A COMPARISON OF PROJECT-BASED LEARNING (PBL) VERSUS PRESCRIPTIVE LEARNING FOR LABORATORY ACTIVITIES IN INDUSTRIAL ELECTRONICS

Une comparaison de l’apprentissage par projet (APP) par rapport à l'apprentissage normatif pour les activités de laboratoire en Électronique Industrielle

Mai 2018
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Problem Statement

I love hands-on electronics ....
I want to become a...

Electronics is not fun....
Maybe, I should have chosen something else...
Problem Statement (one reason)

Lab classes in school....

Working in the field....
Research Questions

**Primary:**
Does project-based learning improve...

- Academic achievement
- Attitudes

**Secondary:**
Does project-based learning improve/change...

- Intrinsic Motivation
- Perceptions
- Learning style
Conceptual Framework
Conceptual Framework

**Project-based Learning (PBL)**

- Start with a driving question
- Inquire
- Project-based learning
- Voice and choice
- Audience
- Revise and reflect
- Students present to a public audience
- Students have need to know
- Students learn as they need to know

**Scrum Agile Methodology**

- Retrospective
- Sprint planning
- Sprint
- Sprint review
- Product backlog
- Sprint backlog


Empass Mobi website (2018). Retrieved May 2018 from https://empass.mobi/blog/is-agile-scrum-really-that-important-yes
Conceptual Framework

Kolb’s Experiential Learning Cycle

Experience ➔ Reflect ➔ Conceptualize ➔ Experiment
Methodology

25 1st year students

1 experimental group + 2 control groups

Mixed-method research

Winter 2016 Analog Circuits 2-hr weekly lab class
# Methodology

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<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
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<th>W11</th>
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<th>W14</th>
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<tbody>
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<td>Lab Group #1 (Wed8)</td>
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<td>Final Test</td>
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<td>Pre-Test Questionnaire</td>
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<td>Post-Test Questionnaire</td>
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<td>X = activities done by all groups</td>
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Control Group #1
Control Group #2
Experimental Group
Methodology (experimental group)

- Objective: In this lesson, you will become familiar using the scrum framework to build the Digital Storage Oscilloscope (DSO).
**Methodology (control groups)**

- **Objective:** In this lesson, you will become familiar with voltage regulators.
- **Procedure:**
  1. Build the circuit below:

```
   +------------------+
   |                  |
   |                  |
   |                  |
   |                  |
   |                  |
   |                  |
   +------------------+
```

2. Set Vdc = 5V and test the operation of the voltage regulator circuit by measuring at U1 (+Out)
3. Explain the purpose of the LM317, R5, R14, and L1.
Results (academic achievement)

<table>
<thead>
<tr>
<th>Group</th>
<th>Midterm-Assess</th>
<th>Final-Grade</th>
<th>% Difference</th>
<th>Avg % Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group 1-Wed8</td>
<td>66.7%</td>
<td>69.9%</td>
<td>4.7976%</td>
<td></td>
</tr>
<tr>
<td>Control Group 2-Wed10</td>
<td>65.2%</td>
<td>66.4%</td>
<td>1.8405%</td>
<td></td>
</tr>
<tr>
<td>Experimental Group-Thurs11</td>
<td>79.5%</td>
<td>79.4%</td>
<td>-0.2%</td>
<td></td>
</tr>
</tbody>
</table>

× No significant change in academic achievement
Results (attitudes)

- No significant change in the emotional construct
- No significant change in the behavioural construct
- Positive change in the cognitive construct

Emotional construct (feeling towards electronics)

Behavioural construct (behaviours associated with electronics)

Cognitive construct (beliefs about electronics)
Results (intrinsic motivation)

- No significant change in the interest construct
- No significant change in the cognitive engagement construct
- Positive change in the academic efficacy construct

**Interest construct**
(Importance of task)

**Cognitive engagement construct**
(Quality of engagement)

**Academic efficacy construct**
(Confidence in one's skills)
Results (perceptions)

✔ (Q3) PBL lab activities more interesting (motivating) than prescriptive lab activities

✔ (Q5) PBL lab activities more helpful in understanding the theory than prescriptive lab activities
Results (learning styles)

Control Groups: Watching to Doing

Experimental Group: Thinking to Feeling

✔ Control Groups: process continuum “planning” from watching to doing

✔ Experimental Group: perception continuum “feeling” from thinking to feeling
## Results (interviews)

<table>
<thead>
<tr>
<th>Themes</th>
<th>Student #1 - Experimental Group</th>
<th>Student #2 - Experimental Group</th>
<th>Student #3 - Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in Electronics</td>
<td>Yes.</td>
<td>Yes. Because you use it.</td>
<td>Yes. Initially thought that there would be more math.</td>
</tr>
<tr>
<td>View of electronics after the course</td>
<td>Understand the topics better</td>
<td>See things differently.</td>
<td>Both labs and theory were useful.</td>
</tr>
<tr>
<td>Activities before vs after the midterm break</td>
<td>Understood my own circuit but did not understand the other circuits. Liked the big project after the midterm. Before the midterm, just copied what was written.</td>
<td>Huge difference. Before you do your thing. After the midterm, it is like work. If you have problems, you can ask others in group. After the midterm, not easy to follow but interesting. Before the midterm, easy to follow.</td>
<td>Before the midterm relied on asking questions to the teacher. After the midterm relied on asking questions to classmates. Liked working in a team and with colleagues. Preferred before the midterm because did not like asking to other classmates.</td>
</tr>
</tbody>
</table>

**Understood my own circuit but did not understand the other circuits**

**Huge difference. Before you do your own thing. After the midterm, it is like work.**
Conclusion (summary)

- Students’ academic achievements
- Students’ Attitudes
- Students’ intrinsic motivation
- Students’ Perceptions
- Students’ learning styles
Conclusion (limitations)

- Complexity of project
- 7 weeks not enough time
- No random assignment in groups
- Sample size of 25 students too small
Conclusion (recommendations)

Implement PBL at a program level instead of at a course level.