

# An Integrated approach for teaching Object Oriented Programming (C++) course

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**Abstract:** As majority of the students were lagging in programming skills, it is a challenging task to teach programming language courses like C, C++, and Java etc. To increase the logical skills of the students while learning C++ course we have applied different innovative teaching learning practices. The result analysis drawn at the end of the semester shows the noticeable improvement in the grades of the students. The course outcome attainment is also calculated and analysed. Finally, the individual students programming skills improvement from C programming, Advanced C Programming to C++ programming has been analysed. The use of different innovative teaching learning practices lead to noticeable improvement in many students.

**Keywords:** Teaching learning practices, programming language, programming skills, C++

## 1. Introduction

The prime purpose of C++ programming was to add object orientation to the C programming language, which is in itself one of the most powerful programming languages. Object oriented programming is method of programming where a system is considered as a collection of objects that interact together to accomplish certain tasks. Objects are entities that encapsulate data and procedures that operate on the data. Understanding of C programming concepts is the prerequisites to understand the Subject. Here in this paper the analysis of the programming skill of the same class of the student for C, Advanced C and C++ course is carried out. The basic reasoning behind the improvement in the individual student is depend on the different teaching learning practices applied during the course.

To teach object oriented programming (C++) course, following teaching learning practices have been applied.

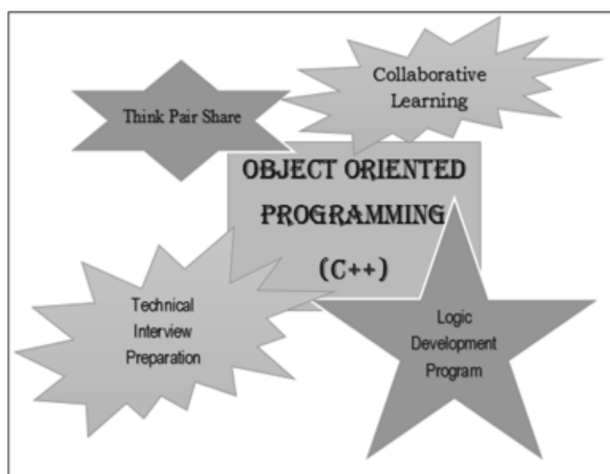
1. Think Pair Share
2. Collaborative Learning
3. Technical Interview Preparation Sheet
4. Logic Development Program

Think pair share is the performance improvement proven activity by many teachers [1]. For overall

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**Figure 1: Teaching Learning Practices**

improvement of the students many activities have been carried out by the department [2, 3, 4], here while teaching this course the more focus is given to placement of the students in reputed company. So, all possible questions asked in placement drives during technical interview were covered in technical interview preparation sheet i.e. one google form is created and shared by all students in the class. For weak students, collaborative learning [5] is beneficial as for a single instructor it is very much difficult to entertain each and every student. If they solve queries in a group, it will help to develop their programming skill and logic. Also it has been observed that in a class of 70 to 80 students, different type of learners are there. Few students may be weak in programming, few might be average and few might be excellent. So, new method: Logic development programme has been introduced and applied in this course. To motivate all type of students, level wise contests were planned and winners were decided separately at each level.

## 2. Teaching Learning Practices

Total five different innovative teaching learning activities have been applied while teaching object oriented programming (C++) course. In this section all activities are explained in detail.

### A] Activity 1: Think Pair Share

#### I Outcomes:

1. To understand the properties of Object Oriented Programming.
2. Able to relate real time situations with OOP concepts.

#### II Student Role:

1. Read the Problem Carefully
2. Note down the Answer
3. Compare Answer with neighbouring student
4. Discuss on the solution
5. Agree on only one solution
6. Share the answer with the class in pair
7. Give the feedback about the activity

#### III Teachers Role:

1. Display the problem
2. Tell Students to think individually and write down the answer
3. Tell students to discuss with neighbouring student about the answer
4. Tell each pair of student to agree on one solution
5. Randomly select two or three pairs from the students and tell to share the answer with the class
6. Disclose the correct answer
7. Note down the pairs those have solved the problem correctly and give the marks
8. Take feedback from the students about this activity

#### IV Activity Plan

1. Task Given to the Students Identify Object Oriented property (Abstraction, Polymorphism, Encapsulation, and Inheritance) which is more suitable for real time situations mentioned in Table 2.
2. Tell students to think individually on each problem statement and note down the answer
3. Next tell students to discuss with neighbouring student (10min) and agree on only one answer
4. Randomly select two/three pairs and tell them to share the answer in front of the class (10min)

5. Disclose the correct answer

6. Give marks to the students according to their performance.

### B] Activity2: Collaborative Learning

This teaching learning methodology has been applied for OODP Laboratory course to enhance the programming skills of the students.

#### I. Outcomes:

1. To enhance the programming skill

**Table1: List of OOP Properties**

Sr No.	Problem Statement	Think Time
1	Talking about Bluetooth which we usually have it in our mobile. When we switch on the Bluetooth I am able to connect another mobile but not able to access the other mobile features like dialling a number, accessing inbox etc. This is because; Bluetooth feature is given some level of abstraction.	<b>20 min</b>
2	When mobile A is connected with mobile B via Bluetooth whereas mobile B is already connected to mobile C then A is not allowed to connect C via B. This is because of accessibility restriction.	
3	In our Bank account class someone accesses the attribute of Balance and trying to change it but due to this property not able to do that.	
4	We are writing a bank account class, essential qualities of bank account are Opening date, Account title, Account number, Balance etc.	
5	We behave differently in front of elders, and friends. a single person is behaving differently at different time.	
6	Suppose if we want to design a Clock class. In this Clock class, we can define Clock properties like: length, width, height, colour, shape, style. But we need not define all those properties. If our client/user needs only length, width and colour of the Clock, then we should consider and define only those as the properties of the class Clock and can neglect/hide other unnecessary properties.	
7	Father and Son Relationship	
8	TV Remote Button: in that number format and power buttons and other buttons there. Just we are seeing the buttons, we don't see the button circuits. I.e. buttons circuits and wirings all are hidden.	

9	Person Person in Home act is husband/son, In Office acts Employer. In Public Good Citizen.	
10	Medical Capsules I.e. one drug is stored in bottom layer and another drug is stored in Upper layer these two layers are combined in single capsule.	

2. Better understanding of OOP concept

3. To become good programmer

#### II Student Role:

1. Discuss and write algorithm of the given problem statement
2. Write program in C++
3. Group leader will discuss the solution of the assigned problem statement in front of the remaining students in the LAB
4. Once complete assigned problem statement go for remaining 4 statements.
5. Group leader role will be in rotation
6. Repeat steps 1 to 4.

#### III Teachers Role:

1. Provide total 5 problem statements on the MOODLE
2. Assign one problem statement to each group
3. Once any group complete check their implementation Tell that group to choose group leader for assigned problem statement
4. Group leader present the algorithmic solution in front of the remaining students
5. If any correction or modification require then teacher will provide that.
6. The same procedure repeat for all remaining groups

#### IV Activity Plan:

1. In lab, 20 students are divided in to groups of 4 students and set of five problem statements are given (one for each group). It was instructed to all

groups to solve one problem statement that was assigned randomly by the teacher.

- All group members need to discuss and write algorithms in a notebook to solve assigned problem statement.

**Table2: List of sample questions GroupWise**

Group No.	Problem Statements
1	<p>Write the definition for a class called Rectangle that has floating point data member length and width. The class has the following member functions:                      void setlength(float) to set the length data member                      void setwidth(float) to set the width data member                      float perimeter() to calculate and return the perimeter of the rectangle                      float area() to calculate and return the area of the rectangle                      void show() to display the length and width of the rectangle                      int sameArea(Rectangle) that has one parameter of type Rectangle. sameArea returns 1 if the two Rectangles have the same area, and returns 0 if they don't.</p> <ol style="list-style-type: none"> <li>Write the definitions for each of the above member functions.</li> <li>Write main function to create two rectangle objects. Set the length and width of the first rectangle to 5 and 2.5. Set the length and width of the second rectangle to 5 and 18.9. Display each rectangle and its area and perimeter.</li> <li>Check whether the two Rectangles have the same area and print a message indicating the result. Set the length and width of the first rectangle to 15 and 6.3. Display each Rectangle and its area and perimeter again. Again, check whether the two Rectangles have the same area and print a message indicating the result.</li> </ol>
2	<p>Write the definition for a class called complex that has floating point data members for storing real and imaginary parts. The class has the following member functions:                      void set(float, float) to set the specified value in object                      void disp() to display complex number object                      complex sum(complex) to sum two complex numbers &amp; return complex number</p> <ol style="list-style-type: none"> <li>Write the definitions for each of the above member functions.</li> <li>Write main function to create three complex number objects. Set the value in two objects and call sum () to calculate sum and assign it in third object. Display all complex numbers.</li> </ol>
3	<p>Write the definition for a class called Distance that has data member feet as integer and inches as float. The class has the following member functions:                      void set(int, float) to give value to object                      void disp() to display distance in feet and inches                      Distance add(Distance) to sum two distances &amp; return distance</p> <ol style="list-style-type: none"> <li>Write the definitions for each of the above member functions.</li> <li>Write main function to create three Distance objects. Set the value in two objects and call add () to calculate sum and assign it in third object. Display all distances.</li> </ol>
4	<p>Write the definition for a class called time that has hours and minutes as integer. The class has the following member functions:                      void settime(int, int) to set the specified value in object                      void showtime() to display time object                      time sum(time) to sum two time object &amp; return time</p> <ol style="list-style-type: none"> <li>Write the definitions for each of the above member functions.</li> <li>Write main function to create three time objects. Set the value in two objects and call sum () to calculate sum and assign it in third object. Display all time objects.</li> </ol>

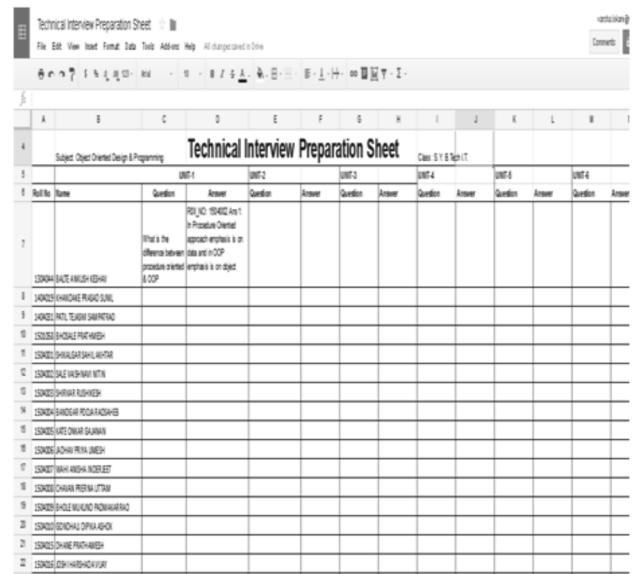
- Once the algorithm finished, all group members individually implement that algorithm on a computer.
- After successful completion, one group leader writes and explains the code on a blackboard.
- Group leader role is in rotation, so that every student will get a chance to speak up and share his/her knowledge with others.
- Though any student is weak in programming can be able to improve his/her programming skill by working in a group.

**C]Activity 3: Technical Interview Preparation Sheet**

**I. Outcomes:**

- To prepare students for technical interview
- To enhance the technical knowledge of the students

**II Student Role:**



**Figure 2: Format of Technical Interview Preparation Sheet**

- To fill one question on the provided Google form in front of their Roll No for each Unit.
- Fill answer for at least one question asked by other students in the answer column and mention his/her Roll No. before that.

**III Teachers Role:**

1. Prepare Google form.
2. Monitor data filled on Google form

Google Form Link:

[https://docs.google.com/spreadsheets/d/1XH6-Uw5H-2tG3TrSqNWCK7TMW039\\_xUYSIUixljZd0/edit?ts=58679c85#gid=0](https://docs.google.com/spreadsheets/d/1XH6-Uw5H-2tG3TrSqNWCK7TMW039_xUYSIUixljZd0/edit?ts=58679c85#gid=0)

**IV Web Resources:**

1. [https://www.tutorialspoint.com/cplusplus/cpp\\_interview\\_questions.htm](https://www.tutorialspoint.com/cplusplus/cpp_interview_questions.htm)
2. <http://quiz.geeksforgeeks.org/commonly-asked-c-interview-questions-set-1/>
3. <http://www.techfaq360.com/freshres.jsp?catId=1>
4. <http://blog.oureducation.in/c-aptitude-questions-answers>

**D] Logic Development Programme****I. Outcomes:**

1. To enhance the programming skills of the students
2. To prepare students for programming contests

**II Student Role:**

1. Participate weekly in programming contests
2. Mentor group of 3, 4 students

**III Teachers Role:**

1. Organise programming contest weekly
2. Display the result list on noticeboard weekly
3. Identify list of students, after 1 month those have cleared all four previous programming contests, assign them the role of mentor.
4. For each mentor allocate 3, 4 students

**IV Activity Plan:**

1. Upload one problem statement on Moodle

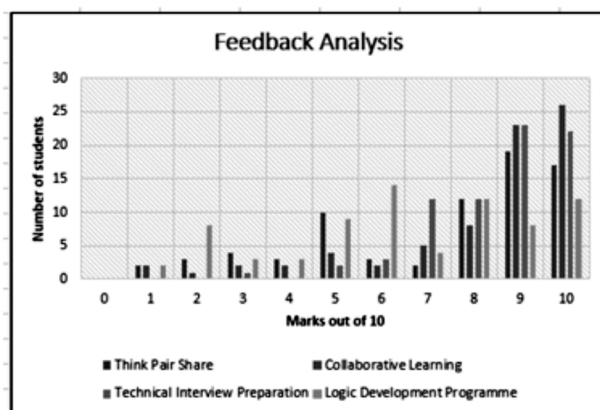
under Level: EASY per week. Do this exercise for complete one month

**Level: Easy**

Sr. No.	Name of Mentors	Assigned Students
1	GUJAR SNEHA BRAHMANAND	CHAVAN PRERNA UTTAM
		<u>Khant Priyanka Ashokkumar</u>
2	PAWAR DNYANESHWAR MARUTI	HANKARE GANESH
		BHUPAL
		<u>Pawar Gouri Ramesh</u>
<b>Level: Moderate</b>		
Sr. No.	Name of Mentors	Assigned Students
1	JADHAV HARSHAD DILEEP	DESHMUKH MEGHA
		RAJENDRA
		DUDHANE SAMPADA
2	SHIKALGAR SAHIL AKHTAR	BHOLE MUKUND
		PADMAKARRAO
		<u>MANE AKASH SHANKAR</u>

**Figure 3: Sample result of Logic Development Activity**

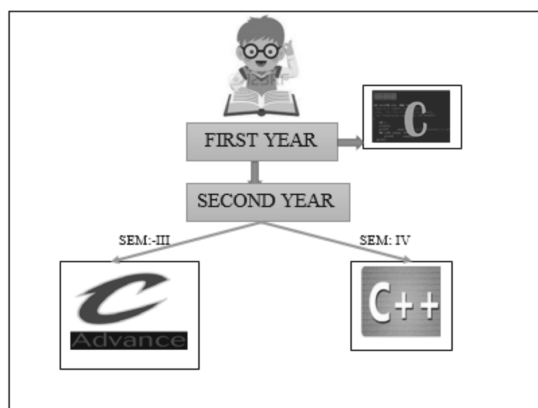
2. Analyse one month progress of individual student by 4 programming contests.
3. Select some students as a mentor those have cleared all programming contests.
4. Allocate 3, 4 students to each mentor
5. Next month onwards upload one problem statement under Level: EASY and another problem statement under Level: MODERATE (for students selected as mentors) on Moodle per week
6. Repeat steps 2 to 4
7. Next month onwards upload one problem statement under Level: EASY and one problem statement under Level: MODERATE (for



**Figure 4: Feedback Analysis Graph**

students selected as mentors for easy level) and one problem statement under Level: HARD (for students selected as mentors for moderate level) on Moodle per week

8. Appreciate the students by giving gifts monthly those have performed excellent. Note: separate winners for easy, moderate and hard level.



**Figure5: Programming Languages learned by the students**

### Feedback Analysis

After completion of all activities, feedback from all 75 students have been taken on the scale of 0 to 10. Following figure shows the comparative feedback received from the students on each activity. It has been observed by the graph that collaborative learning and technical interview preparation, these activities are appreciated by many of the students. While think pair share is moderately appreciated and less weightage is given to logic development programme. Hence, some modifications are required in logic development plan as students may hesitate to ask to their friends regarding queries. Less interaction between mentor

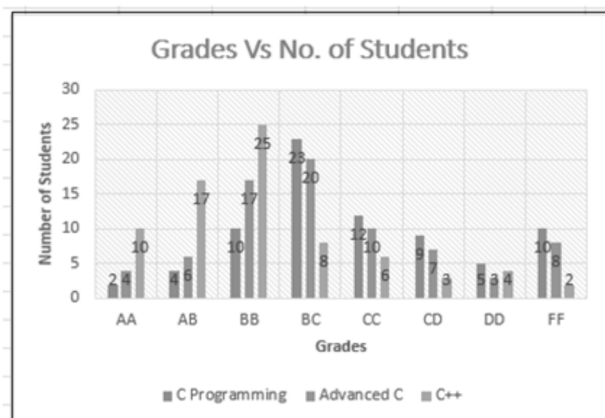
**Table3: Teaching Learning Methodologies per course**

Class	Course Name	Teaching Learning Methods
First Year	C Programming	Traditional Chalk and Board
Second Year (Sem :III)	Advanced C Programming	Demonstration, PPTs, Animation tools
Second Year (Sem :IV)	Object Oriented Programming (C++)	Think Pair Share, Technical Interview preparation plan sheet, Logic development programme, Collaborative Learning

and group members may result in failure of this activity. So teacher has to monitor this activity also.

### Result Analysis

To analyse the improvement in the programming skill of the students, the result of total three courses has been considered here. As shown in figure 1, every student learned total three programming courses up to



**Figure6: Result Analysis Graph**

second year namely C programming, Advanced C and C++.

To teach each course, different teaching learning strategies were applied as shown in below table:

From above table, it is observed that in first year for teaching C programming course no any teaching learning methodology was applied. The entire course was taught by traditional method of chalk and board. To teach advanced C programming, other than traditional way few animation tools were used to explain the C concepts along with the debugging of the code. Many innovative teaching learning practices have been applied while teaching C++ course like Think Pair Share, Technical Interview preparation plan sheet, Logic development programme, Collaborative Learning etc. From figure no. 3, it is observed that the percentage of achieving higher grades (AA, AB, and BB) is increased from C to Advanced C course as Demonstration, PPTs, Animation tools were used to teach advanced C course. Also there is around 30 to 35% increase in the higher grades from Advanced C to C++ course due to different teaching learning practices as mentioned in table no. were applied. Also the failure percentage is decreased from 13.33(C) to 10.66 (Advanced C) to 2.66(C++).

## Conclusion

Traditional teaching methodology has its own advantages and disadvantages. It has been observed that to teach programming courses this method is not much suitable. Debugging and animation tools are also not much sufficient to develop programming skills of the students. Different teaching learning practices like Think Pair Share, Technical Interview preparation plan sheet, Logic development programme, and Collaborative Learning etc. shows much better results than traditional way. From the feedback collected from the students it has been observed that there is a need to monitor logic development activity more effectively by the teacher. Also collaborative learning is appreciated by many of the students. The resulting analysis shows that there is around 30 to 35% increase in the higher grades from Advanced C to C++ course due to different teaching learning practices were applied. Also the failure percentage is decreased from 13.33(C) to 10.66 (Advanced C) to 2.66 (C++).

Hence, Technical interview preparation sheet and logic development program along with collaborative learning plays an important role to enhance the programming skills of the students and in turn for better placement results.

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