

Learning difficulties of 'object-oriented programming paradigm using Java': students' perspective

M. Sivasakthi and R. Rajendran

Department of Education, NITTTR, Chennai-600113, India
sivasakthi.info@gmail.com, rajendra.2314@gmail.com

Abstract

Java programming is popular both in Academia and IT Industry. Further, it is the maximum usage of programming across the world. There is a wide edge between industry expectations and knowledge of students in Java programming. Teaching and learning of Java programming in academia is the greater responsibility to shrink that edge. The present study has been conducted in this regard to investigate the factors that lead to students' learning difficulties in Object-Oriented Programming Paradigm using Java. The result of this study indicates that the students have learning difficulties on the topics of Java programming. The nature of difficulties, situations and the various factors that lead to poor performance in learning of Java programming were also identified.

Keywords: Learning difficulties, OOPs paradigm, Java programming, instructional methods

Introduction

Undergraduate CSE and IT students in affiliated colleges of Anna University, Chennai, India have been studying Object Oriented Paradigm. The subject, earlier, covered C++ and Java. Since 2009, both the papers were split up into two individual papers. However, students have exposure with other programming languages such as C, C++ and VB before learning Java as per the curriculum.

Object-Oriented Programming particularly, with Java has in recent years become the most influential programming paradigm, which is being taught to undergraduate students of CSE and IT. In spite of having prior knowledge and skills of Object Oriented Programming Structure (OOPs) with C++, learning of OOPs using Java has become a hard task for below average students due to various factors.

Generally, the Java Programmer requires more of declarative and Object Oriented (OO) knowledge. The former is the knowledge of Java programming language syntax and semantics which in turn needs memorization and comprehension abilities; whereas, the later is the higher level of abilities which in turn needs additional skills such as: abstraction, encapsulation, polymorphism and inheritance. Hence, learning of Object Oriented Programming using Java is challenging task and it needs multiple skills and knowledge.

In this study, an attempt has been made through data collection and analysis to identify the various learning difficulties of Java programming. For this, a questionnaire was designed with relevant questions and distributed for data collection among CSE and IT undergraduates. The data analysis shows that the students have learning difficulties on various factors including the topics of Java programming. The result of this study will be a beginning for further research on teaching methodology for Java programming and some directions to improve the Java programming education.

Teaching Java is challenging one in computer education (Nedzad & Yasmeen, 2001). There has been plenty of reports (Michael, 1999; Nedzad & Yasmeen, 2001; Michael & John, 2001; Michael & Desmond, 2002; Maria *et al*, 2003) in Teaching and learning of Java programming. Each of which, represent the issues or challenges or difficulties in teaching or learning of object oriented and Java programming.

Phit-Huan Tan (2009) identified the various dimensions in learning difficulties of programming course with the aim to bring the alternatives for teaching programming such as: computing background, computing programming experience, difficulties while learning programming and factors that lead to poor performance in programming subject (Phit-Huan *et al*, 2009).

Students will struggle in their understanding until they gain a clear mental model of how their programming is 'working' that is how it is stored in memory, and how the objects in memory relate to one another (Iain & Glenn, 2002). Michael madden and Desmond chambers (2002) identified that Java is easy to learn compare to C; due to absence of pointers also they did find object oriented programming concepts difficult. Further, student's preference for learning through the medium of assignments and tutorials rather than lectures (Michael & Desmond, 2002). Nedzad and Yasmeen (2001) indicated the certain problems with Java such as: input and output, availability of books, keywords and syntax and no help available (Nedzad & Yasmeen, 2001).

Researchers have been searching for alternatives in teaching and learning of object oriented programming particularly with Java due to certain challenge and compulsory subject in the field of information technology. There are certain interactive and integrated environments such as: 'BlueJ', 'Greenfoot', 'Processing' that makes easy to learn and teach Java programming particularly for novices. Here object visualization and object interaction are the key elements. More over it is freeware.

Table 1. Level of learning difficulties on different topics of Java programming

Topics	Mean (\bar{x})	S.D	Rank (R)
Concurrent programming	3.25	0.78	1
UI Components with swings	3.10	0.92	2
Generic programming	3.00	0.91	3
Exceptions and Assertions	2.85	0.85	4
Event Handling	2.41	0.68	5
Interfaces and inner classes	2.23	0.70	6
Graphics programming	1.99	0.99	7
OO Access controls	1.50	0.91	8
Object Orientation	1.12	0.88	9
Fundamental programming-structure in Java	1.05	0.76	10

Methodology

In survey method, the questionnaire is an economic way to collect data from a relatively large group of respondents. Out of 225 questionnaires distributed, the investigator has received 195 responses (86.67%). Four affiliated Engineering colleges of Anna University, Chennai has been randomly selected for data collection and the respondents were undergraduate students of Engineering and Technology. During the course, students have learnt Java Programming subject named Programming Paradigm for Computer Science and Engineering (CSE) degree course and Java programming in information technology (IT) degree course. This study was conducted during the period of Jan-June 2011. The reliability of the data depends mainly on the design quality of the questionnaire and quality of its administration.

The questionnaire was customized from existing instruments by Phit-Huan Tan (2009). The questionnaire consists of five parts that covers the demographic profiles, Level of learning difficulties on different topics of Java programming, difficulties while learning Java, situations that help to learn Java programming more efficiently and finally factors that lead to poor performance in Java programming.

Results

This section reports on the data collected from Part I of the questionnaire. The first part gathers the students' demographic profile. Female students were 56.41% of total participants and 43.59% of them were male students. 56.41% of responses from CSE and 43.59% of responses from IT. While look into the medium of instruction in their schools up to higher secondary, it is noticed that 65.10% of students were studied in Tamil medium, 31.22% were English medium 5.68% were studied through other languages such as Telugu,

Malayalam and Hindi. Only 67% of students have their own computer.

The second part investigates the level of learning difficulties on different topics of Java programming that help to improve the teaching and learning process. The items shown in Table 1 is designed with 5-point Likert scale (0, Not at all difficult; 1, rarely difficult; 2, Sometimes difficult; 3, Difficult; 4, Very difficult).

Table-1 summarizes students' level of learning difficulties on various topics of Java programming. The sequence of topics in the table is listed from the highest mean value to the lowest mean value. Concurrent programming, UI components with Swing and Generic programming of Java are the most difficult topics to learn as shown in the mean values (3.00-3.25).

Exceptions and Assertions also could be the difficult topic to learn. Students stated that the topics such as: Event handling, Interfaces and Inner classes, Graphics programming are the sometimes difficult in Java programming. OO(Object Orientation) and OO access controls are less difficult for students. The students mentioned that the fundamental Java programming structure is not at all difficult to learn.

Table 2. Difficulties while learning Java programming

Nature of Difficulties	Mean (\bar{x})	S.D	Rank (R)
Designing a program to solve certain task	3.85	0.93	1
Finding bugs from my own program	3.80	0.76	2
Understanding the concepts	3.65	0.87	3
Applying the correct logic	3.40	1.09	4
Java Programming Syntax	3.35	0.87	5
Program development environment	2.50	1.10	6

In the third part, students need to response on the difficulties while learning Java programming. 5-point Likert scale (1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Disagree) is used on the items shown in Table-2 and Table-4. The difficulties faced by students while learning Java programming is shown in the Table. The items evaluate the students' level of agreement. Students agreed that they were having problems while designing a program to solve certain task, debugging in their own program. Understanding the concepts and applying the correct logic could be the problems in learning of Java programming. It is noticed that the least problems on Java programming syntax and program development environment.

The fourth part of questionnaire dealt with the situations for efficient learning of Java programming (Table-3). Most of the students responded that they can learn Java programming more effectively in practical or Lab session as shown in mean value of 3.81. Discussion with others might be helpful compared to small group exercise session. Practicing could be effective in learning Java programming as students rated that working alone on Java programming course work is better than lectures.



Table 3. Situations that would help to learn Java programming more efficiently

Situations	Mean (\bar{x})	S.D	Rank (R)
In practical or Lab session	3.81	0.91	1
Discussion with lecturers, seniors or friends	3.52	0.88	2
In small group exercise sessions	3.24	0.96	3
While working alone on Java programming	3.14	1.14	4
Coursework in lectures	3.00	1.05	5

The fifth part of the questionnaire concerned with factors that leads for poor performance in learning of Java programming which is shown in Table 4 (mean value of 4.31). Students highly stated that less effective in teaching methodology which leads them to perform poorly while learning Java programming. Less real world examples in class room teaching and less examples in practical use were also the major factors for poor performance.

The factors like, lack of interest to learn Java, the wide coverage of syllabus, less examples towards OOPs, presentation of instructor and attention, learning environment were also rated in the study as a poor performer in Java programming. The improper working condition of the computers in lab was considered as a less factor that leads for poor performance in learning of Java programming.

Conclusion

In order to investigate the learning difficulties of 'OOPs with Java', this paper analyzed various data collected from undergraduate CSE and IT students. This study brings out the various learning difficulties of students in learning of Java programming. The topic, 'Concurrent programming' in Java programming was identified as the most difficult topic to learn for the students. Also, students have faced the most difficulties in designing a program to solve certain task. Further, this study confirmed with the earlier study of Phit-Huan Tan that practical situations was very helpful for the students

Table 4. Factors that lead to poor performance in Java programming

Factors	Mean(\bar{x})	S.D.	Rank (R)
Teaching Methodology is less effective	4.35	0.58	1
Teaching with real world Examples is less	3.85	0.74	2
Less examples in practical use	3.70	1.12	3
Lack of interest to learn Java	3.45	1.09	4
Syllabi coverage is too wide	3.15	0.83	5
Less examples towards OOPs	3.10	0.91	6
Presentation of instructors and their attention on students	3.00	0.89	7
Learning environment that is not conducive	3.00	1.00	8
Computers provided in the labs are not-functioning well	2.95	0.86	9

to learn Java programming more efficiently whereas the course work situation through lectures decrease their interest level. Furthermore, it was identified that the ineffective teaching methodology is one of the major cause for poor performance of students in learning OOPs with Java.

References

1. Iain Milne and Glenn Rowe (2002) Difficulties in learning and teaching programming- Views of students and tutors. *J. Edu. & Info. Tech.* vol 7, pp: 55-66.
2. Maria Hristova, Ananya Misra and Megan Rutter (2003) Identifying and correction Java programming errors for introductory computer science students. *SIGCSE Bull.* Vol.35, Issue 1, pp:19-23.
3. Michael Kolling and John Rosenberg (2001) Guidelines for teaching object orientation with Java. *Proc. 6th Conf. on Infor. Technol. in Computer Sci. Edu. (ITICSE)*, Vol 33, Issue 3, pp:33-36.
4. Michael Kolling (1999) The problem of teaching object-oriented programming. Part 1: languages. *J. of Object-Oriented Program.* Vol 11, Issue 8 pp: 8-15
5. Michael Madden and Desmond Chambers (2002) Evaluation of students attitudes to learning the Java language. *ACM Intl. Conf. Proc.* 25, 125-130.
6. Nedzad Mehic and Yasmeen Hasan (2001) Challenges in teaching java technology. *Informing Sci.* pp:365-371.
7. Phit-Huan Tan, Choo-Yee Ting and Siew-Woei Ling (2009) Learning difficulties in programming course: Undergraduates' perspective and perception. *Proc. IEEE Intl. Conf. on Computing Technol. and Development*, Vol.2 pp: 42-46.