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A Structured Peer Interactive Method to Overcome the Learning Gaps of the Students

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Teaching the basics of programming languages to novice learners is a challenging task for teachers all over the world. Even after engaging the latest teaching methods and techniques, it is often found that students have problems in using data, conditions, sequences and loops which are considered the key concepts of programming. In this study, after taking a specially designed test, a web based peer teaching method was used to help students bridge the learning gaps. The design of the test helped to identify learning gaps while debugging simulated errors in a trivial program. To check the effectiveness of this method, a research frame was designed. In the research method it was ensured with a test that none of these students have any prior knowledge about programming. After completing certain level of the course, a test named pre-test was taken to test the level of the students and find out their difficulties in understanding of applying debugging steps, i.e., finding and fixing errors in a computer program. Pre-test score of the students proved that they needed to improve their skills of debugging, i.e., they have problems at differing steps of the process. To mitigate learning gaps, students were instructed to post their problems in debugging online, and their peers were instructed to help their friends overcome their learning gaps. After one week of intervention, a post-test was taken and this time score by the students were found to have improved significantly. One month after the post-test, a retention test was taken and the scores statistically showed that this technique helped the students to overcome their learning gaps as well as to retain their mastery of the debugging process. This web based peer interactive method was found effective to reduce learning gaps and it can be easily applied to any course provided the process steps are individually tested in a test. Without significant online involvement of a teacher the students can help each other to bridge the learning gaps and become more confident learners.

Keywords: *Teaching technique, web based, learning gaps, empowering students.*

Introduction

Teaching difficult subjects at tertiary level is a great challenge for teachers all over the world. The process of teaching at tertiary level involves giving feedback to students on their weaknesses and give practice insolving real world problems in their area of expertise. Accordingly, enabling students to solve problems in their own subject areas has become a challenge (Stephenson, 2007). The challenges are to develop basic skills and attitudes which are important for effective learning from both sides (teachers and students) (Barg et al., 2000).

To overcome the challenges of effective teaching, educators are trying to find out effective methods. Sorva (2012) proposed that *levels of engagement* which actively engaged is a effective way of

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teaching.Graham (2013) suggested to empowering students about their interest of learning to engage them whereas Milyavskyia et al., (2012)mentioned that extrinsic motivation actually works towards diminishing intrinsic motivation as well as it also helps students to feel respected and trusted. Problem Based Learning (PBL) is a popular approach where students learn by solving non-trivial practical real-life problems (Barg, et.al, 2000, Fee & Holland-Minkley, 2012). Most recently, the use of Social Media to supplement classroom learning experiences has increased in leaps and bounds (Griesemer, 2014). Griesemer (2014) lists a variety of ways that Social Media can be used for collaborative learning and reports positive student experiences. The studies on the use of Social Media do not however pinpoint the exact gains in learning. This study proposes that students, as novices, need support to identify their learning gaps, which then can be supported by collaborative and peer teaching methods.

The objective of the study is to propose a method that will empower students to solve their own learning gaps.

Proposed Method

It is well accepted that programming is not easy to learn and so we decided to design best practice teaching-learning lessons and check the progress of our students. It was planned that in case of unsatisfactory learning, blog intervention would be applied for helping students to overcome their learning gaps. Besides, to help the students to find their learning gaps we had prepared our quiz questions in such a way so that it can be divided in different blocks which represent different areas of difficulties in programming which were categorized using Bloom's Taxonomy (1956) taking help from previous work by Khairuddin & Hashim (2008) in Table 1. A comparative summary of the thinking levels used to assess learning is given in Table 2 demonstrate that the quiz tests across the whole range of thinking skills which is considered as a "Best Practice Assessment" by Boettcher (2010). Questions were checked and justified by the subject matter experts also.

Table-1

Classification of the test Questions according to Bloom's Taxonomy

Level of Bloom's taxonomy considered	Keywords Given by Khairuddin &Hashim (2008).	Sample questions given by Khairuddin & Hashim (2008)	Text of Quiz Question in Pre-test	Justification for classification	Pre-test Question Categorized as
Analysis Level	Analyze, compare, contrast, distinguish, categorize, calculate, differentiate, and test.	•Differentiate between call by value and call by reference. •Differentiate PRINTf function calls for displaying prompts and for echoing data.	***Question 1:*** A student wants to add THREE pairs of numbers shown in the DATA statements using the program above. Write the output that ***should*** appear in the box on the right	The given Qbasic code was wrong so student have to analyse and compare, contrast, distinguish, what output *should* appear if it was a correct program adding three pairs of data. This question refers to a student's ability to separate a whole into various component parts and predict what the output should be.	Analysis Level

Knowledge Level	Define, list, arrange, order, and state	What is a global variable? • List 5 reserved words in C programming.	***Question 2:*** To check the program line-by-line a table with all the variables and conditions in the program needs to be prepared. In the table below, add the variables and conditions that you would need to check in each line.	Question 2 refers to students' ability to recall basic concepts that they have learned in class by listing or adding the variables and conditions that they would need to check in each line. Student has to be able to recognize variables & conditions used.	Knowledge Level/ Comprehen-sion Level

Under-standing level &	Explain, describe, discuss, identify, review, select, and predict.	Identify the value of x after running this
		program fragment
		x=0; y=0;
		while (y<50) {x++; y=y+5}
			Question 3: As the program is executed, write the value of the variables and the output from the conditions for each line in the trace table.	Question 3 refers to students' ability to understand and restate or describe what happens when the program is executed.	Under-standing level &Application level

Application level	Classify, write, apply, choose and interpret.	Write a FOR loop that produces this output 0 1 1 2 2 4 3 8 4 16 5 32 6 64		Question 3 also refers to students' skill in interpreting the value of the variables and the output which was a new problem to them. They have never seen the faulty program before.	
Evaluation Level	Argue, debate, recommend , prioritize, justify, rate, and decide.	Given the two solutions to the stated programming problem, rate the solutions in terms of efficiency and readability.	***Question 4:*** Circle and show the incorrect output/s.	Question 4 refers to students' ability to judge, critic and decide on the correctness of the value determined by them in the trace table.	Evaluation Level
Synthesis Level	Create, construct, design, develop, manage, organize,	Write a C program that accepts integer inputs from the screen, computes the total and average	***Question 5:*** Rewrite the program (on the reverse side of this page) to give the correct	Question 5 refers to students' ability to relate learned the concepts of organizing given the wrong code and producing the correct code.	Synthesis Level

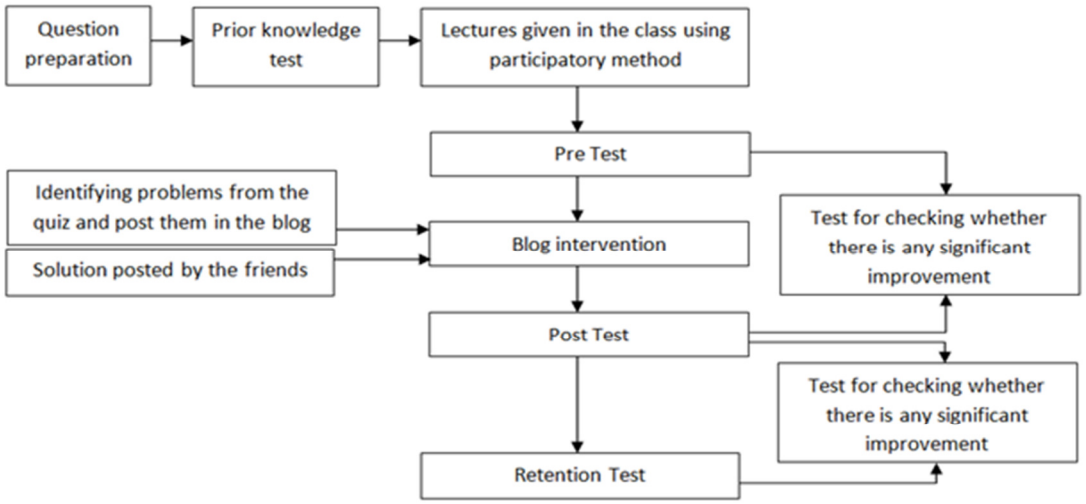
	plan, predict and propose.	values; and displays the values on the screen.	output. If needed, you may renumber the program lines.		

Table-2
Summary of Thinking Level Classification

Test Question	Classified as Bloom's Thinking Level	Stage of Bloom's Taxonomy
Q.1	Analysis	4th Level (HOT)
Q.2	Knowledge & Comprehension	1st and 2nd Level (LOT)
Q.3	Understanding & Application	2nd and 3rd Level (LOT)
Q.4	Evaluation	5th Level (HOT)
Q.5	Synthesis	5th Level (HOT)

To ensure the fairness of the research and assessment of the outcome a prior knowledge test was planned test to verify that none of the students had any prior knowledge of programming languages. In addition, "Activity Based Class Lecture" was developed to ensure that due to different course teachers the activities in classroom did not differ from section to section. After completing the required number of classes pre test quiz was designed to take place followed by blog intervention of a week. After the intervention post test quiz was designed and at the end of the semester retention test was considered. For the blog intervention students activities were limited to two types of work. The first one was to post at least two questions about the problems they faced in their quiz. The post would contain what he did not understand in the question and in what part of the answer he did not know what to write. Another task was to study all the posts of their friends and explain about any two of the problems they feel they can explain in the blog. Scores of the pre test and post test were planned to test to verify whether there is any significant improvement. Another significant test between post and retention test was planned to verify whether the method helps the students to retain what they have learned. All the activities of the research are summarized in the framework presented in Figure 3.

Figure-3
Framework of the Study



Empirical Justification

Sampling and Data Collection

The methodology of teaching was applied in the department of Computer Science and Engineering (CSE) and Software Engineering (SWE) for the course programming in the Computer Fundamental class. The number of students admitted in the semesters of Summer 2013, Fall 2013 and Spring 2014 was averaged 500 which is considered as population and sample size was required 116 with 95% confidence level and 8% margin error (raosoft.com). However, 133 students from different sections of the same course are considered as sample. The sections were chosen based on the teachers' interest to follow the methodology.

After selecting the sample size, the overall frame as shown in Figure 3was developed to conduct the research. Four teachers who were interested to take part in the research were given two batches of students each. The same teaching methods and lecture slides which contained each activity to be done in class were used. Before starting the course teaching activity a test, named "prior knowledge test" was taken to evaluate whether the students have any prior knowledge of programming controls. Then 5 lessons were taken to teach the students about variables, sequence, conditions and loops using the QBASIC language. To gauge the student learning from the teaching, a test named "pretest" was taken. The same pattern of questions were given to all groups for a particular test. The marking scheme was divided into marks out of 15 and the mark obtained by students is used as data for the study.

Analysis

Table 1 presents descriptive statistics of the pre-test, post-test and retention test of the selected students. The mean marks of the tests are 6.88 with standard deviation 2.652, 10.67 with standard deviation 2.762 and 12.14 with standard deviation 2.074 in pre-test, post-test and retention test respectively (Figure 3.1). It is found from the results that the gain of the students in post-test from pre-test is 3.82 whereas in retention test from post-test is 1.42.

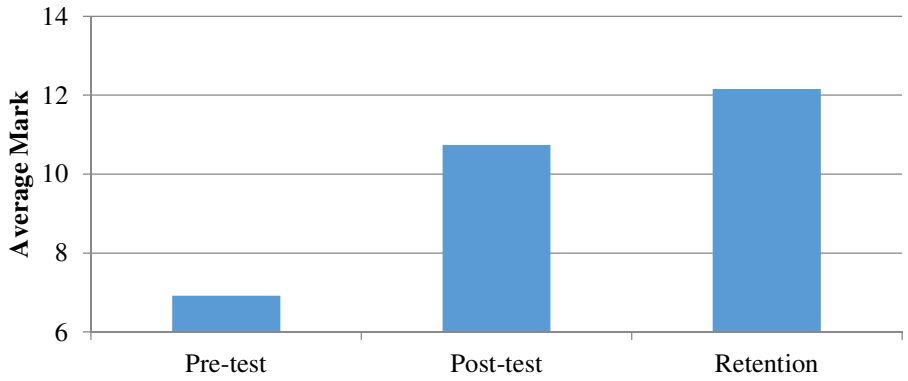
Table-4

Descriptive Statistics of the Marks Achieved

	Minimum	Maximum	Mean	Std. Deviation	Gain
Pre Test Mark	2	14	6.88	2.652	
Post Test Mark	2	15	10.67	2.762	+3.82
Retention Test Mark	5	15	12.14	2.074	+1.42

Figure-4

Average Mark in Different test by the students



Question wise gain is shown in the Table 4.Though Q2 and Q3 was questions from lower level of teaching, highest number of students (67) treated Q3 and lowest number of students (9) treated Q2 as difficult problem after pre-test. Q1, Q4 and Q5 was questions from highest level of teaching and number of 29 students, 58 students and 12 students mention these as difficult problem after pre-test. Highest gain (34.81) was found in post-test of the Q3which is followed by the Q4. In post-test, there is no negative gain however, in retention test, there is negative gain in Q1 and Q2.

Table-4

Question Wise Gain Comparison after Intervention Activity

Question number (Stage of Bloom's Taxonomy)		Mean scores (%)	Number of students mentioned as Problems after pre-Test	Solved by students in Blog	Gain (%)
Q1 (4th Level (HOT)	Pre-test	48.31	29	16	
	Post-test	69.66			21.35
	Retention	60.19			-9.47
Q2 (1st and 2nd Level (LOT)	Pre-test	97.46	9	12	
	Post-test	100			2.54
	Retention	99.54			-0.46
Q3 (2nd and 3rd Level (LOT)	Pre-test	44.67	67	51	
	Post-test	**79.49**			**34.81**
	Retention	91.73			12.25
Q4 (5th Level (HOT)	Pre-test	12.5	58	58	
	Post-test	**37.39**			**24.89**
	Retention	56.02			18.63
Q5 (5th Level (HOT)	Pre-test	31.57	12	13	
	Post-test	51.92			20.36
	Retention	71.3			19.37

To test the hypothesis, is the gain in post-test and retention test positively significant?" t-test was conducted and it is found that gain in both test is positively significant.

Table-5

Results of the T-tests Conducted between Different Stages

Significance test	Pretest		Retention test	
Post test	P-value	Significant Difference?	P-value	Significant Difference?
	0.000	Yes	0.000	Yes

Conclusion

The whole system of setting and assessment marking was aligned in a way to help learner isolate and identify their learning gaps. In this case, identify lack of understanding in a stage to fix faulty program. Collaborative interventions using Social Media that allow students to identify their own learning gaps and solve learning problems o be a strong learning strategy. The use of Social Media offered time flexibility for the teacher.

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