Workshop: Puzzle-Based Learning for Software Engineers

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Abstract

Puzzle-based learning (PBL) is a new and emerging model of teaching critical thinking and problem solving. In this interactive workshop we will examine a range of puzzles, brainteasers, and games. What general problem solving strategies can we learn from the way we solve these examples? A learning goal of PBL is to distill domain independent transferable heuristics for tackling problems. Teachers of software engineering face numerous pedagogical issues in terms of motivating and explaining activities of the software development life-cycle. We will explore the possibility of using puzzles to introduce some of these activities. In the past year we have created and taught new courses on PBL in three countries under different academic settings. In this workshop we will introduce PBL and discuss how it may be offered as an independent course or integrated in with other CS/SE courses.

1. Topic, Theme, Goals

Why PBL? Today's marketplace needs more skilled graduates capable of solving real problems of innovation in a changing environment. What is missing in many of the engineering/computer science curricula that we have examined is coursework focused on the development of *general* problem-solving skills. Further, courses that introduce elements of problem-solving skills, do so at the 3rd or 4th level of the programs after students have already faced the majority of their in-academy intellectual challenges. While some courses with a design content emphasis may meet this requirement, many students do not learn how to think about solving problems in *general*. Throughout their education they are constrained to concentrate on textbook questions at the end of each chapter, solved using material discussed earlier in the chapter. This constrained form of "problem solving," is not sufficient preparation for addressing real-world problems—On entering the real world, students find that problems do not come with instructions or guidebooks.

What is PBL? Consider the following puzzles:
o   Given two eggs, for a 100 storey building, what would be an optimal way to determine the highest floor, above which an egg would break if dropped?
o   Suppose you buy a shirt at a discount. Which is more beneficial to us: apply the discount first and then apply sales tax to the discounted amount or apply the sale tax first and then discount the taxed amount? What do stores do?
o   If you have a biased coin (say comes up heads 70% of the time and tails 30%), is there a way to work out a fair, 50/50 toss?
o   A $10 gold coin is half the weight of a $20 gold coin. Which is worth more: a kilogram of $10 gold coins or half a kilogram of $20 gold coins?

What is common to all of the above? Apart from being fun to ponder ☺, solutions to these puzzles exemplify several problem solving strategies. Puzzle-based learning (PBL) is a new and emerging model of teaching critical thinking and problem solving (www.PuzzleBasedLearning.edu.au). In the learning continuum of project-based and problem-based learning, puzzle-based learning forms a foundation [1]. In this interactive workshop we

will examine a range of puzzles, brainteasers, and games. What general problem solving strategies can we learn from the way we solve these puzzles? A learning goal of PBL is to distill domain independent transferable heuristics for tackling problems. Teachers of software engineering face numerous pedagogical issues in terms of motivating and explaining activities of the software development life-cycle. We will explore the possibility of using puzzles to introduce some of these activities. In the past year we have created and taught new courses on PBL in three countries under different academic settings [2].

Goals of PBL. In this workshop we will introduce PBL, discuss its goals, and share our experience. Our objectives for puzzle-based learning are to introduce students to:
- A range of general problem solving strategies that transcend disciplines
- Introspection and the value of meta-level reasoning of one's problem solving process
- Transference and the ability to reapply a prior result or method in a new context

Our goal is to provide a framework that educates and engages students and motivate them to become better problem solvers.

2. Audience

At a high level, this workshop is targeted towards anyone with a broad interest in puzzles and problem solving, who wish to encourage and develop the problem solving skills of their students. More specifically, participants of this workshop will emerge with the needed pedagogical foundation to offer a full course on PBL or to include it as part of a course such as software engineering.

3. Activities and Format

The following are the broad themes we plan to address in the workshop:

- Motivation and goals of Puzzle-Based Learning
- Introduction to PBL
- General structure of a course on PBL and variations
- Using puzzles to introduce concepts of software engineering (requirements analysis, iterative design, software maintenance etc)
- Relating PBL to the broader UG curriculum

The workshop will require the active involvement of all participants collectively and in small groups. Participants are encouraged to share their experiences in teaching software engineering concepts and the pedagogical challenges they face.

4. Time Needed for the Workshop

We plan to run the workshop in two 90 minute sessions with a break in between. We will discuss puzzle-based learning in general and examine how PBL could be integrated into various courses in the CS/SE curriculum.

6. References

[1] Falkner, N. J. G., Sooriamurthi, R., and Michalewicz, Z., *Puzzle-Based Learning for Engineering and Computer Science*, To appear in IEEE Computer 2010.

[2] Falkner, N. J. G., Sooriamurthi, R., and Michalewicz, Z., *Puzzle-Based Learning: The first experiences*, Proceedings of the Twentieth Annual Conference of the Australasian Association for Engineering Education (AaeE 2009), Adelaide, Australia, December 6 – 9, 2009.