# A Comparison of Project-Based Learning (PBL) Versus Prescriptive Learning for Laboratory Activities in Industrial Electronics

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## Problem Statement

- Students enjoy the hands-on part of electronics.
- Students appear to lose interest and enthusiasm in learning electronics in their progression in the program.
- Is this a reflection on the teaching methods used in the program?

## Research Questions

**Primary:**
- Do students’ academic achievement improve using the experiential learning method of PBL for laboratory activities?
- Do students’ attitudes towards learning electronics improve using the experiential learning method of PBL for laboratory activities?

**Secondary:**
- What are the effects on students’ intrinsic motivation when using PBL for laboratory activities?
- What are students’ perceptions when using PBL for laboratory activities?
- What are the effects on students’ learning style when using PBL for laboratory activities?

## Conceptual Framework

The following theoretical concepts guided this research study:
- Project-based learning (PBL): (Mills & Treagust, 2003; Prince, 2004)
- Scrum agile methodology: (Milenitjevic, Cric & Vokinovic, 2008)
- Attitudes towards a subject matter: (Greenwald, 1989)
- Intrinsic motivation: (Pintrich, 2003)
- Learning styles: (Tsingo, Bosnic-Anticevich, & Smith, 2015)
- Constructivism: (Dewey, 1938; Piaget, 1973)
- Experiential learning: (Dewey, 1938; Piaget, 1970; Kolb, 1984)

## Methodology

- Sample size of 25 first-year students
- Mixed-method research:
  - Quantitative research: quasi-experimental time series with a non-equivalent control group
  - Qualitative research: sequential explanatory design
- Conducted during the Winter 2016 semester in the Analog Circuits 2-hour weekly laboratory class

## Results

<table>
<thead>
<tr>
<th></th>
<th>Students’ Academic Achievement</th>
<th>Students’ Attitudes</th>
<th>Students’ Intrinsic Motivations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>× No significant change</td>
<td>× No significant change in the emotional construct (feeling towards electronics)</td>
<td>× No significant change in the interest construct (importance of task)</td>
</tr>
<tr>
<td></td>
<td>PBL lab activities more interesting than prescriptive lab activities</td>
<td></td>
<td>× No significant change in the cognitive engagement construct (quality of engagement)</td>
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<tr>
<td></td>
<td>PBL lab activities were more helpful in understanding the theory than prescriptive lab activities</td>
<td></td>
<td>↑ Increase in the cognitive construct (beliefs about electronics)</td>
</tr>
<tr>
<td></td>
<td>↑ Increase in the emotional construct (feeling towards electronics)</td>
<td></td>
<td>↑ Increase in the academic efficacy construct (confidence in their skills)</td>
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</table>

### Students’ Learning Styles (Kolb’s LSI)

- **Control Groups:** Watching to Doing
- **Experimental Group:** Thinking to Feeling

## Conclusion

- The research goal was to compare two laboratory teaching methods: PBL (active learning) vs prescriptive learning (deductive learning).
- No significant change in students’ academic achievement when using PBL.
- Mixed results in students’ attitudes towards learning electronics.
- Mixed results in students’ intrinsic motivation when using PBL.
- Positive changes in students’ perceptions of PBL.
- Students’ learning styles moved from watching to doing in the control groups (using prescriptive learning) and from thinking to feeling in the experimental group (using PBL).

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