

Impact of ICT Tools in Logic Development of Computer Programming Skills

Jayashree A. Patil¹, Shubhangi P. Kale²

^{1,2} School of Computer Engineering & Technology

^{1,2} MIT Academy of Engineering Alandi (D), Pune - 412105, India

¹ japatil@it.maepune.ac.in, ² spkale@comp.maepune.ac.in

Abstract : Every field of engineering and technology consists of problems to be solved using computers. Learning problem solving skills using computer programming in the first year is important. At first year, students learn various courses of engineering streams, they should inculcate the development of solutions to problems which yields better logic development for further years of graduation. So the aim of Computer Programming (CP) course as part of curriculum in first year is to develop solutions to the problems using Python and MATLAB programming. Students get admitted to first year by Directorate of Technical Education (state government body for allocating engineering seats for merit students) with various backgrounds like heterogeneous culture, unable to cope with learning abilities, immaturity, language and communication gap, different education boards etc. Need a different kind teaching learning methods where every student must understand and solve the problems. Earlier we used to teach students of Savitribai Phule Pune University the course, Fundamentals of Programming Languages-I & II, when many challenges came to surface as discussed, which impacted on their result. Earlier the result was around 50 to 60%, now use of ICT and conducting different activities it is reaching around 80%. Thanks

to IUCEE for conducting training for how to teach millennium students and providing awareness of different kinds of ICT tools for teaching. By this we have come to know that teaching using ICT is one of the best ways to develop solutions to problems using programming skills. We used different learning aids such as learning management system like moodle, google classroom, canvas. Activities like think-pair-share(TPS), online quizzes on socrative, kahoot, zipgrade etc., roleplay, collaborative learning strategies like STAD, jigsaw etc., gallery walk. The paper also shows the reflective report of each activity conducted in graphical representations. The graphs show that thinking ability of students has improved. In the future, we want more ICT tools to be used to improve thinking ability and result of final course examination by overcoming difficulties occurred during previous year implementation.

1. Introduction

The computer programming course is introduced in the first-year, as similar courses at other autonomous institutes. The content was always dictated by the needs of computer science majors. The main objective of this course is to develop the thinking and logic building for the problems and to address the weaknesses in student's abilities for abstract thinking and generic problem-solving skills by concrete constructions. This requires a new way of teaching, which implements the theories of constructivism, active learning, and collaborative learning activities

Jayashree A. Patil

School of Computer Engineering & Technology

MIT Academy of Engineering Alandi (D), Pune - 412105, India

japatil@it.maepune.ac.in,

like think-pair-share, minute paper, roleplay, gallery walk, quizzes by using the app's like kaun banega crorepati (Jean-charles et al., 2011), kahoot tool, poster making, power point presentations, mindmap. Participation in such activities promotes learning by doing as it is requirements for 21st century learners. We introduced Python and MATLAB programming as a practical course and problem-solving techniques as a theory. Students were attracted towards this course due to the use of innovative teaching-learning aids such as learning management system like moodle, google classroom, canvas, whatsapp group, where teachers can configure the quizzes and assignments as they want. Students will upload all the programs in moodle and assessment is done online on different test cases. We follow both continuous and summative assessments, the continuous assessment will check the students daily activities and programs what they perform in the lab and activity participation. Summative assessment will be assessed on mid-semester examination and end semester examinations.

The School of Computer Engineering & Technology at MIT Academy of Engineering has offered computer programming course in the first-year since last two years. The content was always dictated by the needs of computer science majors. It is difficult to engage many engineering students because engineers and computer scientists approach towards programming have divergent goals. While engineers typically create programs that they will use themselves, computer scientists typically create programs for use by non-programmers. Students of all disciplines have to learn this course. In first-year engineering, students are of varying backgrounds, like different culture, different language and from different boards of education. Students of CBSE (Central Board of Secondary Education) and ICSE (Indian Council of Secondary Education) board have good knowledge of programming whereas others are very poor. So maintaining the uniformity in learning is a difficult task.

We introduced Python and MATLAB programming as practical course and problem solving techniques as theory. Python and MATLAB are dynamic programming languages that can be used to learn and teach a full range of computer science concepts—from conditionals and variables to recursion and object-oriented programming. This course introduces students to one of the most modern

tools used in the creation of contemporary arts of programming: creative coding and computing. It teaches creative coding and computing as a form of expression and real-time problem solution. It also covered how computer programming and its ease-of-use have changed the face of creative coding in the modern world and push the boundaries of logical thinking. Using the right blend of computer programming along with science and technology, it expands students' understanding of computing applications, with a specific focus on the creation of digital arts. Using a hands-on, exploratory approach, this course was designed for students with no particular background in computing, except basic computer literacy at the level of operating a computer for personal daily use and with some interest. Students were attracted towards the computer programming course due to the use of innovative teaching, learning aids such as learning management system, mobile application, blended learning, animations, gamification and much more.

2. Methodology

Participants: Today's children use more technology than any previous generation. They are known as a millennium learners and as per the survey attention span of these students is 15 minutes. These millennium learners are of various backgrounds; so used different learning styles and aids for teaching and learning. Our institute has class strength of seventy(70) students, and all of them participated in this research.

Materials: Activity 1: Entry Level Test

In each semester, the entry level test was conducted to check the basic knowledge of the computer programming. By this activity, we have analyzed the programming skills in a student. To do this we used Zipgrade mobile app, a format has shown in below Fig 1. Each student will get the sheet, and they need to fill all details and questions that are displayed on the projector. Student has to circle the correct answer and submit the sheet to teachers. The zipgrade mobile app is available on which scans the grade sheet and give the evaluation of the students in percentage form.

Activity 2: TPS(Think-Pair-Share)[3]

Think-Pair-Share (TPS) is an in-class active learning strategy in which students work on individual

activities, discuss with peers and share their newly discovered knowledge with class. TPS helps in eliciting and sharing different possible solutions from students.

Activity 3: Scenario based Learning to use STAD Collaborative Learning

The objectives of the collaborative activity is to share strengths and develop the weaker skills, to improve positive interdependence and interpersonal skills, to make students understand the Problem solving concepts and to increase the creativity of the students while writing code (Luisa et al., 2011) (Tiantong et al., 2013).

STAD (Student Teams-Achievement Divisions) is a collaborative learning activity, in which students are assigned to four-member learning teams that are mixed in performance level, gender, and ethnicity. The teacher presents a lesson, and then students work within their teams to make sure that all team members have mastered the lesson. Finally, all students take individual quizzes on the material, at which time they may not help one another. The activity was planned for two hours, student were informed to discuss their experiences related to given task.

Activity 4: Role Play for sorting techniques:

The role-play is an effective teaching activity in which each student concentrates on playing the role as a participant to explain the different sorting techniques such as bubble sort, merge sort and selection.

Procedure: Designed the class preparation in such a way that different learners can be taught differently. For the reason we have prepared micro and macro level course planning to define various activities and learning techniques to conduct Computer Programming course in first year. Micro level course planning consists of minute to minute class conduction details. We have divided one hour lecture into 4 to 5 segments each segment will be of 10 to 15 minutes in that what points we covered the lecture is mentioned. And it also consisted activity to be conducted for that particular class. Macro level course planning consists of topic level planning. The materials used for teaching are hardware and software tools like, audio or video kits, Animation videos, Power point presentation. The various activities are

conducted to explain the basic concepts of the computer programming, like quiz using mobile app (socrative, mobile moodle, zipgrade, google classroom, kahoot), role play for different sorting techniques, jigsaw activity, TPS activity, student information card.

3. Results And Discussion

The below figure represents the demonstration of role-play activity conducted during laboratory hours. The rubrics followed to evaluate the student's performance in role play activity and the same performance considered as part of Internal Assessment for the course computer programming.

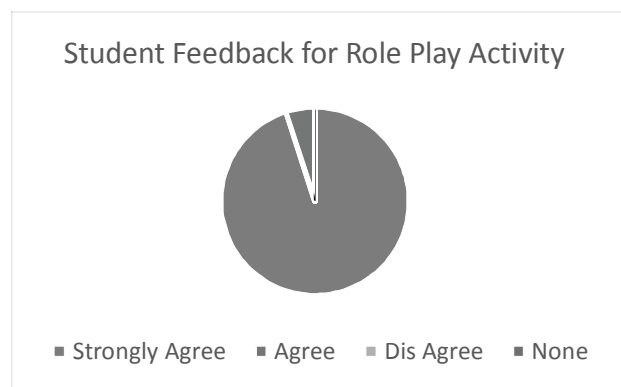


Fig 1: Students demonstrating the role-play activity for bubble sort technique

**Table 1: Rubrics of role-play activity
(Tracy et al.,2012)**

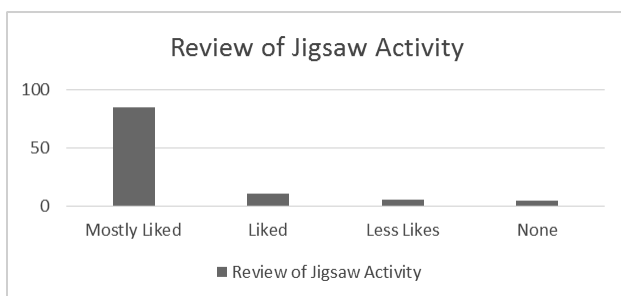
Criteria	Rating		
	Excellent 2 points	Good 1 point	Poor 0.5point
Understanding of Sorting Technique	Excellent 2 points	Good 1 point	Poor 0.5point
Performance of Sorting Technique	Excellent 2 points	Good 1 point	Poor 0.5point
Algorithmic Solution of Sorting	Excellent 2 points	Good 1 point	Poor 0.5point
Involvement of the Students	Excellent 2 points	Good 1 point	Poor 0.5point
Time Management	Excellent 1 point	Good 0.5 point	Poor 0 point
Analysis of Sorting Techniques	Excellent 1 point	Good 0.5 point	Poor 0 point

The student's constructive feedback was taken to evaluate the students learning from the role-play activity.

**Fig. 2: Students feedback on the role-play Activity**

The reflections of the role-play activity motivates weak/shy students to participate, Pre-assignment and time management are necessary to get 100% success in role-play activity. So, its an effective tool to explain sorting techniques of computer programming.

Similarly, the jigsaw activity was conducted on Computer Applications. After conduction of the jigsaw activity, the student's review was taken for the activity as:

**Fig 3 : Review of Jigsaw Activity**

Reflection of teachers:

Dynamic crowd, large class strength, activities like TPS, minute paper activity were less efficient. Whereas STAD, role-play have a high impact in learning and all the concepts will be cleared related to topic chosen for activities. The reason for high impacts are as follows:

- Rich exchange of responses
- Individual accountability
- Active interaction promoting active learning
- Exact picture about the depth of their understanding
- Peer evaluation
- People know very well each other.

Things that did not work:

Any activity conducted will not give 100% satisfaction, as students are of various background like reluctance of few students to participate: some students are shy, not to open with others, showing negligence to people. Activity like TPS cannot be possible to complete in 10 minutes as class size is big.

Strategies to improve:

Help the students, identified with weaker concepts and work collaboratively to build a strong foundation by providing them good references, practice papers, regular interactions etc. so that they are confident enough to participate next time, hence ensuring 100% participation. Need to work on time management.

Benefits of activity:

There are some topics in our course which cannot be taught using chalk and talk or PPT. We surveyed different kinds of activity to suit the topic. According to it we designed the activity and conducted.

Conclusions

For the millennium learners, the life long learning is very important than the teaching. In First Year B.Tech course, the first responsibility of the instructor is to provide computer engineering skills,

programming knowledge, based on experiences. To improve the quality of teaching, the life-long learning should focus on learning needs and requirements of the learners. The various activities are conducted to explain the basic concepts of the computer programming such as: an entry level test to check the knowledge of the learners, quiz using mobile app (socrative, mobile moodle, zipgrade(Padmashree et al., 2012), google classroom, kahoot), role Play for different sorting techniques, jigsaw activity for Computer Programming applications, group presentations, TPS activity. The reflection of the activities conducted during teaching learning are as: motivation to weak/Shy students, time management, lack of confidence, extra excitement, class control, strength of class.

Acknowledgements

We would like to show our gratitude towards Dr. Yogesh Bhalerao, Director, MITAOE Alandi (D) for sharing his pearls of wisdom with us during the course planning, teaching, providing various training in Engineering Education. We thank our management for infrastructure, facilities made available. Last but not least we thank to our students who are the main soul of this paper.

References

- [1] Maria Kordaki, Maria Grigoriadou, (2010). A Collaborative and Adaptive Design Pattern for the Students Team Achievement Divisions' Method: An Implementation within Learning Design-Based E-learning Systems, International Conference on Intelligent Networking and Collaborative Systems, 24-26.
- [2] Ladislav Végh , Veronika Stoffová, (2017). Algorithm Animations for Teaching and Learning the Main Ideas of Basic Sortings, Informatics in Education, 16(1), 121–140. Patil Deepti Reddy
- [3] Shitanshu Mishra, Ganesh Ramakrishnan, Sahana Murthy, (2015). Thinking, Pairing, and Sharing to Improve Learning and Engagement in a Data Structures and Algorithms (DSA) Class, International Conference on Learning and Teaching in Computing and Engineering, 9-12.
- [4] Luisa M. Regueras, Elena Verdu, María Jesús Verdu, Juan P. de Castro (2011). Design of a Competitive and Collaborative Learning Strategy in a Communication Networks Course, IEEE Transactions on Education, 54(2), 302-307. Tracy Chow
- [5] Edmond Ko, Cindy Li, Catherine Zhou, (2012). The systematic development of rubrics in assessing engineering learning outcomes, IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE), 20-23. Padmashree Desai
- [6] G.H. Joshi, (2012). Activity based teaching learning in software engineering - An experience, IEEE International Conference on Engineering Education: Innovative Practices and Future Trends(AICERA), 1-6. Pang Nai Kiat
- [7] Yap Tat Kwong, (2014). The flipped classroom experience, IEEE 27th Conference on Software Engineering Education and Training (CSEE&T), 39-41. Aracele Garcia de Oliveira Fassbinder
- [8] Tiago Gonçalves Botelho,; Ricardo José Martins, Ellen Francine Barbosa, (2015). Applying flipped classroom and problem-based learning in a CS1 course, IEEE Frontiers in Education Conference (FIE), 21-24. Jean-Charles Marty
- [9] Thibault Carron, (2011). Observation of Collaborative Activities in a Game-Based Learning Platform, IEEE Transactions on Learning Technologies, 4(1), 98 -110.
- [10] Umadevi V, Collaborative Learning: Design and Reflections in a Web Programming Course, Journal of Engineering Education Transformations, eISSN 2394-1707.
- [11] www.unipune.ac.in/ (2018).
- [12] Tiantong, M., & Teemuangsai, S., (2013). Student team achievement divisions (STAD) technique through the moodle to enhance learning achievement. International Education Studies, 6(4), 85.

ANNEXURE

Activity 1: Entry Level Test

370

Name	AMEY NERKAR		
Date	04/01/2017	Period	

ABCDE					ABCDE				
1	☐	☒	☐	☐	11	☒	☐	☐	☐
2	☐	☐	☐	☒	12	☒	☐	☐	☐
3	☐	☐	☐	☒	13	☐	☐	☒	☐
4	☒	☐	☐	☐	14	☐	☐	☒	☐
5	☐	☒	☐	☐	15	☐	☒	☐	☐
6	☐	☐	☐	☒	16	☐	☐	☒	☐
7	☐	☐	☒	☐	17	☐	☐	☒	☐
8	☒	☐	☐	☐	18	☐	☐	☒	☐
9	☒	☐	☐	☐	19	☒	☐	☐	☐
10	☐	☒	☐	☐	20	☐	☐	☒	☐

Get this form and more at: ZipGrade.com Form 23

Fig 4 : Answer Sheet of Entry Level Test

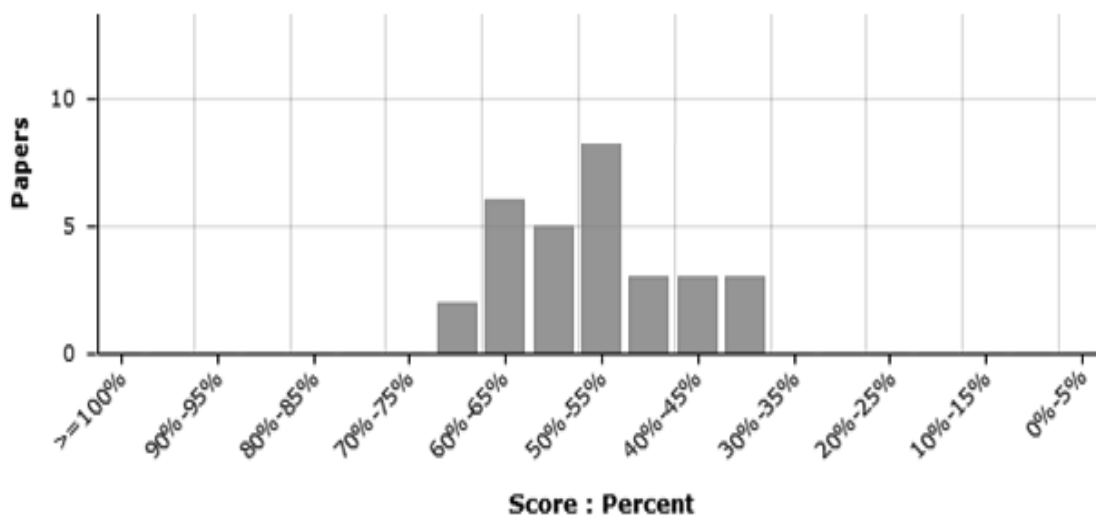


Fig 5: Performance Analysis of zipgrade App

After scanning of the all answer sheets using zipgrade mobile app, this excel-sheet is used for the performance analysis of students.

Activity 2: TPS(Think-Pair-Share)(Patil et al., 2015)

TPS activity: objectives: 1) To make better understand of the topic.

2) To increase the thinking, sharing ability in students.

Design:

Resource – <i>Think-Pair-Share Activity constructor</i>	Version 1.0 June 2016
--	------------------------------

Part 1 – Plan your TPS activity

1. Topic Name: Unit-I (Operators)

Abstract: operators are predefined actions performed on data items combined with variables to form expressions and statements which denote the work to be done by the program. Each operator may correspond to many machine instructions.

Three things to know about each operator

- (1) Function: what does it do
- (2) Precedence: in which order are operators combined
- (3) Associativity: in which order are operators of the same precedence combined

Most widely used operators are:

- 1) Assignment operators 2) Arithmetic operators 3) Logical operators
- 4) Relational operators 5) Bit wise operators 6) Special operators

2. Think phase:

A large department store has its own charge card. The policy for a customer to charge an item is that the customer must have a valid charge card and either a balance of less than \$500 or a charge amount of less than \$50.	7 Minutes
What will Instructor do: Provide list of f operators to be used and their precedence	
What will students do: Create the expressions using the operators and their precedence.	
Deliverable from this Phase: Final expression	

3. Pair phase: Two students can work on together

Identify 1) Whether the expression gives correct result 2) The correct sequence of operators in each one's expression. 3) If 1) and 2) or wrong than together can build the expression with proper use of operators.	8 Minutes
What will Instructor do: Hint how to write	
What will students do: Writes new set of expressions with precedence and associativity	
Deliverable from this Phase: power of knowledge sharing	

4. Share phase:

Compare your solution with instructor's demo program for exchange sort. Identify points where your solution is different and share them with the class	7 minutes
What will Instructor do: show the demo program for the solution	
What will students do: cross verify the result and find their mistakes	
Deliverable from this Phase: Complete knowledge of operators	

Activity 3: Scenario based Learning using STAD Collaborative Learning

Following strategy used for group forming.

- 1) selected students who have already studied computer programming languages in their 10th and 12th standard.
- 2) made him/her as team leader. under each leader added four to five students.
- 3) Among four to five students, 2 are from CBSE board and 3 from state board.
- 4) totally 12 groups are formed.
- 5) for each group one different task is given like to write the algorithm and flowchart for real-time applications problems.
- 6) group scattered across the classroom as our classroom size is big enough.

Design: the class is converted in three batches like A1, A2, and A3. Each batch will have 23 students. I have decided to divide into group of 4 students' batch wise and assign the problems,

Read the given phrase and answer the questions given at the end.

Question: Mira and her best friend Leena are now ending high school and soon they both will head separate ways. Mira will obviously study Computer Science while her best friend will study Arts. However, as Mira didn't want to lose contact with her, she decided to mix Art and Computer Science one last time and amaze her friend with Computer Science, so she could have a geek coding partner. To amaze her, she encoded a message in two strings, which she presented to her friend: Mira: "So, Leena, as you can see, we have two strings here, yes? We have a first longer string, S1, which encodes our common path together, and is represented by some letters which represent our lives so far as well all the events we lived together. The second string, S2, will be as long as the first one or possibly shorter and it is here to represent what the future might bring to both of us :) It is also only composed of letters, which represent some life events we might still experience together in the future(www.unipune.ac.in).

What I would like you to do, is to find out if the future will be just like now, and, for that, you need to find a contiguous sequence of letters in both of these two strings. Obviously, as I want our friendship to last very, very much, I ask you to find the longest sequence of life events we might still experience together and tell me which sequence is it and how long is it.

However, if fate doesn't want us to be together, simply tell me the number 0 and we shall both head separate ways forever. Turns out, that after Leena solved the problem, she became so interested in CS herself, that both she and Mira are now working together at a very reputable software company.

- 1) Identify inputs required
- 2) Identify the required output
- 3) Identify the constraints
- 4) Explain with an example

Input

The input will consist of two strings composed only of the letters a..z, both of which are at most 250.000 characters in length.

Output

The output should be as stated. If there is a common life event in Mary and Lira's lives, you should output it on a single line and, on another line, you should output the length of the event. Otherwise, simply output 0.

Activity 4: Role play :

The main objectives of role-play activities for sorting techniques are as follows:

- To explain the different sorting techniques (Bubble Sort, Selection Sort, Merge Sort)
- To demonstrate the different sorting techniques
- To analyze the different sorting techniques
- To build solution for sorting techniques using programming skills

The implementations of the role-play activity as follows:

- At the start, the definition of sorting, uses of sorting, ascending and descending order of sorting with one basic example was explained
- The formation of three major groups of 8 to 10 students by number calling 1,2,3. The student who called 1- Group 1, 2- Group 2 and 3- Group 3
- Group No 1 performed role-play activity for Bubble sort
- Group No 2 performed role-play activity for Selection sort
- Group No 3 performed role-play activity for Merge sort
- 10 minutes gave to understand, think, preparation of the given sorting techniques
- First group has performed role-play activity for Bubble Sort, explained the algorithmic steps required for the Bubble Sort and other groups analyzed the Bubble Sort.
- Similarly other two groups performed the role-play activity for selection and merge sort.

The assessment of the groups performed based on the rubrics.