

USING THE PROBLEM BASED LEARNING (PBL) PROCESS IN THE DESIGN AND CONSTRUCTION OF ELECTRONIC CIRCUITS

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Abstract: *As educators search for ways to make curriculum and learning more relevant for our students, the question of whether the rigor of curriculum is maintained as explore new methods always is a concern. The need to face students with real problems and situations where they apply what they are learning at the classroom, bring the opportunity to work with the Problem Based Learning Method (PBL). This method is both a curriculum and a process. This method was used with a small group of students to design and develop electronic circuits. Our goal was to design a parallel port interface for the personal computer (PC) that permit students in the microprocessors programming course to have the opportunity to develop their own projects and increase their skills in electronics.*

promotes motivation, relevance and context, higher order thinking, learning how to learn and authenticity since engages students in learning information in ways that are similar to real life and real employment situations. Demonstrating understanding and not mere acquisition.

Small groups setting is recommended to be used in PBL, and if it is a big group, divide it in small groups. In this way encourages an inquisitive and detailed look of all issues, concepts and principles contained within the problem.

Electronic technicians need to develop manual troubleshooting and repairment skills, in order to be good technicians. But these abilities are developed as student practices and exposes to situations or solution of real problems; therefore PBL is a perfect way to do this.

Introduction

The Problem Based learning is a total approach to education, is both a curriculum and a process. Curriculum consists of carefully selected and designed problems that demand the learner acquisition of critical and creative knowledge, problem solving proficiency, self-directed learning strategies and team participation skills. The process, is the commonly used systemic approach to solve problems and meet challenges that are encountered in life and future professional career.

In this method roles of teachers and students change, now teachers become resources, tutors and evaluators that guide students in their efforts to solve problems. Students assume responsibility of their learning, and then they are more motivated and feel the need of accomplishment, setting the pattern for them to become successful life-long learners.

Problem Based Learning began over 25 years ago, showing that this method prepares students as well as traditional methods. Students acquire knowledge and become proficient in problem solving, self-directed learning and team participation rather than passive listeners. They become better practitioners of their professions.

Problem based learning begins with the introduction of an ill-structure problem on which all learning centers. Problem as initial challenge and motivation appeals to human desire for resolution/stasis/harmony. Problem sets up need for and context of learning which follows. This method

Investigation

In order to begin with our investigation, four students were selected to work with. They needed to have fundamental knowledges in electronics to perform the proposed study, so they were students of the fourth year in the Electronic Technology Curriculum. Investigators made the selection and designed the problem, which is the center of learning in this method.

Traditional methods usually fail to prepare students to use what they learn to solve real problems, which they encounter in the workplace or in real life. PBL will increase retention of knowledge, help students transfer concepts to new problems, enhance student's interest in the content, and enhance self-directed learning. So in this way this method is an optimal option to implement with our students.

In our first meeting, the selected students were introduced to the method. No one of them knew about the method prior to our meeting, but was interested to be enrolled in the investigation. In theory it seemed to be a good method and we wanted to try it.

Problem

In PBL the problem is presented first since it serves as the organizing center and context of learning. The problem is one ill structure so there will have multiple solutions. Is met as a "messy" situation, often changes with the addition of

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new information, is not solved easily or formulaically and does not always result in a “right” solution.

By solving those problems, students will meet the competencies for all the courses in their program. The problems will be carefully selected so their solutions will encompass the degree competencies. Students will test their solutions in a real-world lab prepared with equipment such as oscilloscopes, curve tracers, logic analyzers, computers, printers, stepper-motors, generators, Voltage-ohms meters (VOM), digital multi-meters (DMM), printed circuit boards (PCB) machine and other. Also students will have available simulators, drawing circuits’ software and Internet. The problem selected was:

- Design an electronic board to be connected in the parallel port of the personal computer (PC) that will work as an interface to connect and control other circuits using the PC. Also the reduction of board size, improvement of the designed circuit and construction of were a most. Another goal is to design and write experiments using those boards, and use them in courses like Microprocessors and Computer Programming.

Only the first part was presented to students in first meeting since problem was divided by parts. First part: design an electronic board to be used in the parallel port of the personal computer (PC) that will work as an interface to connect and control other circuits using the PC. The group initiates a brainstorming:

- What do we know about this?
- What do we need to know?
- What do we need to work with?

After first meeting students need to look for information: Internet, library, books or notebooks, in order to begin with the design. Each week meetings of the group were necessary to monitor learning and solutions of problem, identify essential or specific issues and assign new work. Each student contributed with the results of his research.

After some weeks of work students have almost finished their first design. Next the first design was evaluated and new tasks were assigned: simulation of the circuit, reduce the size of design. Also they prepare a list of electronic components and material needed for the construction of first prototype.

Each meeting students bring their weekly work, new information, new designs and any trouble they have. At same time teachers monitor learning, ask about thinking, probe and challenge students thinking, keep students involved. Teachers also manage the group dynamics, adjust levels of challenge if necessary and keep process moving.

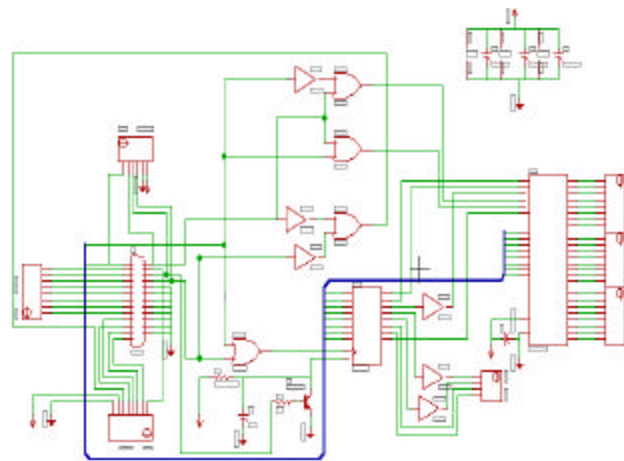


FIGURE 1
CIRCUIT FOR THE PARALLEL PORT INTERFACE

Results

After six months of beginning investigation good results and new commendations arise. Students are motivated and engaged since they have concrete results. They learned to use the printed circuit board machine, for the construction of the boards. Designed, reduced and improved circuit. Now 4 different boards were constructed and all of them are functioning. Four boards are different since in process of construction and test of circuits some changes were introduced and improved for next board to be constructed. In spite of boards are different in layout or type of integrated circuits used, perform the same electrical function. Our goal is to construct other four smaller boards more. Reduction of boards will be implemented by use of PALs, PEELS, PLL or GALs to reduce the combinational logic of gates in circuits. Programmer is available and students are learning how to program these integrated circuits.

Students Reactions

Students fill really engaged with their process of learning. They were asked to list skills, in ascending importance order, that had learned or developed during the process. Their reactions were:

- Exposition to equipment and knowledges that have not seen or obtained prior to this experience.
- Design and implement electric circuits.
- Develop troubleshooting skills.
- Use of Internet or library.

- Design experiments and procedures.

They believe, as investigators do, that the method is a good one for use in electronic courses, because it:

- Promotes to share ideas with a team prior to have a decision.
- Improves retention of material.
- Improves teamwork.
- Improves oral and written communication skills.

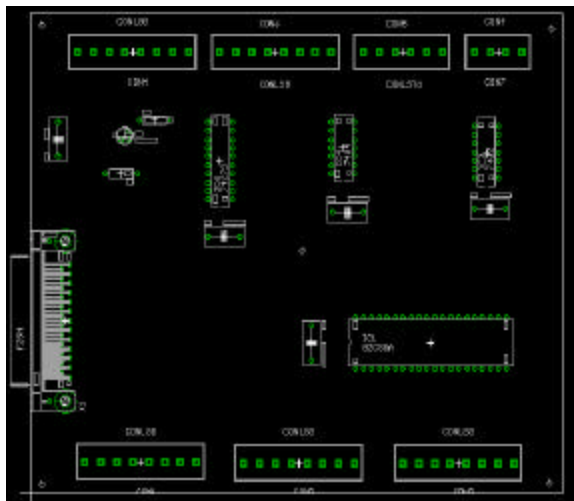


FIGURE 2
BOARD LAYOUT

Investigators Reactions

As investigators in this project, learned to diversify our teaching methods. The process of teaching has changed, it is not the traditional process in which the professor talk and write in a board while student just listen and copy. It was a challenge for us to select a group of students, with the necessary self motivation to work in a project in which they have to look for the source of knowledge, and to assume an active role in their learning process. Letting them to be part of a team with a common goal give them the commitment to produce successful results.

Findings and Recommendations

In conclusion we believe that our results clearly demonstrate that Problem Based Learning (PBL) is a good method for students that are enrolled in technical courses such as Electronic Engineering Technology. It develops important skills necessary for real workplaces, also students understand

knowledge and it is not a mere acquisition of concepts. PBL increases higher level thinking skills, troubleshooting skills, teamwork skills. We re going to continue working with this method and want to expand its implementation to other courses, as much as is feasible.

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