Scaff folding based Problem- Solving Activity in Analog Communication

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Abstract: Problem-Based Learning (PBL) holds the promise of training students to tackle unclear, ill-structured problems and enhance transference of student knowledge from typical classroom activities to real-world design and analysis. The case study was introduced to engineering undergraduates at Central State University, US. The proposed method uses gamification is one of the techniques for implementation to motivate students to participate in the process of learning. By constantly increasing the system complexity, students strengthen their conceptual understanding, mathematical kills as well as problem- solving expertise In previous studies, it has been observed that in most of the engineering courses students face difficulties in solving methodical problems due to lack of theoretical understanding and basic knowledge while solving engineering problems. Problem solving skills are one of the higher-order intellectual skills need to be inculcated to all the twenty-first-century learners. Additionally, professors often assume that problem- solving ability increases by mastering a specific field conceptualization as well as mastering relevant problem solving by encouraging students. At (institution name) in the course EMTL, AC, PTSP, other courses students face difficulties in understanding problem statement and also solve the problems properly. In order to infix the problem-solving skills, this research is carried out which uses gamification and scaffolding concept.

Keywords: gamification, encouraging, implementation, intellectual skills, knowledge, enhance, conceptualization.

1. Introduction

It is commonly believed that scaff folding helps in problem solving. Many researchers have worked on the scaff folding. It is observed that students struggle in college because of their instability in problem solving. This is generally due to lack of conceptual understanding and difficulty in employing their mathematical knowledge (Dr. Morris,2015). Professors want students to know how to design bridges that do not fall down, but it is not possible to know whether students have that knowledge or not if students' ability to communicate their knowledge is unclear (Rebecca Alber, 2015). Active learning projects that engage students in methodize course activities benefit students more than traditional lecture-based approach because students learn to create their own version of knowledge and skills.(Dr. Morris, 2011). The problem-solving process followed by Dr. Morris does not focus on the step of the general problem-solving process. Therefore the proposed method fuses both General Problem Solving process and Dr. Morris scaffolding technique. Interested in using it, though they have suggestions for improvement. This kind of practice offers vision in the development of a diagram-based guide to help problem set up (Streveler,2008).However, some educational researchers (e.g. Kirschener Sweller, 2007) contend that least amount of guidance techniques such as PBL fail to account for "human cognitive architecture" and produce exceedingly high intellectual loads, resulting in less learning than guided instruction (Nancy Lape, 2011). Problem-Based Learning (PBL) holds the promise of educating students to tackle ill defined, ill-structured problems and enhance communication of student knowledge from typical classroom activities to real-world design and analysis (David Jonasses, 2011). In this paper we propose a method based on scaff holding technique, general problem solving and gamification to inculcate problem solving skills in students. The details of implementation are discussed in details in the following section.

2. Method

Problem collection and segregation: Primarily, the topics for which problems are asked repeatedly were found. This was

done by looking at the previous question papers of the university and students of third year electrical branch were summoned. It was found that problems are asked on these topics:

• Modulation index

• Power relation

Specifically for amplitude modulation technique, therefore, problems were collected from various analog communication textbooks for the above-mentioned topics. The problems selected for segregation are classified into three levels of difficulty in ascending order:

- ❖ Level 1 – simple
- ❖ Level 2 – intermediate
- ❖ Level 3 – complex

Three questions for each level were classified and collected. The selected problems were then solved by the instructor used the design problem-solving process which involves the following steps with their respective weight in terms of percentage.

1. Read and translate the problem statement (10%)
2. Identify concepts to apply (10%)
3. Represent the concept mathematically (10%)
4. Work through mathematics (30%)
5. Show the plan of solving the problem (30%)
6. Final results (10%)

CPI (Conceptual & problem solving) Inventory generation:

Once the problem was solved by the instructor, it was easy to identify for the instructor. What are the concepts to be applied for the given problem statement? Instructor listed all the possible concepts related to the problems and created a conceptual and problem-solving inventory which consists of problem statement of these level difficulties from simple to complex as shown below. Students were instructed to mark the field below the problem statements corresponding to the concepts are related to the sample of the student and CPI inventory. The CPI inventory designed as shown in table1.

In the class implementation:

a. CPI Inventory test:
Students who secure 70% as greater than 70% in CPI inventory were allowed to proceed for the game based learning and remaining were made to study the concept and get back to the game
b. Game-based problem solving:
Students were given the level 1 – simple questions in the first round!
Today generation of students is more towards the gamification and since the problems in the scaffolding techniques belong to different levels. The instructor made the implementation interesting by converting into game and scaffold at each stage.
- Each three levels of game-based learning were implemented in their sessions as follows:
  - ❖ Level 1 – session 1 (31st July 2017)
  - ❖ Level 2 – session 2 (1st August 2017)
  - ❖ Level 3 – session 3 (2nd August 2017)

At the end of each session, students get the last questions of each level as homework to reflect solve and come.
Instructor classified the concepts at the beginning of each session based on the last session. The scaffolding was minimized slowly at each level and complete scaffolding was eliminated by the instructor in the last round of level 3 as shown in table1.

Table1. CPI Inventory

Problem statement/concept to solve the problem	The antenna current of an AM transmitter is 10A, when the carrier alone is transmitted. The current in the antenna increase to 10.98, when the carrier is modulated by a sine wave. Determine modulation index at 80% modulation-LEVEL 1	The antenna current of an antenna transmitter is 10A, when the carrier alone is transmitted. The current in the antenna increase to 10.98, when the carrier is modulated by a sine wave. Determine modulation index and also find antenna current at 80% modulation-Level 2	A modulating signal, given by em=2sin(2pi104t) is used to modulate a carrier signal, given by ec=10sin(2pi106t) modulated wave is developed across 50ohms load resistor. a. Calculate the current in load. b. Calculate the total average power. c. Calculate power at one side frequency. d. Calculate the power in the carrier component-Level 3
Amplitude modulation	✓	✓	✓
Antenna current	✓	✓	✓
Carrier current	✓	✓	✓
Modulation	✓	✓	✓

index			
I in terms of modulation index	✓	✓	
Ic in terms of R			
Carrier power			✓
Total power			✓
Power in side band			✓
Amplitude of carrier and modulation signal			✓

3. Result

Number of students who attended the CPI inventory exam was 36 and 25 students out of 36 secured greater than 70%, 11 students got less than 70%. Sample of the CPI inventory is attached in the appendix done by students, 25 students were allowed to enter into level1 of the game and remaining 11 were allowed to brush up the concepts then join the game. Table 2 shows the level wise scores of students from which it is found that almost all the students secured above 60% marks. Example of the students level wise data and also the questions of the each level are shown in the appendix .In Comparison to Dr. Morris work if the pass percentage is increased 70% for the students in game then total students who got greater than 70% are 14 out 17 students whose data was collected. This score itself shows that students performed well in the game based problem solving activity. Table 2 shows the CPI inventory vs. scores of the game based problem solving, it is found that students who secured greater than 70% and also below 70% both of them performed well in all the levels of the game due to the concepts review and also the problem solving process followed using gamification. In correlation to Dr. Morris class size of 5 students, this activity was implemented for 36 students and result is documented for 17students. As shown in fig 2, the answers solved by a student is evaluated accurately according to the content in each step, may it be required formula or given matter.

Table2. Score of students for each level of Game

Name	Roll no.	Level 1	Level 2	Level 3	Final Result
Tejaswini	15-4A7	70	70	70	70
Meghana	15-474	75	80	28	61
Sanchita	15-493	76.6	96.6	61	78.1
Sai Kiran	15-468	87	86	56.6	76.5
Nikitha	15-498	70	70	70	70
Vaishnavi	15-4A5	95.5	90.6	99	95.5
Madhusudan	15-470	93	89	79	87
Hafeez	15-497	83	54	61	66
Tarun	15-467	85.3	60	59	68.1
Renuka	15-406	100	97	96	96.1
Srujana	15-473	85	96	91	90
Anusha	15-471	90	90	85	88.3
Ramya.V	15-486	93.3	90	85	89.4
Shasank	15-480	82	90	90	87.3
Ashwini	15-485	100	96	90	95
Sahiti	15-468	100	93	86	93
Shiva Teja	15-405	95.6	90.6	99	95

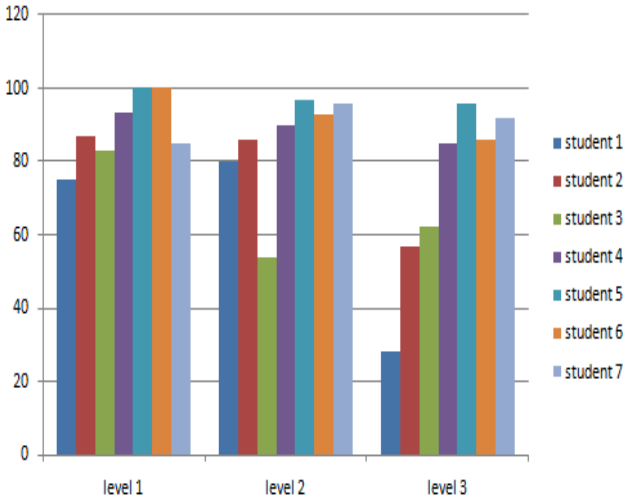
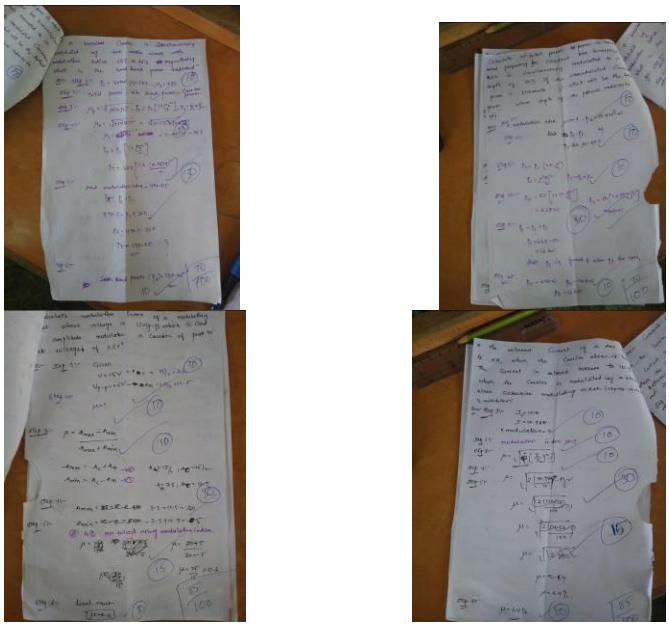


Fig 1 Student result with respect to level of problem



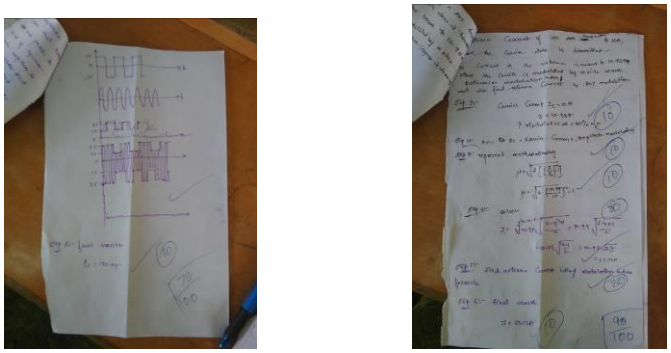


Fig 2 Evaluation of answer sheet of level 2 and 3 problem

4.Discussion

Previous studies by professors like Dr.Morris and Nancy lape have acknowledged that a class size of five students is small, it was beneficial to both the students and instructor to conduct this scaffolding exercise .Including the behavior of student with respect to instruction and mathematical complications. Scaffolding a lesson may, in fact,take longer to teach, but the end product is of far greater quality and the experience much more rewarding for all involved showing its pros and cons.

Merits:

1. Keeps students centralized: Being constitutionally aware to each student's requirement, scaffolding enables students to maintain betrothal and motivation to whole-length assessment tasks.
2. Develops formative data that is useful for educators: When students encounter instructional scaffolding as they are assessed, their reverberations are aligned to their zone of consequence evolvement.
3. Reduces unease and uncertainty: An assessment that offers scaffolding in response to incorrect answers maximizes learning and eliminates the potential unease caused by a too-difficult task. Moreover, scaffolding serves as feedback about correctness puts an end to delusion from taking hold and analyse uncertainty that may otherwise overspread the assessment experience.
4. Creates propulsion: With planted scaffolding, unsubstantial results are met with just-in- time assistance, leading to a convincing teaching opportunity that gains each student where they need it most.

Demerits:

a. Facilitating all the students was difficult.
b. Involving all the students to solve the problem was a challenge as they are not used to doing so much intellectual work.
c. They want their instructor to solve the problems.
d. Evaluations were difficult since students did not write problem step wise.
e. It was not easy to keep answer in order due to time constrain.
f. Collecting proper data of solved problems were difficult.
g. Peer evaluation was not executed properly by the students.

5. Conclusion

Problems of different levels of difficulty from simple to the complex were classified and CPI inventory was designed successfully. The activity of game-based problem solving was successfully implemented and a new model of the problem-solving process was proposed. Students feedback shows that they learned problem-solving skills and are confident to solve any problem related to topic enjoyed game- based learning. There was the challenge in problems of different levels of difficulty from simple to the complex were classified and CPI inventory was designed successfully. The activity of game-based problem solving was successfully implemented and a new model of the problem-solving process was proposed. Students feedback shows that they learned problem-solving skills and are confident to solve any problem related to topic enjoyed game- based learning. There was the challenge in evaluating, monitoring students which can be eradicated by the use of technology-based automatic evaluator step by step. So that it can be implemented easily and also evaluated thereby reducing instructor labour, increasing the accessibility from in class to out of the class & also can be applied to large classroom.

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