Comparing the effectiveness of self learning Java workshops with traditional classrooms

Eranki L.N. Kiran[a], Kannan M. Moudgalya[b]
IDP Educational Technology, IIT Bombay, Mumbai, India
e-mail:erankikiran@iitb.ac.in[a], kannan@iitb.ac.in[b]

Abstract

In this work, we study the effectiveness of a method called Spoken Tutorial, which is a candidate technique for self learning. The performance of college students who self learned Java through the Spoken Tutorial method is found to be better than that of conventional learners. Although the method evaluated in this work helps both genders, females seem to benefit more through self learning workshop based approach. Self learners found to be more interested in ease of learning and the availability of content, while classroom learners focused more on evaluation. All of these findings are in agreement with the literature. Although the proposed method seems to be effective to a restricted class of topics, the benefits can still be enormous and suitable for flipped classrooms, MOOC, etc.

Keywords: `Programming, Spoken Tutorials, Self learning, Gender Difference, Perception Analysis`

Abbreviations

SRL :	Self Regulated Learning,
ICT :	Information and Communication Technology,
SELF :	Spoken Tutorial based Education and Learning through FOSS,
FOSS :	Free and Open Source Software.

Introduction

This study looks at the effectiveness of the Spoken Tutorial methodology, developed to provide IT training through the self learning route (Moudgalya, 2011). Although a large use case of it is reported by Moudgalya (2014) with feedback from 25,000 people, no controlled study of it has been carried out so far. As this methodology has the potential to provide computer literacy to a large number of people and thus improve their employment potential, it will be beneficial to understand its strengths and ways to improve it.

According to Moudgalya (2014), self learning capability is the main reason for the widespread acceptance of Spoken Tutorials. Self learning seeks to put the learner as much as possible in control of the learning process. This mode of learning involves behavioral motivation and meta-cognitive understanding of social perspectives through self learning (Pintrich, 1999). Self learners proactively seek out information when needed and prepare to master them. Self learners use obstacles as

opportunities to succeed (Zimmerman and Martinez-Pons, 1990). Students' perception of self learning shows both a motive to learn and subsequent outcomes of effort to succeed (Schunk et al., 2012). Self learners select learning strategies to achieve desired outcomes based on the feedback received from learning outcomes and levels of difficulty (Hiltz and Wellman, 1997). Socio-cognitive learning models proposed by Zimmerman (1989), Winne and Perry (2000) have shown that learners performed better through Self learning approach. On the other hand, studies on classroom show that students fail to interact with teachers to clarify their doubts despite the opportunity due to low self esteem, which may be because of instructor/parent-dependence and poor self control (Schmid et al., 2014). Othman et al. (2014) have found that the teaching method based on self learning enhanced students' skill of using application software in computing environments. Moreover, based on these results, they suggest that instructors should help students regulate their learning by applying self learning instructional methods in e-learning environments.

Studies in computing education have shown differences among male and female student perceptions and learning outcomes: males seem to find programming easier, showing higher intentions and higher learning outcomes than female students (Guzdial et al., 2014; Alvarado et al., 2014; Carter and Jenkins, 1999). Gender differences have also been noticed among Asian and Indian learners across all social and socio-economic groups with serious issues on parental control and education delivery systems (Arnold, 2014). The above research studies imply that learners benefit from self learning approach, by engaging them into planning, monitoring, adaptability and evaluation phases of learning.

Almost all the studies on self learning have been carried out in a classroom setting. In the Indian context, it is important to make the self learning feature available through workshops also. To the best of our knowledge, workshop based self learning approach has not been studied for its effectiveness. In the current study, we use the Spoken Tutorial approach to train learners using self learning workshops (Moudgalya, 2014).

Although a lot of papers have appeared on the Spoken Tutorial method, its effectiveness is not established through a rigorous study, which is one of the main contributions of this work. In addition to this, we also have identified self learning characteristics of workshop and classroom learners through this study. We also study the effect of gender on self learning.

Spoken Tutorial Methodology

Spoken Tutorial project is an initiative of National Mission on education through ICT (NME-ICT), Ministry of Human Resource Development (MHRD), Govt of India (Sakshat, 2013). Spoken Tutorials are developed to improve the quality of programming education in India. Each Spoken Tutorial consists of a 10-12 min screencast of an actual session, demonstrated by an expert, illustrating various programming concepts, as shown in Fig. 1. This recording is accompanied by the narration with a script, As Spoken Tutorials are created for self learning, it is possible to provide large scale training, thereby addressing the shortage of employable youth in India (Ray, 2014). All the content developed through this project is attributed under a creative commons license (CC BY SA).

Spoken Tutorials are made suitable for self learning through novice check of scripts before creating the tutorial. The self learning feature is verified through pilot workshops. These steps are similar to the ones proposed by Moseley (2005). Spoken Tutorials follow the example-centric and example-based approach suggested by L.R.Neal (1989). Spoken Tutorials attempt to reduce

the cognitive overload by (i) juxtaposing audio and video (ii) keeping sentences short (iii) taking time to explain difficult or new concepts and (iv) recording an actual session (Moudgalya, 2014). Cognitive overload and temporal contiguity are two impediments for self learning (Moreno and Mayer, 1999). Localization and the use of short sentences make Spoken Tutorials accessible to students who are not fluent in English (Barac and Bialystok, 2012).

Spoken Tutorial based Education and Learning through free FOSS study workshops are abbreviated as [1]SELF workshops. FOSS stands for free and open source software. SELF workshops are conducted to help students with limited access to computers, bandwidth and access to Internet, during college hours (Moudgalya, 2014). Organizing workshops through colleges provide the following benefits: it becomes an accepted academic activity; all systems can be pre-loaded with Spoken Tutorials and required software. SELF workshops allow students to learn at their own pace, using a language of their choice, as the audio of Spoken Tutorials is dubbed into all 22 languages of the Eighth Schedule of the Indian Constitution.

We will briefly point out the reasons why the Spoken Tutorial approach provides large scale training. The ability to download an entire collection of Spoken Tutorials for offline use obviates the need for Internet access in every computer system, one of the biggest bottlenecks for ICT based learning in India. SELF workshops are conducted by volunteers, who need not be experts. A volunteer who conducts a workshop on a topic can easily conduct several others as well. As no software is to be bought and as SELF workshops are offered free of cost, administrators can easily approve this training. Finally, as students trained through this method do well in exams and also get better jobs, many educational systems are including Spoken Tutorials as a part of their curriculum (Tamil Nadu Department of Technical Education, 2013).

We will now discuss the pedagogical benefits of Spoken Tutorials. The side-by-side method encourages a student to reproduce every action that is demonstrated in a Spoken Tutorial, resulting in active learning see Fig. 2. The benefits of active vs. passive learning are well known (Grissom et al., 2003; Kroll and Laboskey, 1996). Learning at a convenient pace allows students to resolve their doubts then and there. Lack of this opportunity in synchronous lectures often leads to doubts not getting cleared at all (Vrasidas, 2000). Localization of tutorials allows students to learn new and complicated concepts also easily (Alanis and Rodriguez, 2008). As every Spoken Tutorial comes with an assignment, a student is forced to try out their understanding immediately, a facility that may not be available in conventional methods (Hung et al., 2010). Students can use Spoken Tutorials as a reference material and to practice difficult topics even after the completion of SELF workshops (Eranki and Moudgalya, 2013). SELF workshops help scale up training through Spoken Tutorials. Raval et al. (2012) show that workshop based approach to teach students and teachers is effective.

Research Questions

Not much research is available on self learning workshops in the context of non-conventional education practices in India. As explained above, there are many benefits if the results of self learning are comparable with that of the classroom methodology, the main one being large scale training without quality dilution. Moudgalya (2014) has demonstrated that Spoken Tutorial based training is scalable. But the effectiveness of this method is not demonstrated with a controlled, rigorous, study. So, we arrive at the first research question.

[1] **S**poken Tutorial based **E**ducation & **L**earning through **F**ree and open source software

Figure 1: A sample screenshot of Java Spoken Tutorial (`http://www.spoken-tutorial.org`

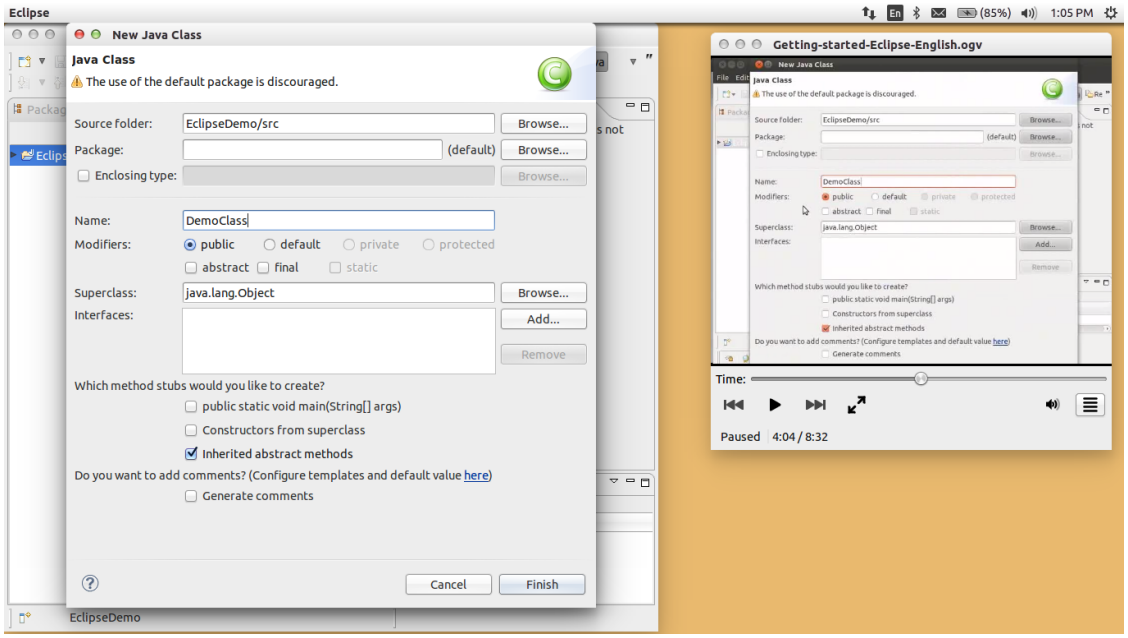


Figure 2: A sample screenshot of side-by-side method showing Spoken Tutorial on righthand side and eclipse tool on the left-hand side in the Java demo

1. Are Spoken Tutorial based self learning workshops as effective as traditional classrooms?

If the answer to the above question is positive, and if we can characterize self learners, it will help us determine to which type of students the self learning methodology proposed in this study will be effective. If the perception of students matches the actual performance, it will increase the confidence level of our approach. So, we arrive at the next research question:

2. What are the characteristics of self learners and are their perceptions in agreement with actual performance?

Females generally tend to perform worse than males in programming (Lee, 2014). As a result, there is a possibility of this happening in the proposed approach as well. As a matter of fact, there is a possibility of females performing much worse than males. If this were to happen, the proposed method would have to be rejected as ineffective. So, we arrive at the final research question:

3. Does the gender difference influence learning?

Methodology

In this section, we will describe about the research methodology applied to evaluate the student perceptions and validate them with actual performance in Java post-test. We begin with sample for the study, followed by Self Regulated Learning (SRL) questionnaire used to predict self learning ability of the participants and further, validation of student perceptions with actual Java test.

Java SELF workshops and classroom course, compared with post-test

We will first explain the control and experimental groups we selected for this study. A total of 400 students were randomly selected for the study and distributed among the control and experimental groups. We selected these students as most of them have expressed having watched Youtube (2015) online videos outside the classrooms or at home, either to complete the coursework or seek better understanding of concepts based on pre-workshop feedback.

The control group consisted of 180 students, studying at a local engineering college. The experimental group consisted of 220 students from the same college. We established the equivalence amongst these groups using a pre-workshop questionnaire. None of these 400 students had exposure to any programming language. All of these students were of same age group (below 25), from different departments, other than Computer Science. The participants from the experimental group (n=220) attended a three hour Spoken Tutorial based SELF workshops on Java programming course. As a SELF workshop could accommodate a maximum of 40 students, owing to the limited computer infrastructure, the experimental group underwent Java training in six batches. The control group (n=180) attended conventional Java classroom lectures, conducted by a teacher on topics similar to the SELF workshop. They attended five lectures of one hour duration each.

Next, we will explain how the course was conducted for the two groups. We choose the following ten Java concepts for the test: *Operators, Arrays, Constructs, Classes, Methods, Inheritance, Polymorphism, Overloading, Constructors, Modifiers.* The classroom students learnt these topics in five one hour lectures, learning two topics per lecture. On the other hand, the workshop students studied the same ten topics in a three hour SELF workshop. The post test included questions of three different levels of difficulty (apply, analyze, evaluate) based on revised blooms taxonomy (Thompson et al., 2008).

Table 1: Questionnaire of Zhao and Chen: Questions in primary and secondary characteristic

	LO	LR	LC	Total
Planning	4	3	4	11
Monitoring	5	4	5	14
Adaptability	6	4	6	16
Evaluation	6	6	4	16
Total	21	17	19	57

Zhao and Chen's SRL Questionnaire

We have used Self Regulated Learning questionnaire (SRL) to study the implications of self learning among the workshop and classroom learners. Background work by Zimmerman (1989); Schunk et al. (2012); Pintrich (1999) included:

- Validity and reliability of SRL Questionnaire was already established through studies conducted by Zimmerman and Martinez-Pons (1990); Zimmerman (1989); Pintrich (1999).
- According to Zimmerman (1989), Bandura and Martinez-Pons (1992) and Schunk et al. (2012)., self learning instructional content should contain four ingredients: Self evaluation and monitoring; Strategy to plan learning outcomes; Adaptability; and Strategy to monitor learning outcomes.

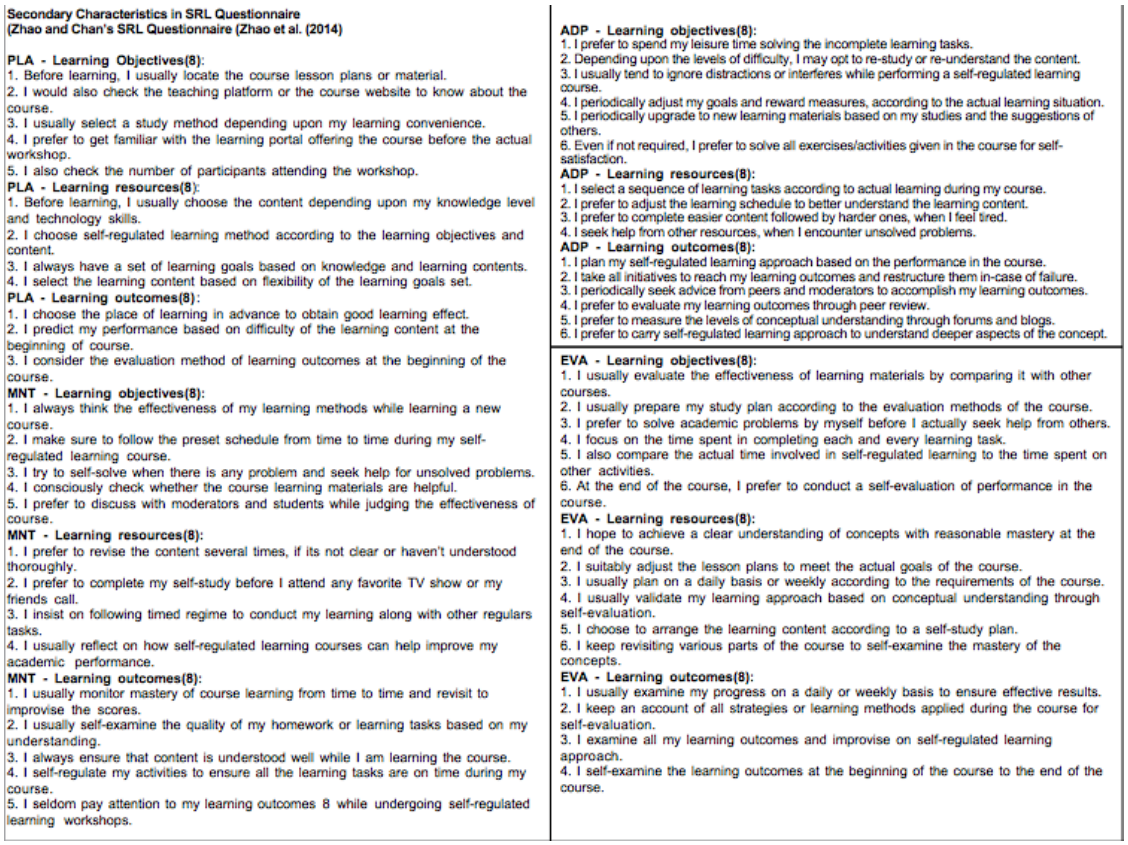
Zhao et al. (2014) found the same four to be applicable to other types of self learning situations, such as online and distance learning modes. They identified three secondary characteristics for each of the above mentioned four primary characteristics. These are (i) Learning objectives (LO), (ii) Learning resources (LR) and (iii) Learning outcomes (LC).

- **Learning Objective [LO]** focuses on the interest of a learner towards conceptual knowledge, programming skill and motivation.
- **Learning Resource [LR]** refers to course learning materials, method of teaching-learning for supporting and improving programming skills.
- **Learning Outcomes [LC]** focuses on conceptual understanding of basic programming skills, mainly comprehension and debugging skills of the participants.

Zhao et al. (2014) validated a questionnaire of 57 questions on distance learning, as shown in figreffig:srlques. The breakup of these 57 questions is given in Table 1.

Applicability of Zhao and Chen's questionnaire in our study

This questionnaire is applicable also to workshop based, self paced, learning process, because in the Spoken Tutorial method also, learning is individualistic and not group based. Spoken Tutorials, created for self learning, play the role of mentors. This claim is validated by comparing the results of questionnaire with the actual performance in a test. We only changed the phrase *distance learning* by the word *workshop* in this study. Student perceptions were captured through this questionnaire to evaluate their self learning behavior and motivation to learn Java programming course.



Secondary Characteristics in SRL Questionnaire
(Zhao and Chan's SRL Questionnaire (Zhao et al. (2014)

PLA - Learning Objectives(8):
1. Before learning, I usually locate the course lesson plans or material.
2. I would also check the teaching platform or the course website to know about the course.
3. I usually select a study method depending upon my learning convenience.
4. I prefer to get familiar with the learning portal offering the course before the actual workshop.
5. I also check the number of participants attending the workshop.

PLA - Learning resources(8):
1. Before learning, I usually choose the content depending upon my knowledge level and technology skills.
2. I choose self-regulated learning method according to the learning objectives and content.
3. I always have a set of learning goals based on knowledge and learning contents.
4. I select the learning content based on flexibility of the learning goals set.

PLA - Learning outcomes(8):
1. I choose the place of learning in advance to obtain good learning effect.
2. I predict my performance based on difficulty of the learning content at the beginning of course.
3. I consider the evaluation method of learning outcomes at the beginning of the course.

MNT - Learning objectives(8):
1. I always think the effectiveness of my learning methods while learning a new course.
2. I make sure to follow the preset schedule from time to time during my self-regulated learning course.
3. I try to self-solve when there is any problem and seek help for unsolved problems.
4. I consciously check whether the course learning materials are helpful.
5. I prefer to discuss with moderators and students while judging the effectiveness of course.

MNT - Learning resources(8):
1. I prefer to revise the content several times, if its not clear or haven't understood thoroughly.
2. I prefer to complete my self-study before I attend any favorite TV show or my friends call.
3. I insist on following timed regime to conduct my learning along with other regulars tasks.
4. I usually reflect on how self-regulated learning courses can help improve my academic performance.

MNT - Learning outcomes(8):
1. I usually monitor mastery of course learning from time to time and revisit to improvise the scores.
2. I usually self-examine the quality of my homework or learning tasks based on my understanding.
3. I always ensure that content is understood well while I am learning the course.
4. I self-regulate my activities to ensure all the learning tasks are on time during my course.
5. I seldom pay attention to my learning outcomes 8 while undergoing self-regulated learning workshops.

ADP - Learning objectives(8):
1. I prefer to spend my leisure time solving the incomplete learning tasks.
2. Depending upon the levels of difficulty, I may opt to re-study or re-understand the content.
3. I usually tend to ignore distractions or interferes while performing a self-regulated learning course.
4. I periodically adjust my goals and reward measures, according to the actual learning situation.
5. I periodically upgrade to new learning materials based on my studies and the suggestions of others.
6. Even if not required, I prefer to solve all exercises/activities given in the course for self-satisfaction.

ADP - Learning resources(8):
1. I select a sequence of learning tasks according to actual learning during my course.
2. I prefer to adjust the learning schedule to better understand the learning content.
3. I prefer to complete easier content followed by harder ones, when I feel tired.
4. I seek help from other resources, when I encounter unsolved problems.

ADP - Learning outcomes(8):
1. I plan my self-regulated learning approach based on the performance in the course.
2. I take all initiatives to reach my learning outcomes and restructure them in-case of failure.
3. I periodically seek advice from peers and moderators to accomplish my learning outcomes.
4. I prefer to evaluate my learning outcomes through peer review.
5. I prefer to measure the levels of conceptual understanding through forums and blogs.
6. I prefer to carry self-regulated learning approach to understand deeper aspects of the concept.

EVA - Learning objectives(8):
1. I usually evaluate the effectiveness of learning materials by comparing it with other courses.
2. I usually prepare my study plan according to the evaluation methods of the course.
3. I prefer to solve academic problems by myself before I actually seek help from others.
4. I focus on the time spent in completing each and every learning task.
5. I also compare the actual time involved in self-regulated learning to the time spent on other activities.
6. At the end of the course, I prefer to conduct a self-evaluation of performance in the course.

EVA - Learning resources(8):
1. I hope to achieve a clear understanding of concepts with reasonable mastery at the end of the course.
2. I suitably adjust the lesson plans to meet the actual goals of the course.
3. I usually plan on a daily basis or weekly according to the requirements of the course.
4. I usually validate my learning approach based on conceptual understanding through self-evaluation.
5. I choose to arrange the learning content according to a self-study plan.
6. I keep revisiting various parts of the course to self-examine the mastery of the concepts.

EVA - Learning outcomes(8):
1. I usually examine my progress on a daily or weekly basis to ensure effective results.
2. I keep an account of all strategies or learning methods applied during the course for self-evaluation.
3. I examine all my learning outcomes and improvise on self-regulated learning approach.
4. I self-examine the learning outcomes at the beginning of the course to the end of the course.

Figure 3: Self-Regulated Learning Questionnaire Secondary Characteristics (Zhao et.al, 2014)

Sample for Zhao and Chen's SRL Questionnaire

- The questionnaire was administered to 420 participants who gave their consent to participate in the study.
- A total of 400 questionnaires were received (response rate of 98.6%) of which 20 questionnaires were eliminated for incomplete submissions.
- Students who made up the control group for the Java post-test formed the control group for this study also. The experimental group is also identical in the same way.
- All participants voluntarily participated in this study and gave their consent to participate.

Results and Discussions

In this section, we will present answers to the three research questions raised earlier. We will first compare the effectiveness of the Spoken Tutorial methodology in self learning. We will next characterize self learners. We will conclude this section by answering our question on gender differences.

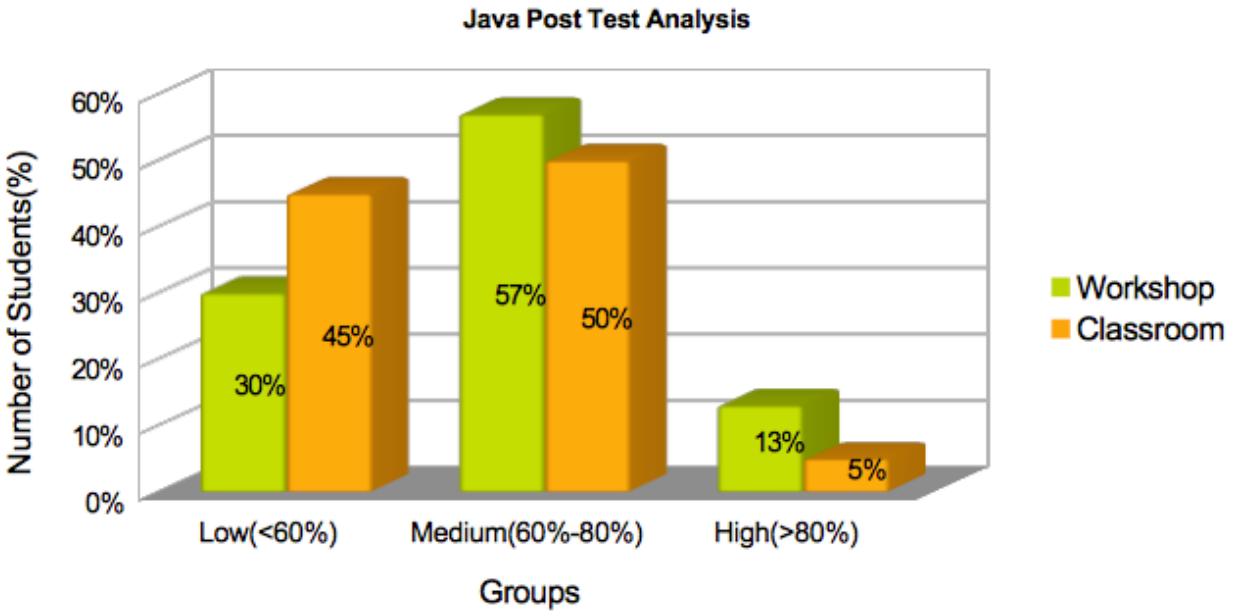


Figure 4: Division of workshop and classroom participants into low, medium and high groups, based on the marks they scored

RQ1: Effectiveness of Spoken Tutorial methodology

We have several reasons to believe that the workshop participants have learnt Java at least as well as the classroom students, thereby answering the first research question:

- The workshop learners had an average score of 69.09%, while classroom learners scored 64.8%. It is also statistically significant ($t = 6.03$, $p < 0.01$).
- The Cohen $d^{X_1 - X_2}$ effect size was 0.623, among workshop and classroom groups, which indicates a significant effect of treatment in improving the programming skill through workshop. As it is greater than 0.6, this values indicates a large effect size among the groups,
- The students were further divided into three groups, based on their scores: high ($\geq$ 80), medium ($\geq$ 60, but $<$ 80) and low ($<$ 60). The numbers of students who fall in these three groups are shown in Fig. 4. We found 13% of workshop students fall in high scorers group, 57% as medium scores, and 30% as low scorers. The corresponding numbers in the classroom group are 5%, 50% and 45%. The number of high scorers in the workshop group are two and a half times the corresponding number in the classroom group. The workshop group has done better in the medium score category also.
- We found 57% of workshop students fall in medium scorers group, 30% of them as low scorers and 13% of them fall in high scorers group. While classroom group had almost equivalent distribution with 45% of them among the low and 50% of them in medium groups. And only 5% of them fall in high scorers group, which is lesser than workshop group.
- The average marks scored by the workshop students on apply, analyze and evaluate type of Java questions are 72%, 71% and 65%, respectively, while the corresponding classroom scores are 66%, 60% and 62%.

Table 2: Marks scored by Workshop and Classroom groups in Apply, Analyze and Evaluate categories of Sec.

Category	Workshop (%)	Classroom (%)
Apply	72	66
Analyze	71	60
Evaluate	65	62

- It is only natural that the workshop group has done better than the classroom group overall. As a matter of fact, in every one of the three of apply, analyze and evaluate categories of Sec. , the workshop team has done better, as can be seen in Table 2.

- Although in general males perform better than females in computer programming as found by Young (2014), it is interesting to note that the workshop females have actually done better than classroom males, see Table 3. This will be taken up for a detailed discussion while answering RQ-3. Naturally, they have done better than classroom females as well. Of course, they perform worse than workshop males, which is consistent with (Cassidy and Eachus, 2002).

- The perception of the workshop group was also better than that of the classroom group. Workshop male learners show statistically significant score for adaptability-learning objective ($t = 2.83$, $p < 0.01$) when compared with classroom males. Similarly, workshop females also show significance for adaptability-learning objective ($t = 1.97$, $p < 0.05$) when compared with classroom females. In the era of lifelong learning, traditional learning can no longer satisfy all learning needs, for the following reasons: (1) High quality teaching requires sufficient number of suitable teaching staff; (2) Studies in public universities/institutes are expensive; thus, accessibility is usually limited and subject to budget cuts and restrictions; (3) Traditional learning is restricted to a particular place, specific time, and a uniform pace (Beller and Or, 1998). Learners who opt for self learning usually adapt themselves to gather more information before they plan to purse a course and this also involves informed choice and commitment to master the course owing to the above mentioned challenges. We found similar aspirations in the workshop learners as compared to classroom learners.

RQ2: Traits of self learners and correlation with performance

We will begin with the perception of learners. We computed the SRL questionnaire scores for all the 57 questions of Zhao et al. (2014) given in Table 1. The average score obtained for all students in both workshop and classroom groups is 4.00. As this is above 3.8 on the 5 point Likert scale, we can conclude that all the students, irrespective of groups, are serious about the Java course. One possible reason for this is the employment potential. We consider null hypothesis H_0 as no difference among the workshop and classroom learners for all four characteristics of the SRL questionnaire. We performed a t-test on questionnaire responses to identify the differences between workshop and classroom learners. Although the average score of the workshop participants for all the 57 questions of Table 1 was higher than that of classroom students (Workshop=4.06, Classroom=3.94), and statistically significant ($t = 2.56$, $p < 0.01$), see Table 6. Naturally, there are statistically significant differences in individual characteristics. Workshop learners scored higher than the classroom learners in all four first level characteristics, see Fig. 5. They are also statistically

Table 3: Java test, inter-group and intra-group, analyses

Groups	Gender (participants)	Mean	Stdev	t	p
$Workshop$		69.09	1.49	6.03	0.0035**
$Classroom$		64.06	1.60		
$Overall_{males}$		67.5	1.55	2.58	0.009**
$Overall_{females}$		65.6	1.68		
Workshop	Male(148)	69.9	1.32	2.31	0.02*
	Female(72)	67.45	1.76		
Classroom	Male(102)	64.7	1.66	0.603	0.546
	Female(78)	63.95	1.54		
$Workshop_{male}$		69.9	1.32	5.47	0.001*
$Classroom_{male}$		64.7	1.66		
$Workshop_{female}$		67.45	1.76	2.05	0.04*
$Classroom_{male}$		64.7	1.66		
$Workshop_{male}$		69.9	1.32	6.03	0.0066*
$Classroom_{female}$		63.95	1.54		
$Workshop_{female}$		67.45	1.76	2.54	0.01*
$Classroom_{female}$		63.95	1.54		

$^{*}p \leq 0.05$, $^{**}p \leq 0.01$

significant in planning ($t = 3.35, p < 0.01$) and monitoring characteristics ($t = 2.47, p < 0.05$), see Table 4.

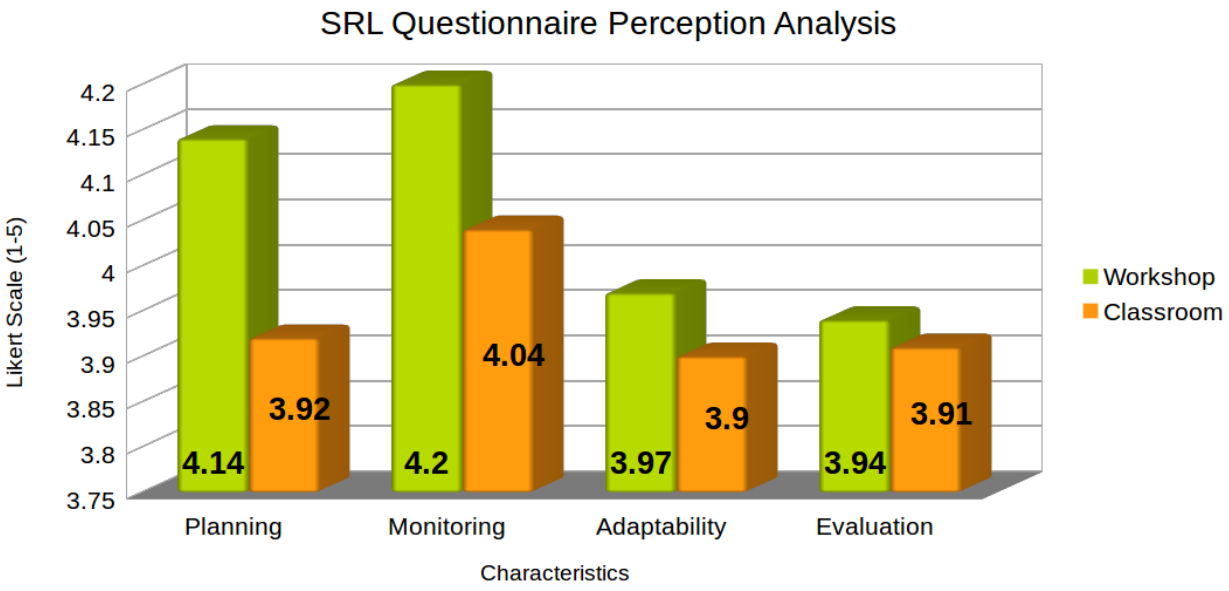


Figure 5: Scores of workshop and classroom participants in first level characteristics of the SRL questionnaire

Workshop learners scored higher than the classroom learners in all four first level characteristics,

see Fig. 5. They are also statistically significant in planning ($t = 3.35, p < 0.01$) and monitoring characteristics ($t = 2.47, p < 0.05$), see Table 4.

Table 4: SRL Questionnaire First-level Characteristics

Characteristic	Group	Mean	Stdev	t	p
Planning	Workshop	4.11	0.4769	3.35	0.0008**
	Classroom	3.93	0.5648		
Monitoring	Workshop	4.195	0.2801	2.475	0.013**
	Classroom	4.068	0.5113		
Adaptability	Workshop	3.988	0.3879	1.208	0.230
	Classroom	3.93	0.5559		
Evaluation	Workshop	3.934	0.5896	0.193	0.8464
	Classroom	3.922	0.6264		

Results also indicate that workshop learners rated higher score for planning-learning objective, planning-learning resources and planning-learning outcomes than the learners from classroom ($t = 1.93, p < 0.05$; $t = 3.45, p < 0.01$; $t = 7.54, p < 0.01$), see Table 5. This confirms that the workshop group is better in every aspect of planning, as compared to the classroom learners. Monitoring-learning resources and monitoring-learning outcomes of workshop learners are also statistically significant as compared to classroom group ($t = 3.39, p < 0.01$; $t = 4.027, p < 0.01$). We also found statistical significance for adaptability-learning resources for workshop learners ($t = 1.93, p < 0.05$). This can be attributed to the difficulties of classroom learners to clarify their doubts and availability of resources (Dehnadi et al., 2009). Although workshop and classroom group scores do not differ significantly in adaptability and evaluation characteristics, we reject the H_0 null hypothesis as we have found statistically significant differences in planning and monitoring characteristics.

Next, we will validate the perception with the post test results.

1. We compared the learners' perceptions with the actual performance in Java test to validate their perceptions. For a question asked on planning-learning outcome, *I predict my performance based on difficulty of the learning content at the beginning of course*, 128 workshop students rated 5 in the Likert scale confirming their confidence on the workshop instructional material. In contrast, no one from the control group rated 5 to this question.
2. Further, these 128 students have also performed better than classroom learners, scoring above 68.8%, which is in agreement with their perception.
3. For a question asked on monitoring-learning resources, *I usually reflect on how self learning courses can help improve my academic performance*, 82 workshop students rated 5 in the Likert scale expressing their belief on self learning to improve their performance. They also showed better performance than others who rated low, scoring above 69%.
4. 58 workshop students who rated 5 in the Likert scale for a question on adaptability-learning outcomes, *I prefer to carry self learning approach to understand deeper aspects of the concept* also scored well in Java test with average scores above 66%.
5. We found 77 workshop students who rated 5 in the Likert scale for a question on evaluation-learning resources, *I choose to arrange the learning content according to a self study plan* also scored above 69% in Java test, indicating a strong belief in our self learning workshop approach and seem to benefit more as compared to classroom group. However no one from control group rated 5 to this question.

Table 5: SRL Questionnaire Second-level characteristics

Characteristic	Second-Level	Group	Mean	Stdev	t	p
Planning	PLA-LO	Workshop	3.98	0.7998	1.93	0.0053**
		Classroom	3.83	0.7621		
	PLA-LR	Workshop	4.12	0.7015	3.46	0.0056**
		Classroom	3.85	0.7435		
	PLA-LC	Workshop	4.46	0.3684	7.54	0.0016**
		Classroom	4.05	0.6502		
Monitoring	MNT-LO	Workshop	3.98	0.5009	0.195	0.855
		Classroom	3.96	0.5147		
	MNT-LR	Workshop	4.22	0.5781	3.39	0.0007**
		Classroom	4.02	0.5951		
	MNT-LC	Workshop	4.38	0.4741	4.027	0.00058**
		Classroom	4.15	0.5341		
Adaptability	ADP-LO	Workshop	4.02	0.5641	1.939	0.052*
		Classroom	3.90	0.6015		
	ADP-LR	Workshop	3.90	0.5586	1.304	0.191
		Classroom	3.82	0.7038		
	ADP-LC	Workshop	3.99	0.5331	-0.521	0.597
		Classroom	3.986	0.5380		
Evaluation	EVA-LO	Workshop	3.93	0.5597	0.185	0.859
		Classroom	3.92	0.6173		
	EVA-LR	Workshop	3.91	0.6929	0.187	0.845
		Classroom	3.87	0.6911		
	EVA-LC	Workshop	3.96	0.6450	0.185	0.847
		Classroom	3.93	0.6458		

*$p \leq 0.05$,**$p \leq 0.01$

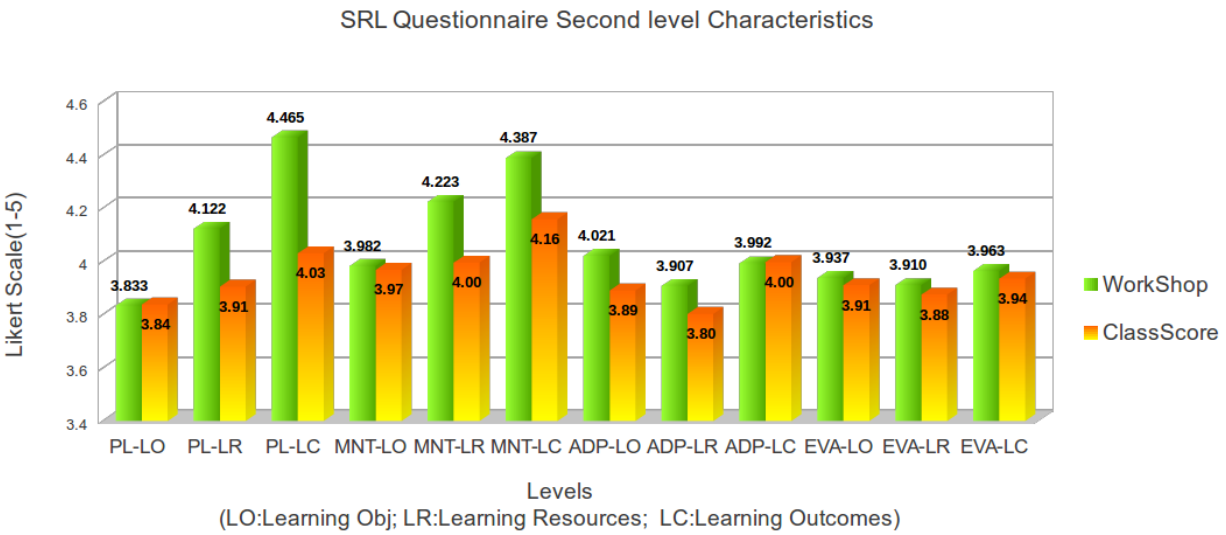


Figure 6: SRL Questionnaire Second level characteristics

We will now characterize self learning.

1. We have found high scores for planning-learning outcomes(4.46), monitoring-learning outcomes(4.38) and followed by adaptability-learning objectives(4.02), evaluation-learning outcomes(3.96) for second level SRL characteristics, see Fig. 6.
2. These scores show that planning-learning outcomes was considered to be more important for self learning and while evaluation-learning outcomes was least preferred, which is true, as most self learners consider learning outcomes based on ease of learning, availability of content as first priority, followed by evaluation of learning especially in online and distance self learning (Lee, 2014).
3. We have found statistically significant difference among the workshop and classroom groups on adaptability learning objective and monitoring learning resources and monitoring-learning outcomes, see Table 5.
4. These results are similar to the reciprocal relationship theory proposed by Schunk et al. (2012), when students set intermediate goals within their proximity of time, they tend to perceive focused learning and this reciprocally prepares them to set more challenging goals.
5. In conclusion, the majority of self learners have good planning, monitoring, adaptability and evaluating capabilities in relation to learning resources. This answers the second research question: the above said four first level characteristics seem to indicate a higher level of learning potential amongst the workshop group.
6. Through a feedback that we collected separately, 78% of the workshop learners expressed an interest to learn other topics through SELF workshops. This shows that the self learners we worked with, liked the Spoken Tutorial approach of self learning.

These results are consistent with the previous research studies (Young, 2014; Hiltz and Wellman, 1997; Winne, 2010). These findings are closely related to the culture of learning in India and several other Asian countries, as explained next. University distance education programs provide provision for part-time learners to complete their courses through study-centers. Students studying

through this mode of classroom-independent teaching-learning also showed similar perceptions to self learning (Iyer, 2014). Educational reforms allowed part-time study for employed adult learners and full-time study opportunities for high school graduates. These options facilitate independent study with less intervention through tele-learning centers and online portals. However, most of these programmes failed to meet the requirements of distant learners due to lack of bandwidth, infrastructure and content delivery issues. In the current approach, bandwidth and the infrastructure are not an issue, as instructional material and the target software were installed in every computer locally.

RQ3: Gender differences

We conducted a full multivariate analysis of the data to determine, if any gender differences are present in the sample. We conducted the t-test to study the gender differences among the groups. We first present the Java post test comparison, before discussing perception.

Overall females vs Overall males

- We found statistically significant differences among the overall male and female learners ($t = 2.58$, $p < 0.01$), see Table 3. Overall males scored 67.5%, while overall female score was 65.6%, confirming males scored higher than females among both the groups. These results can be attributed to the gender differences among programming skills, computer usage, ownership and access issues which is a major challenge among the female learners (Calero et al., 2007).

- Perception scores also showed significant gender difference across the data as a whole ($t = 2.72$, $p < 0.05$), suggesting that males are significantly better across all four first level characteristics than females.We found statistically significant differences among the overall male and female learners for planning ($t = 4.79$, $p < 0.01$**) and monitoring ($t = 2.22$, $p < 0.05$*). However no such significance was found among adaptability and evaluation characteristics. The gender differences among the groups for all four characteristics has been shown in Tables 6-7. Gender differences lead to poor social presence and disparities of opportunity among men and women. After doing a detailed study of Chinese and Indian Women, Harish (2014) points out that the only way to address this issue is to train women on self learning methods. Because of sociological and historical reasons, men are more encouraged to take up employment compared to women. We have shown below that the SELF workshops help workshop women considerably - they end up doing better than classroom males as well. The fact that they can do this despite their initial handicap is because of the self learning nature of the SELF workshops. Thus, we can say that the self learning helps women even more than it helps men.

Workshop males vs Workshop females

- Workshop males showed higher performance in Java test as compared to workshop females. Java test scores were also statistically significant among the workshop males and females ($t = 2.31$, $p < 0.05$), see Table 3.

- Perception scores also showed statistically significant differences among the workshop male and female students for planning-learning objective ($t = 0.0019, p \leq 0.01$), planning-learning

Table 6: Gender perception analysis

Characteristic	Group	LO	LR	LC	t	p
		Mean				
	$Workshop$		4.06		2.56	0.010*
	$Classroom$		3.94			
	$Workshop_{male}$		4.012		2.72	0.0068**
	$Workshop_{female}$		4.125			
	$Class_{male}$		3.98		0.9534	0.3416
	$Class_{female}$		3.93			
Planning	$Workshop_{male}$	3.66	3.88	4.42	2.76(LO)	0.006(LO)**
	$Class_{male}$	3.82	3.875	4.064	1.18(LR)	0.237(LR)
					5.72(LC)	0.0033(LC)**
	$Workshop_{male}$	3.66	3.88	4.42	1.96(LO)	0.050(LO)*
	$Class_{female}$	3.91	3.99	4.03	0.09(LR)	0.922(LR)
					5.39(LC)	0.005(LC)**
	$Workshop_{female}$	4.18	4.61	4.55	2.50(LO)	0.013(LO)**
	$Class_{female}$	3.91	3.99	4.03	8.09(LR)	0.0018(LR)**
					6.16(LC)	0.0063(LC)**
	$Workshop_{female}$	4.18	4.61	4.55	3.52(LO)	0.0005(LO)**
	$Class_{male}$	3.82	3.875	4.064	8.75(LR)	0.00186(LR)**
					5.73(LC)	0.0042(LC)**
	$Workshop_{male}$	3.66	3.88	4.42	5.32(LO)	0.0019(LO)**
	$Workshop_{female}$	4.18	4.61	4.55	8.80(LR)	0.0039(LR)**
					2.56(LC)	0.010(LC)*
	$Class_{male}$	3.82	3.875	4.064	0.92(LO)	0.357(LO)
	$Class_{female}$	3.91	3.99	4.03	1.20(LR)	0.230(LR)
					0.2730(LC)	0.7850(LC)
	$Overall_{males}$		3.95		4.79	0.0022*
	$Overall_{females}$		4.19			
Monitoring	$Workshop_{male}$	4.03	4.06	3.93	0.473(LO)	0.6359(LO)
	$Class_{male}$	4.00	4.07	4.22	0.072(LR)	0.9420(LR)
					3.80(LC)	0.00017(LC)**
	$Workshop_{male}$	4.03	4.06	3.93	0.914(LO)	0.361(LO)
	$Class_{female}$	3.971	3.875	3.75	1.23(LR)	0.218(LR)
					2.34(LC)	0.0019(LC)**
	$Workshop_{female}$	3.977	3.875	3.75	0.071(LO)	0.942(LO)
	$Class_{female}$	3.971	3.955	4.130	0.780(LR)	0.4366(LR)
					4.32(LC)	0.00023(LC)**
	$Workshop_{female}$	3.977	3.875	3.75	0.363(LO)	0.716(LO)
	$Class_{male}$	4.00	3.875	4.064	2.11(LR)	0.036(LR)*
					5.82(LC)	0.00028(LC)**
	$Workshop_{male}$	4.03	3.87	3.75	0.826(LO)	0.4096(LO)
	$Workshop_{female}$	3.97	4.06	3.93	2.01(LR)	0.044(LR)*
					2.069(LC)	0.039(LC)*
	$Class_{male}$	4.00	4.07	4.22	0.4392(LO)	0.6609(LO)
	$Class_{female}$	3.971	3.955	4.130	1.32(LR)	0.1867(LR)
					1.131(LC)	0.2595(LC)
	$Overall_{males}$		4.04		2.22	0.026*
	$Overall_{females}$		3.95			

*$p < 0.05$; **$p < 0.01$

Table 7: Gender perception analysis-II

Characteristic	Group	LO	LR	LC	t	p
		Mean				
Adaptability	$Workshop_{male}$	4.13	3.83	3.95	2.83(LO)	0.0042(LO)**
	$Class_{male}$	3.93	3.86	4.04	0.2991(LR)	0.765(LR)
					1.225(LC)	0.221(LC)
	$Workshop_{male}$	4.13	3.83	3.95	3.52(LO)	0.0051(LO)**
	$Class_{female}$	3.86	3.76	3.98	0.773(LR)	0.439(LR)
					0.289(LC)	0.772(LC)
	$Workshop_{female}$	4.05	3.80	3.98	1.977(LO)	0.043(LO)*
	$Class_{female}$	3.86	3.76	3.98	0.3831(LR)	0.7021(LR)
					0.0103(LC)	0.991(LC)
	$Workshop_{female}$	4.05	3.80	3.98	1.29(LO)	0.196(LO)
	$Class_{male}$	3.93	3.86	4.04	0.533(LR)	0.594(LR)
					0.800(LC)	0.4246(LC)
	$Workshop_{Male}$	4.13	3.83	3.95	1.19(LO)	0.235(LO)
	$Workshop_{Female}$	4.05	3.80	3.98	0.3411(LR)	0.733(LR)
					0.296(LC)	0.767(LC)
	$Class_{Male}$	3.93	3.86	4.04	0.797(LO)	0.4262(LO)
	$Class_{Female}$	3.86	3.76	3.98	0.8827(LR)	0.3785(LR)
					0.814(LC)	0.4166(LC)
	$Overall_{males}$		3.98		1.17	0.240
	$Overall_{females}$		3.92			
Evaluation	$Workshop_{male}$	3.92	3.86	3.96	0.3112(LO)	0.7559(LO)
	$Class_{male}$	3.95	3.92	4.00	0.707(LR)	0.4801(LR)
					0.4367(LC)	0.6626(LC)
	$Workshop_{male}$	3.92	3.86	3.96	0.397(LO)	0.691(LO)
	$Class_{female}$	3.89	3.85	3.88	0.108(LR)	0.913(LR)
					0.837(LC)	0.403(LC)
	$Workshop_{female}$	3.94	3.87	3.99	0.5765(LO)	0.5651(LO)
	$Class_{female}$	3.89	3.85	3.88	0.2006(LR)	0.8412(LR)
					1.068(LC)	0.2870(LC)
	$Workshop_{female}$	3.94	3.87	3.99	0.044(LO)	0.9645(LO)
	$Class_{male}$	3.95	3.92	4.00	0.521(LR)	0.602(LR)
					0.072(LC)	0.941(LC)
	$Workshop_{Male}$	3.92	3.86	3.96	0.2400(LO)	0.8104(LO)
	$Workshop_{Female}$	3.94	3.875	3.99	0.1084(LR)	0.9137(LR)
					0.324(LC)	0.745(LC)
	$Class_{Male}$	3.95	3.92	4.00	0.6437(LO)	0.5205(LO)
	$Class_{Female}$	3.89	3.85	3.88	0.7411(LR)	0.4595(LR)
					1.189(LC)	0.2360(LC)
	$Overall_{males}$		3.93		0.415	0.677
	$Overall_{females}$		3.90			

$p^* \leq 0.05$; $p^{**} \leq 0.01$

resources ($t = 0.0039, p \leq 0.01$), planning-learning outcomes ($t = 0.0010, p \leq 0.01$) However, workshop females showed higher perception score compared to workshop males($X_{female} = 4.125$; $X_{male} = 4.012$), see Table 6. It is interesting, however, that the workshop female learners showed significantly higher score than workshop males on monitoring-learning resources characteristic ($t = 2.01, p < 0.01$). This could be attributed to higher levels of patience and inquiry abilities in females as compared to males while monitoring learning resources (McGill et al., 2014).

The result of t-test performed on all four characteristics show that workshop males have better adaptability ($t = 0.55$, $p < 0.01$) and evaluation characteristics ($t = 0.201$, $p < 0.01$), compared to the workshop females. These results are in agreement with the findings of Valla and Ceci (2011), who compared distance learners with classroom learners.

We found these results in line with econometric and sociological models of education proposed by Stage and Hossler (1989) where factors such as parental encouragement, educational aspirations, family income, parental education levels also have shown influence in choice of education, which is very predominantly noticed in female learners, although no direct causality has been established in these studies. We found similar results in our study, as most of our sample come from rural and semi-rural backgrounds.

Workshop females vs. Classroom males

- Workshop females scored 67.45% while classroom males scored 64.7%. However, overall workshop group scores were higher Interestingly, workshop females scored higher than classroom males. We also found statistically significant differences among workshop females and classroom males ($t = 2.05$, $p < 0.05$), see Table 3. Workshop females seem to benefit more from Spoken Tutorial methodology than classroom males who showed faith in instructor driven approach as compared to self learning (Allen et al., 2002).

- We also found statistically significant differences among workshop females and classroom males for planning-learning objective, planning-learning resource and planning-learning outcomes ($t = 3.52$, $p < 0.01$; $t = 8.75$, $p < 0.01$; $t = 5.73$, $p < 0.01$). And also for monitoring-learning resources, monitoring-learning outcomes respectively ($t = 2.11$, $p < 0.05$; $t = 5.82$, $p < 0.01$). However, no such significance was found for adaptability and evaluation characteristics among workshop females and classroom male learners, see Table 6. These results are similar to Murray et al. (2015) who found that structured orientation of course content and activity driven approach has contributed to improvement in student performance. Our methodology also uses activity driven approach, which is a concern in conventional classrooms owing to course deadlines or teaching staff issues (Lee, 2014).

Workshop males vs Classroom females

- Workshop males scored 69.9% while classroom females scored 63.95%. Workshop males scored higher than classroom group. We found statistical significance for Java test among workshop males and classroom females ($t = 6.03$, $p < 0.01$). Studies in computing education has shown similar differences among the genders as stated by Hasan (2003), which seem to improve gradually with more females participation through self learning methods.

- Perception scores also showed statistically significant differences among the workshop males and classroom females for planning-learning objective ($t = 2.76$, $p < 0.01$), planning-learning

outcome ($t = 5.72$, $p < 0.01$). adaptability-learning objective($t = 3.52$, $p < 0.01$). This could be due to workshop males paid more attention to choice of the course as compared to classroom females who mostly depend on course instructors advice.

Classroom males vs Classroom females

- Classroom males scored 64.7% while classroom females scored 63.95%. We did not find any statistically significant differences among the classroom males and females ($t = 603$, $p = 0.546$) for the Java test. However, classroom males performed better than classroom females, see Table 3.
- Although classroom males showed higher perception scores compared to classroom females ($X_{LC} = 4.0$, $X_{LR} = 4.07$, $X_{LC} = 4.22$), it is not at all statistically significant in any of the planning, monitoring, adaptability and evaluation characteristics, see Tables 6-7. Perhaps excessive spoon feeding in a classroom setting has made the entire group somewhat homogeneous.
- Schunk et al. (2012) have also found that the self learning ability of classroom students was low, which is consistent with the findings of the present research. This also answers the third research question: the above said gender differences and learning experiences of the learners influences their self learning abilities.

Generalization

We believe that the results of this study will extend for most other programming languages as well, going by the widespread adoption of the self learning methodology through Spoken Tutorials and the feedback received from many (Moudgalya, 2014). The following is a sample testimonial that we received in this regard:

> I find the OpenFOAM lecture video tutorials very useful ... Tutorials in Salome are also my interests, as well as Blender, Scilab, and C++. I am already advocating your website! You are really helping out people, especially those who are not knowledgeable with open source programs, which are essentially the trend nowadays due to economic reasons. Howell Gonzales, graduate student at Kansas State University.

Further, we believe that our methodology is useful in teaching methods that use synchronous and asynchronous teaching strategies. Students can be asked to self-learn through the asynchronous phase, and their doubts can be resolved during synchronous sessions. MOOCs and flipped classroom methods are possible application areas of this approach. Indeed, online platforms, such as (EdX, 2016), have shown that this approach can result in a superior performance, as compared to conventional classroom based teaching methods (Schmid et al., 2014).

Preliminary studies carried out by the authors (Eranki and Moudgalya, 2013) also confirm this generalization. Although the proposed method seems to be effective to a restricted class of topics, the benefits can still be enormous, as the number of people to be trained for employment is close to half a billion in India alone (Majumdar, 2015).

Conclusions

The current study has focused on the comparison of effectiveness of a Spoken Tutorial based self learning workshop with that of classroom teaching by using a standardized SRL Questionnaire and a Java test. As this approach is scalable, it will become extremely useful, if it is as effective as the conventional approach of teaching. We validated the effectiveness of this method in this work. As a matter of fact, the workshop trained students did better than the students who underwent conventional method, with statistical significance. A large number of self learners wanted to use Spoken Tutorials for other topics as well, reconfirming the effectiveness of this approach.

The current study has found that there are significant gender differences among the male and female learners. Workshop males have shown high on adaptability, monitoring and planing characteristics as compared to workshop females, whereas, the latter are high on monitoring learning resources. Workshop females have done better than classroom females. More interestingly the former have done better than classroom males also, a surprising result, as generally, males perform better than females on programming topic

The current study has found that there are significant gender differences among the male and female learners. Workshop males showed high on adaptability, monitoring and planing characteristics as compared to workshop females, whereas, the latter showed high on monitoring learning resources. Workshop females have done better than classroom females. More interestingly the former have done better than classroom males also, a surprising result, as generally, males perform better than females on programming topics.

The results of the current study have significant implications to instructional design and course content, especially through the modern content delivery means. This approach is expected to help everyone, but in particular, the females. This study also shows the suitability of the Spoken Tutorial approach for self learning of programming concepts.

Although we restricted this study to Java training only, we believe that this approach is useful for other programming types of courses also, as seen by the testimonials the Spoken Tutorial methodology received (Spoken Tutorial Testimonials, 2015). We expect this approach to be useful to several other skill based topics as well.

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