

Chapter 15

Board Game Supporting Learning Prim's Algorithm and Dijkstra's Algorithm

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ABSTRACT

The concept of minimum spanning tree algorithms in data structure is difficult for students to learn and to imagine without practice. Usually, learners need to diagram the spanning trees with pen to realize how the minimum spanning tree algorithm works. In this paper, the authors introduce a competitive board game to motivate students to learn the concept of minimum spanning tree algorithms. They discuss the reasons why it is beneficial to combine graph theories and board game for the Dijkstra and Prim minimum spanning tree theories. In the experimental results, this paper demonstrates the board game and examines the learning feedback for the mentioned two graph theories. Advantages summarizing the benefits of combining the graph theories with board game are discussed.

INTRODUCTION

Game based learning (GBL) is a kind of serious games serving for special educational purposes, such as management, politics, city planning, defense and skill training. GBL is mainly comprised of learning content, strategies and even

the learning outcome. Generally GBL aims to cultivate learners' ability for specific educational purposes to apply the methods, strategies and attitude to the real world. Games often include interesting, interactive and fantasy elements to engage players in a learning activity through the predefined storylines.

Computer games have become an integral part of the popular culture in modern societies.

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Moreover, “game-based learning” is the latest buzz word in the computer science educational curriculum. Research (Feldgen & Clua, 2004) shows that students today have a totally different way of learning—react more to interactive learning. If they are not entertained while they learn, the instructor has lost them. However, much of content that needs to be learned by students today lacks of motivation to them. The word “boring”, “dry” and “too technical” often crosses their lips (Prensky, 2003). Finally, it leads to frustration. A good game helps students to enhance their learning techniques, such as learning by doing, learning from mistakes, goal-oriented learning, discovery learning, task-based learning, question-led learning, and etc (Din, 2006). Although game-based learning has been made a good progress in academic research (Squire et al., 2002), using computer games for educational purposes has been rather uncommon. Although learning by playing has been reported to education (Roussou, 2004), nevertheless, it is still less popular in post-elementary education.

Some educational researches discuss game based learning in various application domains, such as discovery learning, learning pyramid and learning by doing. Discovery Learning belongs to the inquiry-based instruction which is considered as a constructivist based approach to education. Learners can draw their own experience and prior knowledge by discovering and solving problems. Students interact with their environment by exploring and manipulating objects, brain storming with questions and arguments with peers, or performing experiments. Although Ausubel and Robinson (1969) have found that discovery learning not the best learning method, especially when there is no deliberate design in learning activities. Dole (1954) proposed teaching methods in audio-visual media. Another similar theory which is called learning pyramid also mentioned how people memorize knowledge. More concrete learning activities leave more memory for people. People learned 75% from what they learned in practical action. People learned 50% from what they learned

in group discussion. People learned 30% from what they learned when they see a demonstration. People learned 20% from what they learned from audio-visual. People learned 10% from what they learned from reading. People learned 5% from what they learned from lecture. Learning-by-doing is a concept of economic theory. It refers to the capability of workers to improve their productivity by regularly repeating the same type of action. The increased productivity is achieved through practice, self-perfection and minor innovations.

GBL assists teachers with changing their teaching functions. It provides an attractive and practical learning environment. In GBL, students have to deal with challenging tasks or missions themselves. After completing the assigned task, learners can get encouragement or reward according to the game rules. This is also the most important motivation for students. However even though there exist quite a lot of benefits brought by GBL, but we still can find the weakness of GBL. For example, instructors have to arrange the learning materials precisely to each learner according to individual ability, and this is hard for instructors to make the general game rules.

The organization of this paper is as follows. First, related techniques are introduced followed by a description of the three minimum spanning tree algorithms. Next, the board game “Ticket to Ride” is demonstrated showing the ways of combining graph theories with the board game “Ticket to Ride”. Then the difference between our work and other researchers are compared. Finally, we discuss the experimental result and the analysis of learning performance followed by a conclusion.

RELATED WORK

GBL makes learning more interesting and attractive, but not all of the games make learning effectively. Van Eck (2006) mentioned card game, *Jeopardy*-style game, Arcade-style game and

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