

## Project Based Learning in Undergraduate Engineering Education

*Lutfi Al-Sharif*

*Professor,  
Mechatronics Eng. Department,  
The University of Jordan,  
Amman, Jordan*



## What is Project Based Learning?

1. Difference between projects (i.e., add-on projects) and Project Based Learning (PBL).
2. <https://www.edutopia.org/>
3. *Project Based Learning* is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge.



## Contents

1. This will revolutionise education (video).
2. What is project based learning (PBL)?
3. Why project based learning?
4. Types of Projects.
5. Examples of Projects.
6. Benefits of Project based learning.
7. Difficulties of Project based learning.
8. ABET Student outcomes.
9. An interesting tale!



## Video on the Difference

1. <https://www.youtube.com/watch?v=dhwuQU2-g5g>



## Project Based Learning



## Disciplines in the Room



Background in PBL



Test

Idiom/expression:

*to have a skeleton in the cupboard*

Video: This will revolutionise education?



Template for your own Project Based Learning (to produce a skeleton outline)





## Project Based Learning



## Project Based Learning

- Pioneered by MIT (2006- ).
- 20% of the course mark is dedicated to a project that the students undertake in a group.
- It complements, rather than replaces, conventional structured education.
- The student needs both a structured content (material and exam) and a more open approach in a project, where he/she can show his creativity.



Idiom/expression: **Test**  
*to have a skeleton in the cupboard*

Meaning: To have an embarrassing or unpleasant secret about something that happened in the past

## Project Based Learning

- A list of projects is offered.
- Students form a group and bid for a project.
- They work for around 6 weeks on the project.
- Then they do a report and make a 10 minute long presentation followed by Q&A.
- The best arrangement is to have a staged/phased approach.
- Bonus marks are given for practical projects or creative ideas.



## Three Possible Approaches to Project Based Learning



## Design Courses

- In by their very nature, design courses can be completely turned into a project based course.
- The “Project” is to design (and build) a system or product.
- Examples: design a building; develop and build a consumer product; develop a marketing campaign for a consumer product; develop the concept for a startup company.



## Three Possible Approaches

- Add-on course project.
- Design courses.
- Complete change.



## Complete Change

- Complete re-arrangement of the course (i.e., all the course becomes a project).
- Applied to early year courses (chemistry, physics....)!
- Students learn by looking for what they need as and when they need it.
- The course has to be carefully designed to ensure that the student uses all the things that he/she would have learned in a traditional class.
- Very difficult to achieve without extensive support and resources



## Add-on Project to the Course

- In this case, we simply offer a project in parallel to the conventional course.
- The nature of the project would help students understand the topics covered in the course.
- The students need the topics taught in the course to complete the project.
- Examples: Analysis of a nameplate of a motor (the students need to have studied some of the topics to complete it).



## Types of Projects



## Types of Projects

- Factory visits.
- Hardware building.
- Coding/Programming Projects.
- System modelling and simulation.
- Engineering Systems Design.
- Research Project (e.g., reading and understanding a paper; investigating a certain industry).



## Modelling and Simulation

- Modelling and simulation (using MATLAB/Simulink).



## Factory Visits

- The students visit a factory.
- They look at the production line and understand how it works.
- They then look at the components of interest to them (e.g., motor, sensors/transducers, hydraulic systems).
- They download the datasheets for these components.
- In some courses, they identify a problem in the production line and work on solving it.



## Total Dissolved Solids (TDS) meter



## Building Hardware

- Some projects involve building hardware.
- The students will work in a group and build an electronic circuit or a mechanical component.
- They then test the system and check that it is working.
- In many cases, they are encouraged to produce a video about the product.



## Total Dissolved Solids (ppm)

- Total dissolved solids in drinking water, measured in parts per million (ppm).
- It is recommended that TDS does not exceed 500 ppm.
- Drinking water with levels of TDS exceeding 500 ppm could cause kidney problems.
- There are TDS measurement devices available for sale.



## Test



Dr. Mohammad AbuShams

View More

Assistant Professor  
School of Applied Technical Sciences

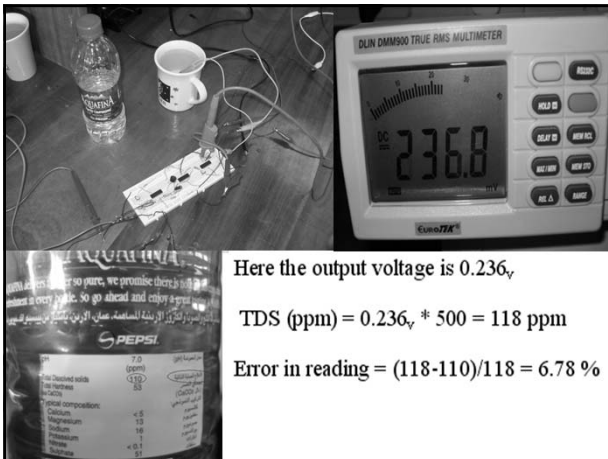
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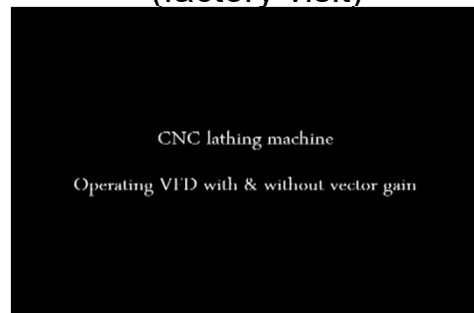
Email

## Variable Speed Drive (factory visit)

- Students studying a variable speed drive course visited a metal fabrication factory.
- There they witnessed in practice the benefits of using a new type of variable frequency drive (flux vector control).



## Variable Speed Drive (factory visit)



## Factory Visit (Variable Speed Drive)



Dr.  
Abdelrahman  
Attili



## Motor Nameplate

3-PHASE INDUCTION MOTOR			
TYPE	DESIGN	CAT. NO.	DT10202
HP	15	KW	11.0
POLES	4	DESIGN	B
PH	3	INS.	F
VOLTS	230	AMP	32.2
R.P.M.	1725	EFF.	88.5
WEGE	14	6580	10000
BRG	6307	254	10000
WEIGHT	78	89	207
USABLE ON	208	NETWORK AT 50 AMP	
100	7.380	AUTS	57.37
			25
			AMPS



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## Strain Gauge

- Student built and tested a strain gauge.
- They also did an educational video about it.



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## Factory visit to identify and formulate a problem



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## Boost Converter

- Another group built a boost converter.



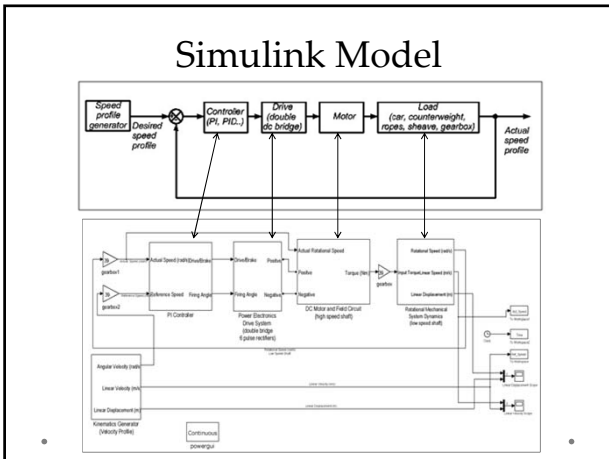
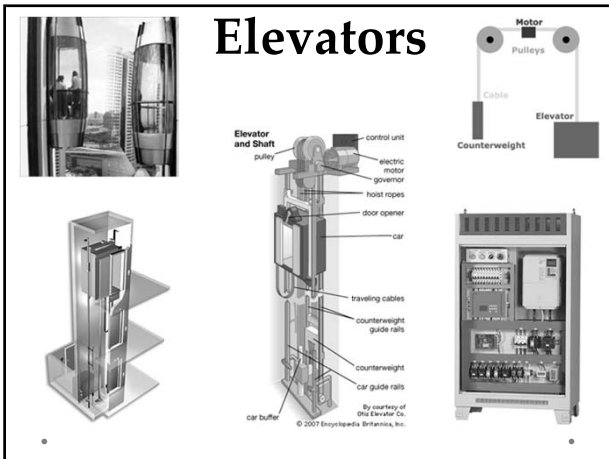
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## Strain Gauge Design, Assembly and Testing

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## Full Elevator Simulator

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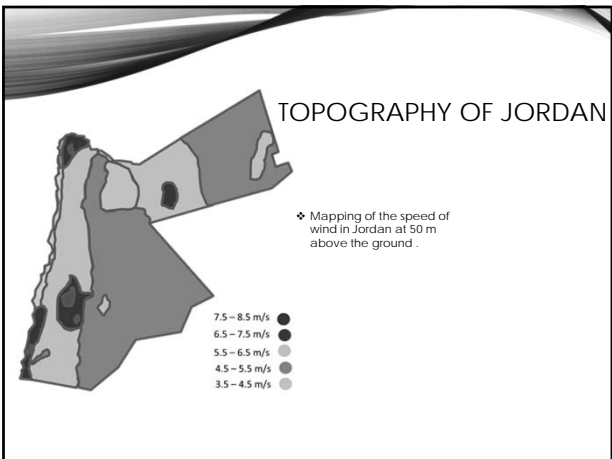
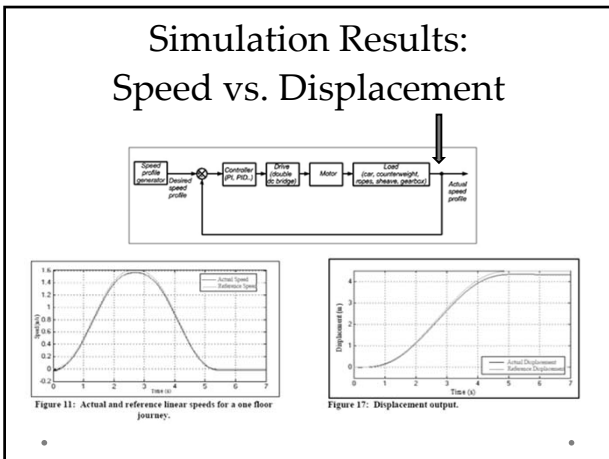


## WIND ENERGY IN JORDAN

**Ma'an Wind Power Project**

- The first stage is to install a 33 WT (each of 2 MW) which produce 66 Mw totally
- The second stage is to adding another seven WT of 2 MW
- That gives total a 40 WT of 2 MW (80 MW)
- It produces 200 GWh per year

Source : Awakeel news YouTube channel





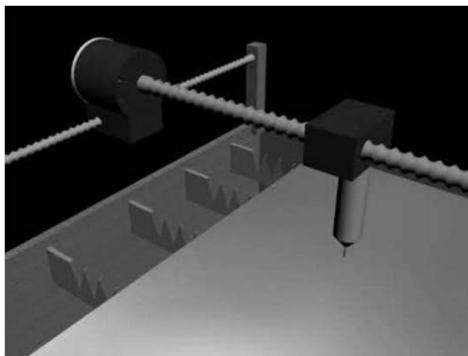
## Design of a Laser cutting machine



## Benefits of Project Based Learning

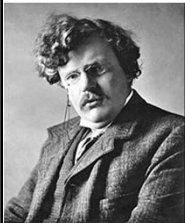


### Design of a Laser Cutting Machine



### Benefits of PBL

1. It makes the course *enjoyable* for many students.
2. It links the theoretical concepts from the course material with practical experience.
3. The students gain more experience in problem solving and overcoming obstacles.
4. It develops the *knowledge seeking and research skills* of the students (lifelong learning).



There is a great man who makes every man feel small. But the real great man is the man who makes every man feel great.

(Gilbert K. Chesterton)

### Benefits of PBL

5. It encourages different *styles* of learning.
6. It develops the *team working skills* of the students.
7. It enhances the *technical writing and presentation* skills of the students (communication skills).
8. It allows the student to practice reading *data-sheets* for engineering components and interpret them.



## Challenges of Project Based Learning



## ABET Student Outcomes

- **4 out of 11 outcomes:**
- (d) an ability to function on a multi-disciplinary team.
- (e) an ability to identify, formulate, and solve engineering problems.
- (g) an ability to communicate effectively.
- (i) a recognition of the need for, and be able to engage in, life-long learning.



## Challenges of PBL

1. It requires extra effort and time from the lecturer.
2. The evaluation/assessment of the projects requires extra care and time.
3. Extra hardware and software must be made available (and longer lab opening hours).
4. The lecture time is already scarce and barely enough to cover the curriculum.
5. The benefits students draw are proportional to the effort they put in.



## The Weasel, the Woodpecker and the Photographer!



## ABET Student Outcomes



The Weasel ابن عرس



Ice Age: Dawn of the Dinosaurs 2009



Hornchurch Country Park, East of London  
2<sup>nd</sup> March 2015



The Woodpecker نقار الخشب



The look on the woodpecker's face!



Woody Woodpecker



...it is the same look as that on the undergraduate student's face when he/she opens the final exam questions paper!

...but our tale has a happy ending!



The weasel/woodpecker story has a happy ending. The woodpecker got away safely!



...and there is now a permanent sign commemorating the event!