

A Novel Approach to improve Logical and Critical Thinking through Collaborative Learning and using Visualization tools

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Abstract: Programming Languages are fundamental subjects in Computer Science and Engineering domain. The programming includes basic knowledge of the language, tools, logic building, critical thinking, and problem-solving. However number of students are facing problems while studying programming language. The reason could be that their logical thinking and critical thinking capacity. Now a day's advanced teaching methodology is the innovative way to boost teaching and learning performance. This paper is based on collaborative learning and use of visualization tools for improving students programming skill as well as their logic building capacity. Visualization of a program, its execution and explanation of program behaviour along with its output help students to advance their logical thinking as well as programming skill. Collaborative learning makes students work in a group and students involve one another to ask for information, evaluate their ideas and monitor work together.

Keywords: Collaborative Learning, Visualization Tools, Logic Building, Critical Thinking, Teaching Learning Process.

INTRODUCTION

Learning C programming Language is the first step towards the study of Programming Languages. Study of any programming language includes analyzing the problem, problem-solving, writing an algorithm, converting the algorithm into solution in terms of the program [1]. It requires problem-solving, logical thinking and critical thinking, hands-on programming skill to get appropriate solution. In traditional teaching system focus was only on the basic concept and its syntax, but students were facing lots of problems to understand how the exact program works, how flow transferred from one point to another, how memory management works. They need more focus on practical oriented approach and hands-on practical sessions. To overcome the limitations of traditional teaching methods, we need to reform teaching-learning methods and need to

make it more collaborative and interactive [6]. C programming language teaching is not restricted to just introduce the basic syntax of C language, but the C language as a practice tool, the main line programming method, the syntax, and structure as the core, focusing on the combination of theory and practice, nurture student's interest and the practical skill. Now a day's number of innovative teaching-learning methods are introduced and are as follows [3]:

1. Think pair share
2. Flipped classroom
3. Collaborative learning
4. Project-based Learning
5. Role play activity
6. Use of MOODLE
7. Use of Visualization Tools.



Figure 1: Teaching Learning Method for C Programming

Figure 1 shows a new approach to teaching and learning C Programming. This is the combination of traditional and modern teaching methods. This approach requires step by step execution of methods in theory session.

1. Introducing basic concepts of C programming.
2. Explaining concepts along with its syntax with the help of chalk and boards or PPT.
3. Display the problem statements related to the concept.
4. Ask students to discuss given problem statement in the group of 3 to 4 students.
5. Ask students to write algorithm and program individually.
6. Ask one student to come forward and implement the same program using visualization tool.
7. The remaining class will verify whether a correct program is written or not.
8. If corrections require then another student will come forward and will correct that program.
9. At the end, all students will come to know how exactly that program works step by step, how and when memory will get allocated to the local variables and global variables, how control transfers from one point to another with the help of visualization tool.

1. Use of Visualization Tool

2. Writing C program is somewhat easy as compare to understanding how exactly it works at the backend. Students use to write C program but sometimes they don't understand how the function call works, what is the local and global variables, how memory is allocated to array, how pointer and structure works. Here, visualization tool plays a vital role to make them understand everything about program execution[2]. Nowadays the number of visualization tools are available that visualize program execution line by line. The following figure shows screenshot taken of the visualization tool during execution of the program.
3. This tool is freely available by following the link: <http://www.pythontutor.com/c.html#mode=edit>.
4. **Problem Statement:** C program to write functions for addition and subtraction of 2 numbers. Following screenshot demonstrate how the function works.

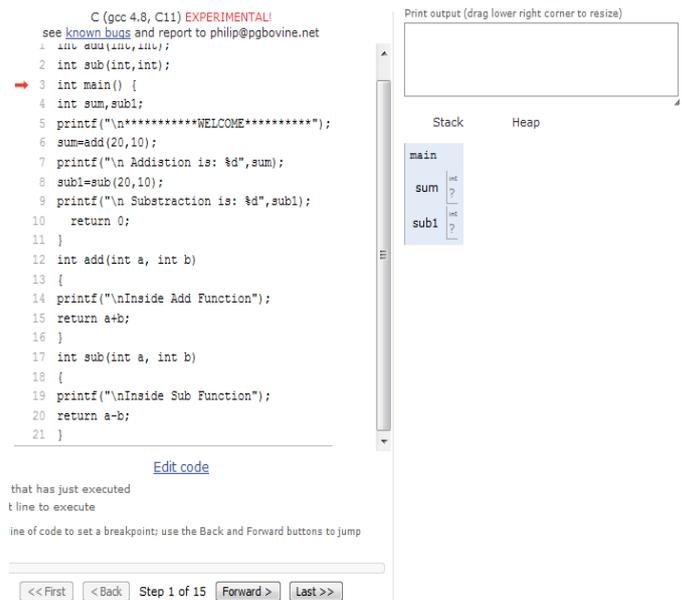


Figure 2.a: Screenshot 1

Screenshot 1 gives outline of visualization tool, which includes C program, Output window, and memory tab (Stack and Heap) and arrows. At the bottom, there are options like first, back, forward and last. Using this we can control the flow of execution and we can see how the program works. There are two arrows, the red arrow points to the next line to be executed and green arrow points to the line that has just executed. Memory tab shows stack and heap allocation as the program executes and output window displays output as the program executes. In figure 2.a, memory tab shows memory space for the main function which includes two variables sum and sub1, with empty output window. Will see step by step execution of this program through screenshots.

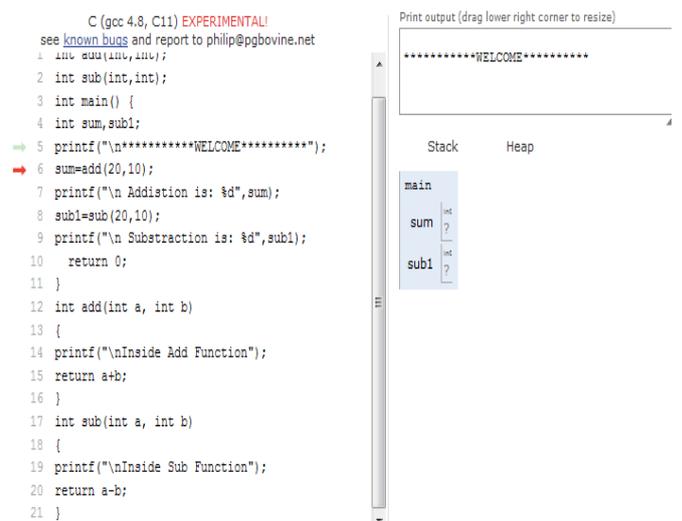


Figure 2.b: Screenshot 2

Screenshot 2, shows output window with some value display by printf function.

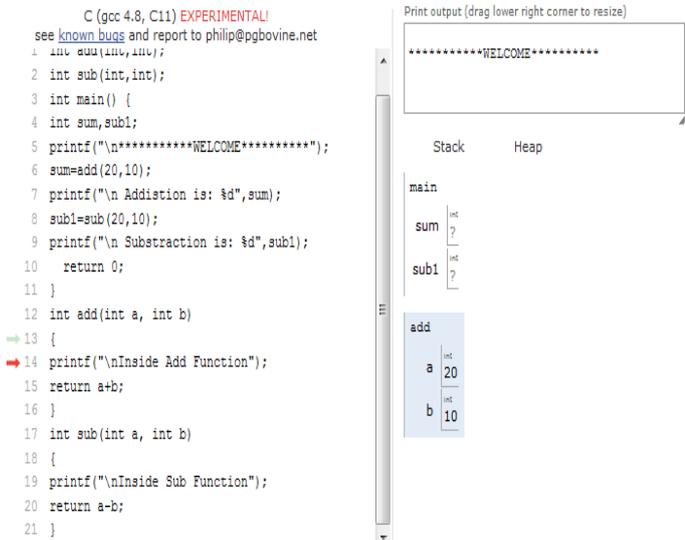


Figure 2.c: Screenshot 3

Screenshot 3, shows memory allocated for user defined function add.

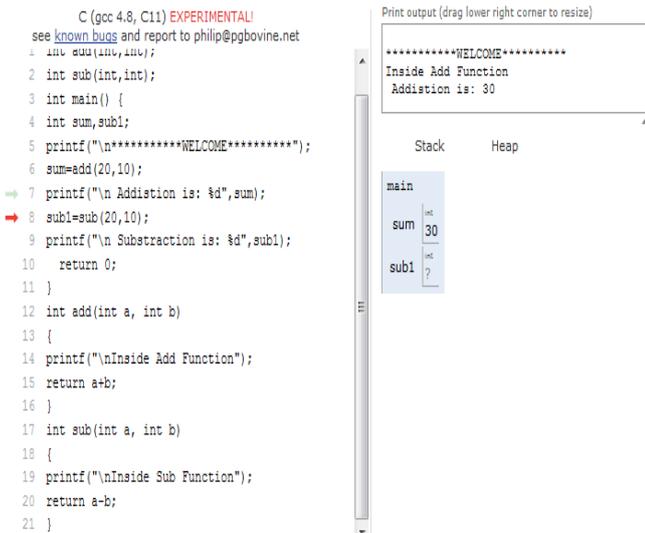


Figure 2.d: Screenshot 4

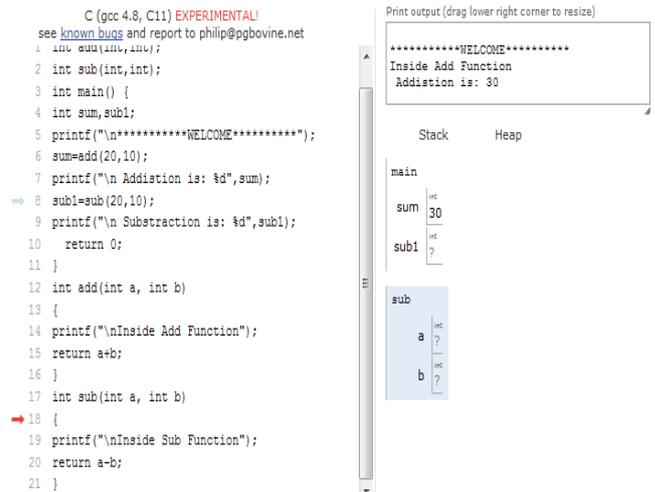


Figure 2.e: Screenshot 5

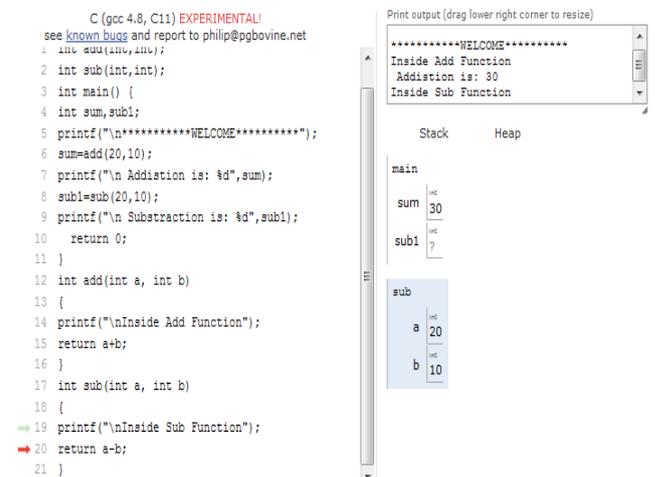


Figure 2.f: Screenshot 6

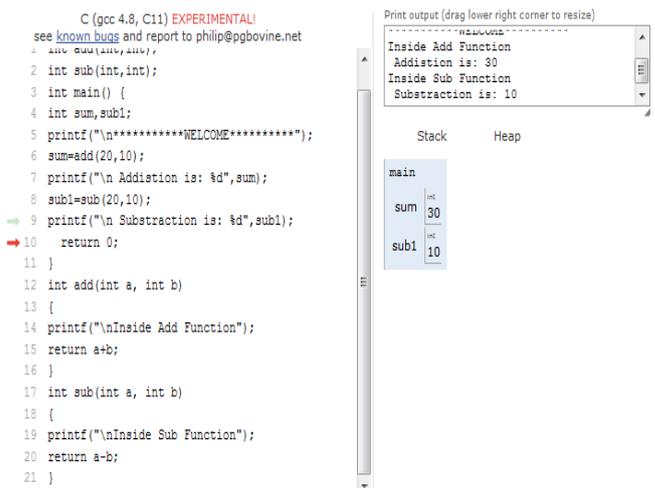


Figure 2.g: Screenshot 7

5. Collaborative Learning

Collaborative Learning includes the group of students that work together to solve a problem and accomplish given task before the deadline. In this learning take place

through active engagement among peers [6]. Figure 3 shows characteristics of Collaborative Learning.



Figure 3: Characteristics of Collaborative Learning

Laboratory sessions are planned to promote active and collaborative learning among the students.

Lab Activity:

1. At the beginning of the semester, students will be divided into group of 3 to 4 students.
2. Before the lab session, problem statements will be uploaded on MOODLE by faculty.
3. At the start of the practical session, faculty will instruct the students about problem statements to be implemented during lab session and discuss the basic concepts required to execute those statements.
4. All the team members need to discuss problem statements and then one student will draw a flowchart, one will write an algorithm and one will write a program in discussion with each other.
5. The student has to note down errors occurred during program execution as well what action they have taken to remove those errors.
6. After completion of one program role of student will get changed like earlier who has drawn algorithm will write a program. Alternatively, they need to follow same.
7. After completion of all the programs students have to submit notebook for checking of algorithm and flowchart and all have to upload programs on MOODLE for assessment.

RESULT ANALYSIS

To check the improvement in the performance of student after applying new teaching-learning methods, the result of two academic years 2015-16 and 2016-17 are considered here. From figure 4, it is observed that there is a drastic change in the result of C programming course. In

the Academic year 2015-16, the Traditional method was used to teach a course and in academic year 2016-17 reformed teaching-learning method was used which results in improvement in student result.

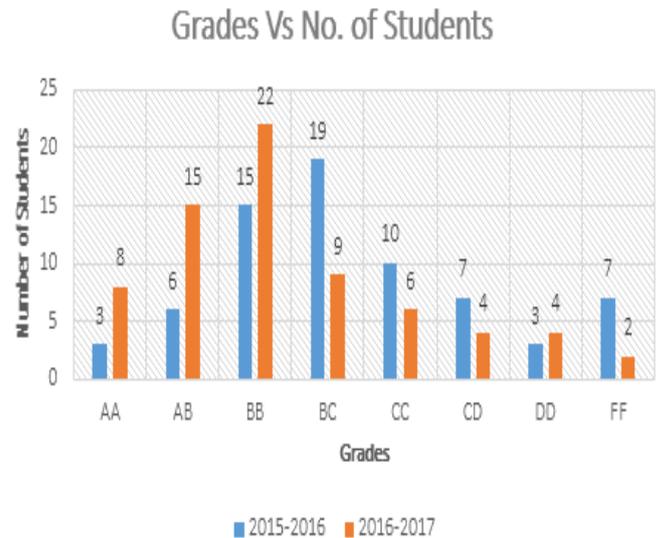


Figure 4: Result Analysis

CONCLUSION

From the above, we can conclude that the Information and Communication Technology has made many innovations in the field of teaching and also made a drastic revolution from the old prototype of teaching and learning. Traditional teaching technique was teaching-centric and now it is transformed to student-centric. Visualization tool makes a great impact on students mind to remember the concepts and to understand the working of the program. In the teaching method of creating a new teaching mode, proper arrangement of teaching content, design teaching case, pay attention to practice and evaluation of curriculum reform is the key. Collaborative learning helps to develop higher level thinking skills and promotes a positive attitude toward the course. Hence, in order to achieve the great result, we need to move toward modern teaching mechanism from traditional teaching methods.

REFERENCES

[1] Hongqing Wu, Shaoyun Song, and Jiong Wu " Innovation Teaching Design on the C Programming of Ability Guidance" Advanced Materials Research Online: 2014-06-25
 [2] Program visualization and explanation for novice C programmers, Matthew Heinsen Egan1 Chris McDonald2 Proceedings of the Sixteenth Australasian Computing Education Conference (ACE2014), Auckland, New Zealand
 [3] V T Lokare, P M Jadhav, "A Holistic Approach for Teaching Data Structure Course in the Department of Information Technology", Journal of Engineering Education Transformations, 2017.

[4] G. G. Shinghan Nagaraj V. Dharwadkar, "Student Quality Circle" , IUCEE-2017, Vardhaman College of Engineering, Hyderabad, 2017Publisher, IUCEE-2017.

[5] AR Jakhale, AC Attar, "A Novel Approach towards Outcome Based Engineering Education for Continuous Quality Improvement: A Case study", Journal of Engineering Education Transformations, 2015.

[6] Zachary A. Reed, "Collaborative Learning in the Classroom", faculty professional development program conducted by the Center for Faculty Excellence, United States Military Academy, West Point, NY, 2014.

[7] P.S.Jadhav, A.M. Mulla , P.M. Jadhav,(2017), "Blending ICT with Project based Learning for effective teaching and learning of Mechatronics", Journal of Engineering Education Transformations, 30(3), 47-51