145j Problem Based Learning (Pbl) for Fuel Cell Powered Chem-E-Car Class

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The general method for teaching and learning of engineering education has been developed. This paper propose the method, applying the problem-based learning (PBL) to the chemical engineering education for students to develop creativity with Chem-E-Car. The PBL is used to give a problem to students and to develop a researching skill, teamwork, communication skill and creativity for students by solving the given problem. The problem in this case is to make the Chem-E-Car, a shoebox sized car powered only by chemical reaction. Four types of Chem-E-Car such as turbine, rocket, voltaic cell and fuel cell type are developed through out this program. And fuel cell powered Chem.-E-Car is introduced to students as new problems with constraints. This paper shows how the students solve the problems with PBL.

Problem-based learning (PBL) is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. That is the principle behind problem-based learning, a teaching technique that educates by presenting students with a situation that leads to a problem for them to solve. It is not only the way to get students to find a correct answer. Students have only given guidelines for how to approach problems. Frequently the problems have no single “right” answer. Instead, students learn through the act trying to solve the problem. The actual learning takes place during the process of solving the problem-thinking throughout the steps such as researching the issues, and developing the project. They interpret the question, gather additional information, find possible solutions, evaluate options to get the best solutions, and then present their conclusions.

Chem-E-Car is a shoebox sized vehicle that must use only chemical reaction for propulsion and travel a specific distance while carrying a load of water. The Chem-E-Car competition has been run for undergraduates by the AIChE for the past six years. The idea is that teams of undergraduate students design and build a small car powered by a chemical reaction, Chem-E-Car. The main objective of this competition is to design and construct a Chem-E-Car and to be able to control a chemical reaction such that the car can stop at a pre-determined distance from the starting line, using only chemical reactions for timing methods. The distance to be traveled and the weight to be carried by the car are not announced until the day of the competition. The emphasis is on control of a chemical reaction, with a keen eye on safety and the environmental impact of the design. The winner is the car which stops nearest to the required distance. As designing and building the car, each team must make poster and oral presentation which describes the car's operating principle, and safety and environmental assessment.

The PBL is applied to the chemical engineering class, ‘Creative Design and Control', for three years with Chem-E-Car. ‘Making a proper Chem-E-Car with some constraints' is the problem for students attended to this class. Three or four students make each group and work together. At first, they have a brain storming about design and concept of the car and make a schedule to do for three months. Next, they try to find a chemical reaction for propulsion system by searching web site and books. Their ideas of design, concept and propulsion system are presented in the class. After the class, any idea of each group is kept secret and the group has a meeting with a lecturer week by week. The teamwork and communication skill are very important to advance the project and solve problems. The case studies include what problems they get and how they solve them are introduced with four cases of Chem-E-Car.

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