

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

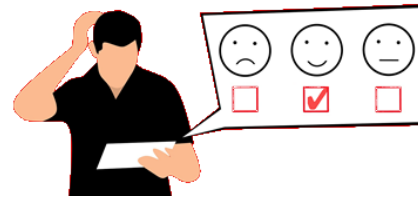
Une comparaison de l'apprentissage par projet (APP) par rapport
à l'apprentissage normatif pour les activités de laboratoire en
Électronique Industrielle

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Problem Statement

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

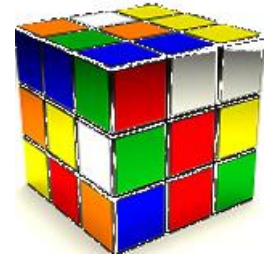
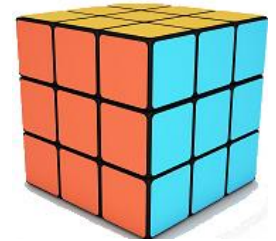


Electronics is not fun....
Maybe, I should have chosen
something else...

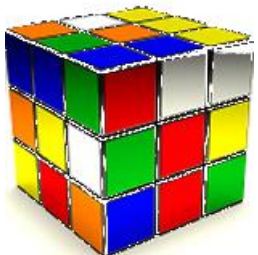


Problem Statement (one reason)

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

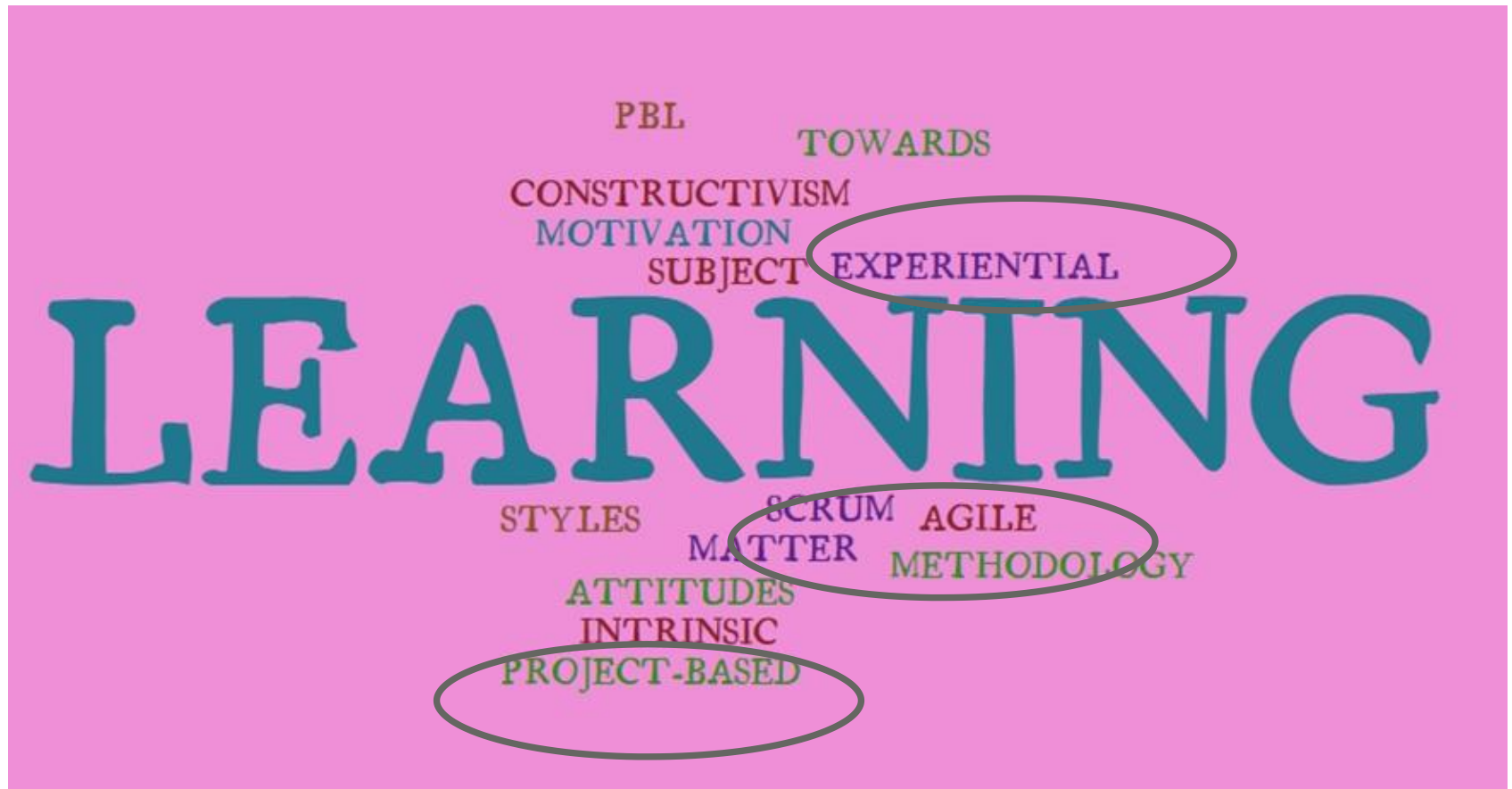


Perceptions



Learning style

Conceptual Framework



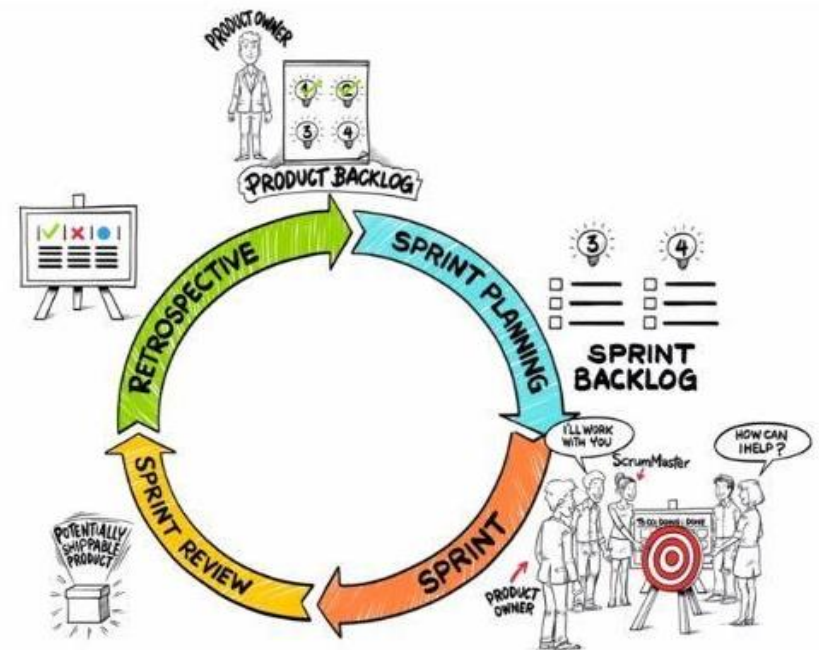
Conceptual Framework

Project-based Learning (PBL)



School District Ashland (2018). Retrieved May 2018 from <https://www.ashland.k12.wi.us/Page/1290>

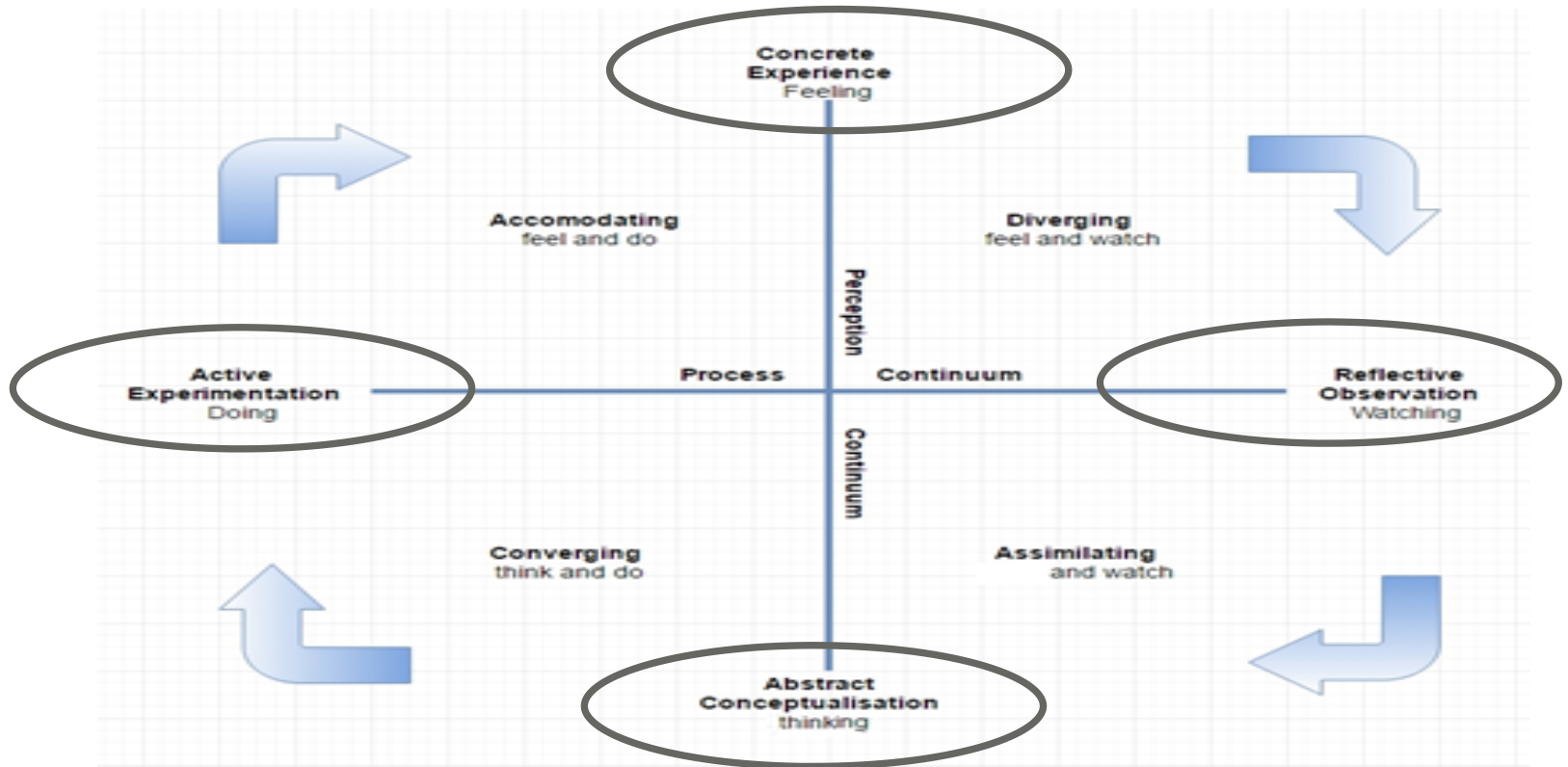
Scrum Agile Methodology



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

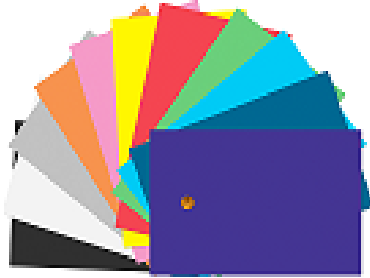
Conceptual Framework

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

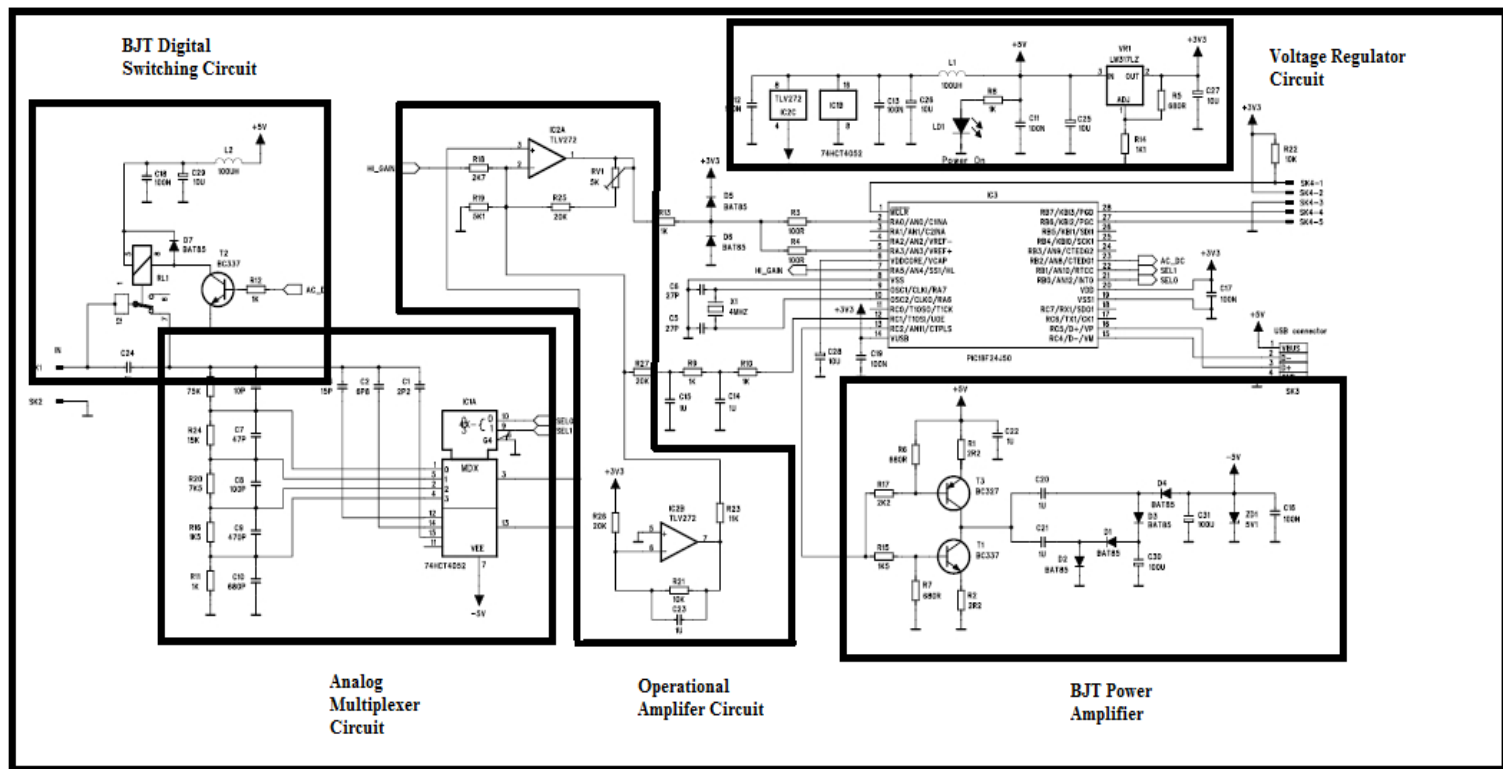
Methodology

	Pre-Test								m i d t e r m b r e a k	Treatment								Post-Test
	W1	W2	W3	W4	W5	W6	W7	W8		W9	W10	W11	W12	W13	W14	W15	W16	
Lab Group #1 (Wed8)	Prescriptive									Prescriptive								Control Group #1
Lab Group #2 (Wed10)	Prescriptive									Prescriptive								Control Group #2
Lab Group #3 (Thurs1)	Prescriptive									PBL								Experimental Group
Midterm Test								X										
Final Test																X		
Lab Report #1				X														
Lab Report #2												X						
Quizzes				X		X		X		X		X		X				
Pre-Test Questionnaire								X										
Post-Test Questionnaire																X		

X = activities done by all groups

Methodology (experimental group)

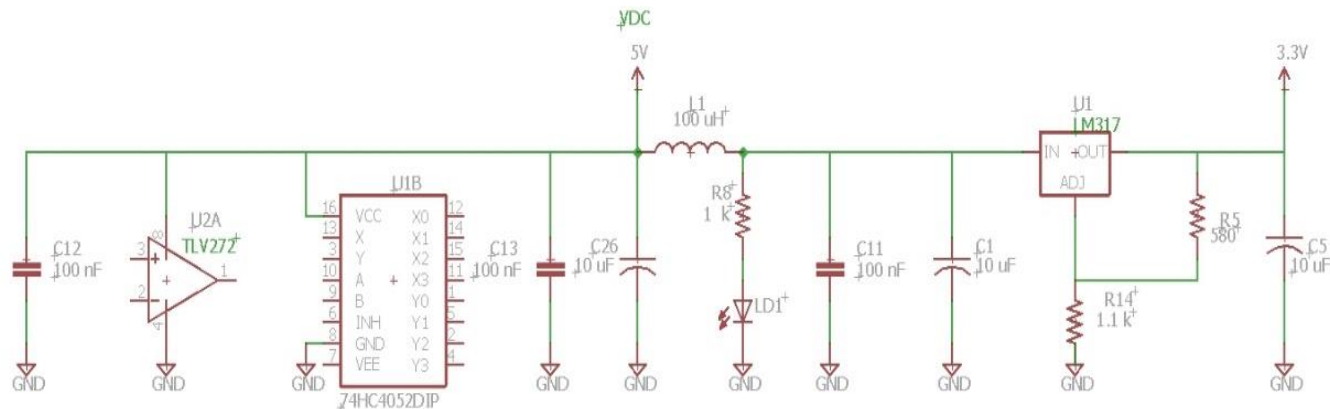
- Objective: In this lesson, you will become familiar using the scrum framework to build the Digital Storage Oscilloscope (DSO).



Digital Storage Oscilloscope

Methodology (control groups)

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



2. Set $V_{dc} = 5V$ 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)

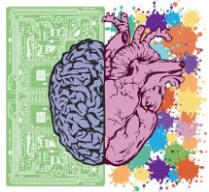
	midterm-assess	final-grade	% difference
ControlGroup1-Wed8	66.7%	69.9%	4.7976%
ControlGroup2-Wed10	65.2%	66.4%	1.8405%
ExperimentalGroup-Thurs11	79.5%	79.4%	-0.2%
			Avg % difference
ControlGroup1-Wed8			14.1%
ControlGroup2-Wed10			2.4%
ExperimentalGroup-Thurs11			1.6%



Grades

× No significant change in academic achievement

Results (attitudes)



Emotional
construct
(feeling
towards
electronics)



Behavioural
construct
(behaviours
associated
with
electronics)



Cognitive
construct
(beliefs
about
electronics)

- × No significant change in the **emotional construct**
- × No significant change in the **behavioural construct**
- ▷ Positive change in the **cognitive construct**

Results (intrinsic motivation)



Interest
construct
(importance
of task)



Cognitive
engagement
construct
(quality of
engagement)



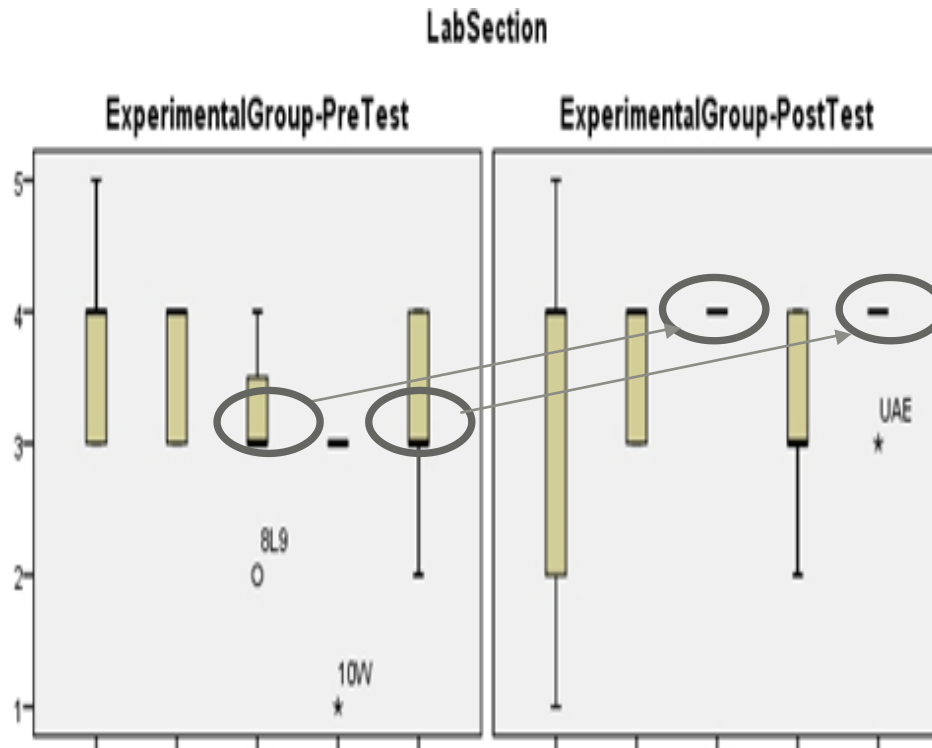
Academic
efficacy
construct
(confidence
in ones
skills)

× No significant change in
the **interest construct**

× No significant change in
the **cognitive
engagement construct**

⊃ Positive change in the
academic efficacy

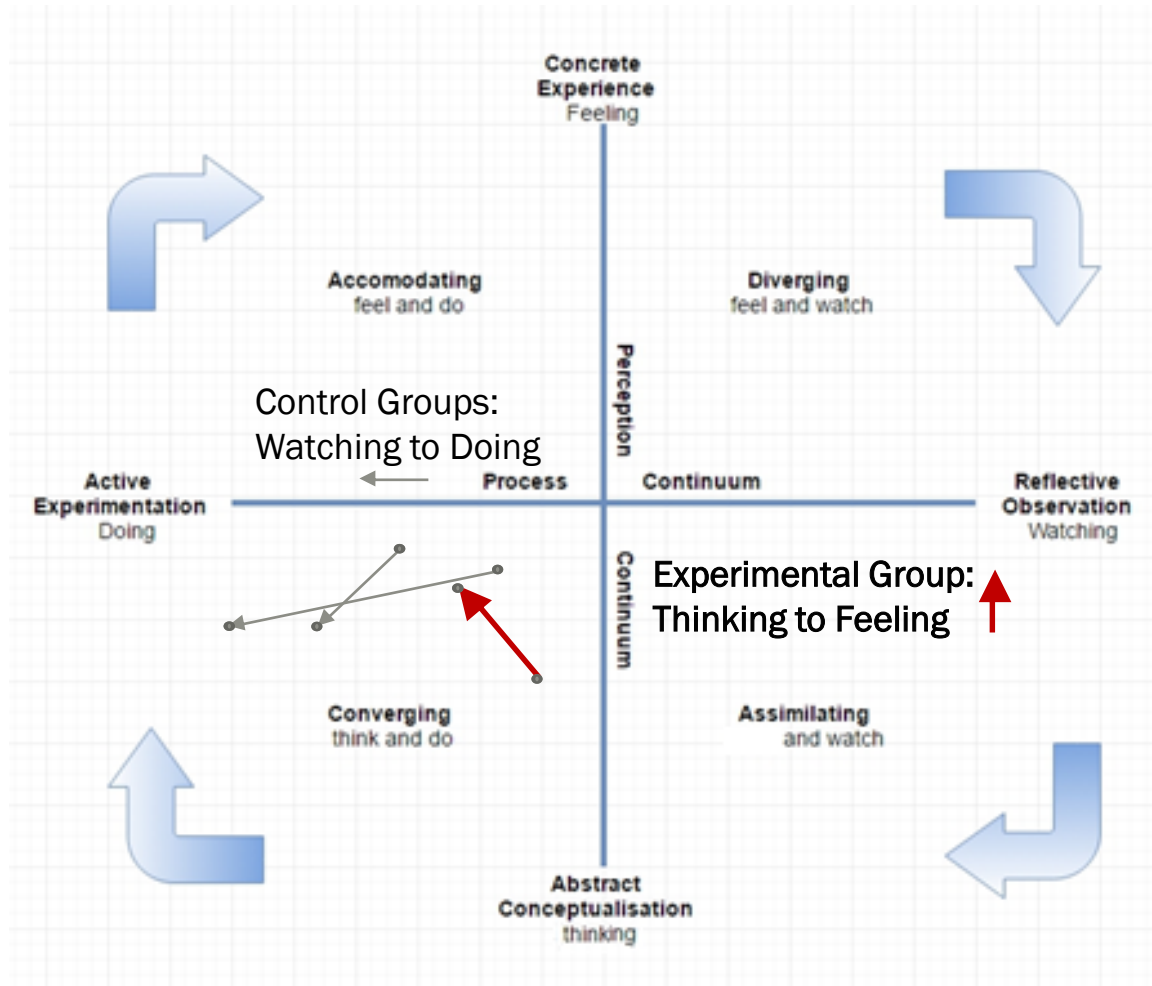
Results (perceptions)



✓ (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:**
process
continuum
“planning” from
watching to
doing

✓ **Experimental
Group:**
perception
continuum
“feeling” from
thinking to
feeling

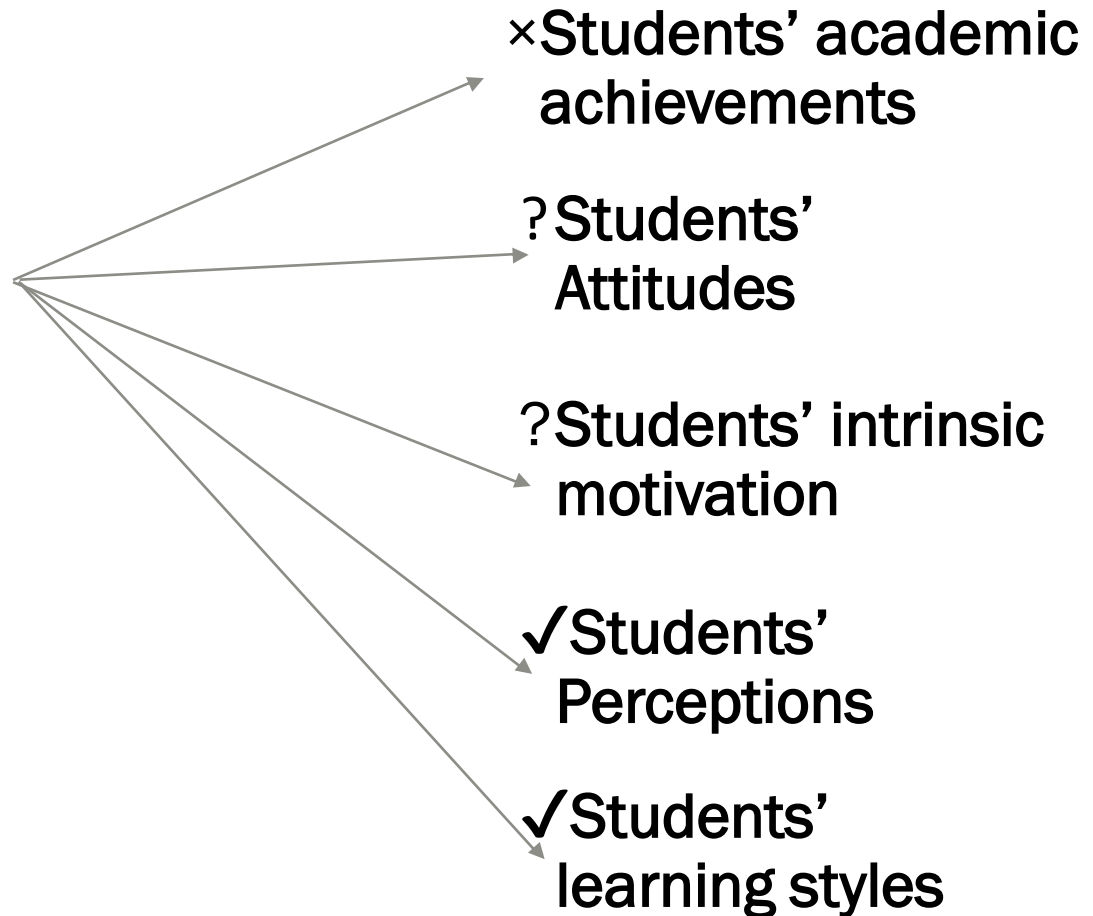
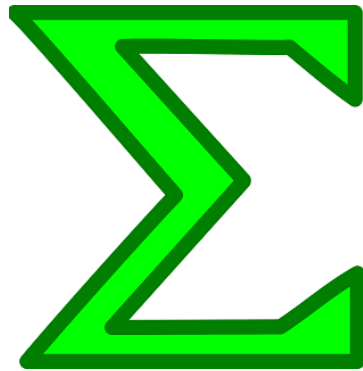
Results (interviews)

Themes	Student #1 - Experimental Group	Student #2 - Experimental Group	Student #3 - Experimental Group
Interest in Electronics	Yes.	Yes. Because you use it.	Yes. Initially thought that there would be more math.
View of electronics after the course	Understand the topics better	See things differently. Learned a lot.	Both labs and theory were useful.
Activities before vs after the midterm break	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.	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.	Before the midterm relied on asking questions to the teacher. After the midterm relied on asking questions to class mates. Liked working in a team and with colleagues. Preferred before the midterm because did not like asking to other class mates.

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)



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



Faculté de génie

Département de génie électrique et de génie informatique