computer programming courses with the use of questionnaires. This method helped me in soliciting their views regarding the teaching methods and strategies teachers use in teaching computer programming and how they familiarize to it. Six hundred (**600**) students make up the population at the Institution. Out of the population of six hundred (600) students, a sample size of one hundred (400) participants was selected to respond to the questions in order to test sample instead of the entire population. Here, I consider students who have taken one programming course or the other. They were largely drawn from second, third and fourth year. The drawn students were who had either failed the course and are repeating and those who have taken computer programming courses and have successfully passed. 35% the population were fourth year students, 44% of the population comprised of third year students and the

remaining 21% of the population were in their second year. I have collected the research data by interviewing 12 expert lecturers including me in computing and informatics school fields with regards to the teaching methods and strategies they or and me currently adapt in teaching computer programming students. A procedure to extract information on the subject matter was designed to serve as a guideline during the interview meetings. The lecturers selected to participate in the interview process was selected based on the number of years of experience in teaching of computer programming courses and their academic background. Some of the lecturers have master's degree and some of them are PhD. Candidates with in the school. Ten lecturers have ten (8) years of teaching experiencing in computer programming and the remaining has four have seven years of experience.

The lecturers teach various computer programming languages including Fundamentals of Programming I, Fundamentals of Programming II, Data structure and Algorithms, Object Oriented Programming, Fundamentals of Internet Programming, Event-Driven Programming, Advanced Programming, Advanced Internet Programming, Introduction to Distributed Systems, Information Storage and Retrieval, Integrative Programming and Technologies, Information Assurance and Security and other computer programming language courses for different fields have been taught by those lecturers in the University. But the course names vary from department to department in the school.

The interview procedure was planned to elicit information with regard to the teaching method and strategy employed by these lecturers in teaching computer programming courses and to find out from those experts the best teaching methods and strategies that can be adapted to minimize the failure rate of computer programming students.

1.1. MATERIALS AND PROCEDURES

A questionnaire was given to each of the participants at the various levels and I have explained to them the meanings of some of the methods and strategies since the participants were not familiar with all of them. The questions posed were, "Which of the following teaching methodologies are the most effective in teaching computer programming to increase knowledge acquisition and understanding?" Individuals were asked to rank many teaching methods in order of effectiveness. The other question was: "which of these teaching strategies are appropriate for teaching computer programming to improve the learner's success rate and enhance the skill of learners?" many teaching approaches were ranked by the individuals' in order of appropriateness. The response was recorded into statistical package for social sciences (SPSS) to analysis the data.

V. EXPERIMENTAL RESULTS

The experimental results are based on the teaching methods and strategies identified. The methods and strategies are listed in table 1 and the discussions are based on these methods and strategies that when adapted will enhance the learning of computer programming and the success rate. The experts interviewed have categorized the causes of failure into two main areas. These recommendations calls for much attention, hence different research has been conducted to obtain the best possible solutions for some of the problems.

The selected experts have been identified the following problems:

- ✓ Background, field of study and teachers teaching methodology
- ✓ Teaching strategies, instructional materials, teacher capability and interactivity with the students

Based on the problems identified by the experts, this research focuses on both of the identified problems.

VI. EXPERTS VIEW ON BACKGROUND, FIELD OF STUDY AND TEACHERS TEACHING METHODOLOGY

The experts believe that the reason why there is lack of skills on the part of students in solving and analyzing problems in computer programming is as a result of the poor teaching methodology adapted by computer programming lecturers. All of the interviewed lecturers agreed that the causes of failure in computer programming courses are highly due to the method adapted by teachers of computer programming. The techniques used by them in the problem representation are not effective. They said that teachers of computer programming do not employ multiple teaching methods in teaching of computer programming courses. They said that most university students lack the understanding of concepts in major topics in computer programming due to the style/method of teaching. Some teachers only adapt the lecturing method; others project approach, some tutorials, some of the teachers left the course problems as group work and the will not check it again, etc. The method either make the course easy to understand or difficult to understand. They believe that most of the teachers do not consider the background of the students into consideration when teaching programming. They also said that some teachers of programming teach only the theoretical aspect of computer programming and neglecting the practical aspects that will provide the student the necessary skill. Five of the selected experts said that, they are unable to adapt the problem solving approach since the number of computers to student ratio do not measure up to the international standard of assigning computers to students. This does not expose the students enough to acquire the requisite skill to enhance their chances of success in computer programming. They also believed that, lack of computer programming projects affects the

performance of the student [1]. In solving this problem, the experts believe that teachers of computer programming must adapt more than one teaching method to improve their teaching in computer programming courses to increase the skill and thinking capacity of the students.

EXPERTS' VIEW ON TEACHING STRATEGIES, INSTRUCTIONAL MATERIALS, TEACHER CAPABILITY AND INTERACTIVITY WITH THE STUDENTS

Computer programming is made challenging if the teaching strategy adapted by lecturers' is inappropriate and ineffective. University students find it difficult to understand computer programming concepts and coding principles (e.g. especially during debugging and fixing of errors) due to the type of teaching strategies lecturers use in teaching and thus contribute to the confusion students and become a possible cause of failure. They said that some of the lecturers adapts to explicit teaching, command style teaching, teaching by task and many more. Three of the experts agreed that he/she initially adapted the explicit teaching strategy to teach his/her students computer programming. He/she aimed at teaching specific knowledge and skills and provided the necessary tools to assist the students in a particular study topic area to enable them understand the concepts. He/she agreed that the strategy is appropriate but does not provide the student the full understanding of the procedures and concepts of the course. The other two experts largely adapted real world puzzle-based teaching. They aimed at teaching students critical thinking and problem solving techniques. They believed using this approach equips learners with the ability to think through the syntaxes in both procedural and object oriented programming languages and they are able to apply these techniques in solving problems. In solving this problem, all the twelve experts invariably agreed to the fact that the teaching strategy adapted by computer programming teachers should be

multifaceted. Adapting multiple teaching methods enhances the success rate of the students and builds their confidence and skills. Though the experts agreed to the fact that sending computer programming students on field trips was a good approach to expose students to expand their horizon in computer programming, none of them employed this method in teaching computer programming. In order to assist the learners improve and strengthen their problem solving skills and sharpen their knowledge on the syntax of the languages taught, teachers must adapt methods, techniques and strategies that will be applicable in teaching the paradigms and the content.

VII. DISCUSSIONS OF METHODS AND STRATEGIES

For the purposes of improving the performance of students in computer programming courses, a list of teaching methods and strategies lecturers use were rated by students who have taken one or more computer programming courses at University. To improve on the success rate of the learner, many factors comprising of teaching methods and strategies have been listed for the students to rank in order of effectiveness and appropriateness.

VIII. FINDINGS ON SOME OF THE TEACHING METHODS

Among the identified teaching methods, it could be realized that the students rated the most effective methods which when adapted will enable them improve on their skills as compared to the least effective methods. From the responses provided by the respondents or students of the University, I have subdivided the level of effectiveness into two (most effective slightly effective is considered as one subdivision and generally effective not effective as the other subdivision) for the analysis.

LABORATORY PRACTICES

A large number of the participants agreed that to better understand the concepts learnt and improve success rate of computer programming, more time should be spent working with the student at the laboratory. They therefore ranked laboratory lectures as the first method among the selected methods in order of effectiveness. 92% of the participants agreed that laboratory practice is the most effective teaching method for teaching computer programming. Only 8% the participants disagreed to this fact. This exposes the learner to write up programs and apply the concepts learnt from teachers.

PROJECT WORKS

The participants believe that when lots of projects are given to students in computer programming courses, it enhances their understanding of concepts and sharpens their skills in the course. This means that if lecturers will actively engage students to improve their learning of computer programming courses, then they are to engage the students with many practical projects. 80% of the students ranked this as the second most effective method that can be applied in teaching of computer programming courses. Although 20 % of the respondents had different opinion, the majority are in favor and are of the view that it is the most second of effective teaching method.

LECTURES

To improve the performance of students in computer programming, students were asked to rank among other teaching methods the effectiveness of teachers' lecturing of computer programming and its impact on their passing rate. This was ranked third to projects in terms of enhancing learners' success rate. A considerable number of the students (68%) agreed unanimously that lectures are an effective method for teaching computer programming courses. On the

contrary, the remaining 32% somewhat disagree or were not in agreement whether lecturing affects their performance or not. In this regard, it could be emphasized that lecturers of computer programming courses are encouraged to adapt this method. Other factors that suffice in terms this method being effective method of teaching computer programming courses to reduce the failure rate and to improve on success or passing are teachers insuring that students actively participate in lectures and ensure effective completion of all aspects of courses properly.

IX. FINDINGS ON TEACHING STRATEGIES

From the findings, eight different teaching strategies were provided for the participants to rank in order of appropriateness. Some researchers explained these strategies. Explicit teaching aims at teaching specific knowledge and skills by providing tools to assist students in a particular study area, command style teaching aims at teachers being the sole authoritarian and students are to comply with the commands initiated by the teacher, teaching by task aims at allowing students to develop at their own rate and direction and take responsibility for their own learning, problem-based teaching aims at students engagement for problem solving, prerecorded lectures aims at using recorded lessons in class whereas puzzled-based teaching aims at teaching students critical thinking and problem solving techniques and pair/group programming aims at students working side by side on concepts taught. And other researchers of the area explained peer tutoring as the system of instruction in which learners help each other and learn by teaching. It is beneficial in helping students learn actively in a setting that promotes multiple-intelligences as cited in [14]. It is one of the most effective methods in promoting student centered learning. According to [14] peer tutoring aims at students teaching other colleagues. Learners understood these teaching strategies and gave their candid opinions on the most appropriate strategy to be

used in the teaching of computer programming courses to enhance the skill of the students as well as reducing the failure rate based on their experiences. Following the teaching method concerns, 84% of the participants indicated that one of the most appropriate strategies to be adapted for teaching computer programming courses is the problem-based teaching. The next strategy ranked second in the order of appropriateness as indicated by 81% of the participants is pair/group computer programming approach. They believe that the lecturer should engage and encourage group programming since it promotes team work and also increase the participatory level of all learners. On the scale of preference, the participants ranked peer tutoring as the third appropriate strategy that could be adapted by teachers of computer programming to improve the skill of learners and also to reduce the high failure rate. 73% of the participants believe that a student teaching a colleague student can be effective and it should be encouraged.

X. INAPPROPRIATE TEACHING STRATEGIES

All the selected participants indicated that command style teaching (78%) used by some teachers of computer programming affects the performance and it should not encouraged. Computer programming courses are difficult and the syntax is bulky to comprehend so the lecturer becomes the sole authoritarian and does not involve the learner it may worsen the case. Most of the participants also were of the view that pre-recorded lectures (69%) are not very appropriate to be adapted to teach computer programming courses. Students might not have the opportunity to understand the syntactical rules of the language being taught. A little over 50% of the participant agreed that explicit teaching, puzzled-based teaching and teaching by task are appropriate whereas almost 50% also are of different view. The participants ranked the methods of teaching and the teaching strategies in reference to the most effective

teaching method to least (Laboratory practice, Projects, Lectures Seminars and tutorials, Problem-based teaching, Field trips, E-learning, Continuous Assessment and Examination) and the most appropriate to the least appropriate (Command style teaching, Pair/group computer programming, Peer tutoring, Puzzled based learning, Teaching by task, Explicit teaching, Prerecorded lectures and problem solving teaching) respectively. In the case of the teaching methods, participants believe that teaching by laboratory practice engagement is the most effective and the least effective teaching method is continuous assessment and examinations. The emphasis should be placed on the acquisition of skill that will put the students above all odds. It turned out that most of the respondents were of the view for them to have the required skill and pass their computer programming courses; they are expecting their teachers to adapt a teaching method in which most of the time will be dedicated to laboratory practice and projects. These approaches will enhance teaching and learning of programming courses. According to [13][5], these methods aim to improve students' success rate by increasing their motivation and encourages the greater pre lectured methods, not only in assignments provided within the course, but also in further exploration of computer programming challenges outside the assignments' boundaries.

XI. CONCLUSIONS

From the analyses of the methods and strategies, the main problems identified by the selected experts who were interviewed and the survey conducted, it has been realized that aside the numerous causes of failure by University students' in computer programming courses discussed above, Computer programming is among the most challenging courses in computing and informatics school at Wachemo University, and the one that many find difficult to grasp, hence it is very important to select an appropriate teaching strategy like that of pre lectured methods [13] that will provide

University students with the most efficient learning environment [13]. It was realized that, the author adapted this strategy due to the long years (about 20 years) of teaching programming. The author though concentrated on first year computer programming students adapts this strategy in order to improve the performance. First of all, concepts are discussed; sample programs are given and other related activities. Following the discussed lessons, students are vigorously engaged in computer laboratory practical works, which is the laboratory practice to test their understanding on the concepts that have been presented. This and other assignments expose University students' different problem solving techniques and establish the students understanding to the steps that can be involved in computer programming. To improve on the teaching methods discussed above, the following have been outlined: a curriculum based computer programming courses that focuses on concepts rather than paradigms, the adoption of analogy in teaching computer programming, assessment (objective testing and performance based assessment although from the survey, but the researcher suggests that in the performance-based category, assessment such as laboratory exercise, programming assignments and examinations help to test students' ability to write working programs, the participants in this exercise are of a different view [15]. Therefore I can infer that this factor might be environmental dependent and must be relooked. To this point, I have been realized that there exists a teaching method and strategy that when adapted for the teaching of computer programming courses, both lecturers and learners will enjoy the course and high performance achieved as a result of the right method and approach that was adapted. Lecturers should adapt the method that will able his/her teaching concepts for the University students to understand and use the right tools such as different flowcharts and algorithms in order to help the students grasp the ideas that are relayed from the teacher to the learner/student. One approach adapted

by the some of the researchers at the time the research was conduct was combination of many methods and strategies. For example any computer programming challenge given to the student, they were expected the walk through the following (identification of problem, analysis (input, processing and output), design (algorithms and flowcharts) and then coding the problem). This method allows the students to bring out the understanding before going to the coding since direct coding in computer programming mostly confuses the students. To improve teaching and learning of computer programming courses, I recommend to lecturers to adapt more than one method or strategy in their instructional process. For students, to acquire hands on skills in computer programming, lecturers are requested to combine laboratory practice sessions, projects, seminar and tutorials along with lectures in order to encourage students to have several opportunities and to adapt to the best practice. This is in agreement to the findings of [15] which states that; lecturer's task is to select an appropriate teaching method or blend of methods. Out of many teaching methods, a lecturer can adapt any of the best approach would best suit his/her teaching environment. On the other hand, more than one teaching strategy should be adapt for teaching computer programming, I recommend that lecturers adapt peer tutoring, cooperative (1 to 5) learning, pair/group programming and problem solving teaching strategies to give learners better opportunities to interact with their peers and lecturers. Most participants believe that adapting one of these methods or one of these strategies makes computer programming very challenging and frustrating [5]. I conclude that computer programming lecturers should adapt effective teaching methods and appropriate teaching strategies in teaching computer programming courses that will encourage more students to work hard and become highly skilled computer programmers. This will mean that there will be an increase in computer programmers and

many real time applications will be developed to solve problems.

XII.RECOMMENDATION

Finally, I have recommended the following points to be considered in the coming research works.

In this research work information was not collected by considering ages, genders, academic discipline of participants as the research focus was teaching methods and strategies; however, future studies may expand on existing knowledge by identifying connections between these factors and teaching methods and strategies adopted by teachers' to enhance computer programming in order to increase university students success rate and skills development.

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