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# Student learning and engagement in Project-based learning (PjBL) activities

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**IOE seed-corn funded project:**

***Fitness for purpose: developing the pedagogy of project-based, collaborative learning in engineering***

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**AIMS**

to develop knowledge and understanding of the ways in which engineering students learn in a PjBL context; and

to consider the implications for the development of PjBL across the IOE portfolio.

## Project Based Learning (PjBL)

Parallels with other inquiry-led learning innovations – such as problem-based learning (PBL) (Prince and Felder, 2006)

**A Project** or Project- Based **Learning**? (Thomas 2000:3)

- P[j]BL projects are central, not peripheral to the curriculum.

- P[j]BL projects are focused on questions or problems that "drive" students to encounter (and struggle with) the central concepts and principles of a discipline.

- Projects involve students in a constructive investigation.

- Projects are student-driven with greater “student autonomy, choice, unsupervised work time, and responsibility”

- Projects aim to maximize authenticity in work-related contexts.

# PjBL and the world of Engineering

The use of the term ‘**project**’ in PjBL Engineering is particularly significant.

Reflects:

- a ‘unit of work’ as experienced in the changing workplace;
- Can ensure inter/multidisciplinary professional realities and
- involves the collaborative application of knowledge, understanding and skills.

(Mills and Treagust, 2003)

# PjBL in the IEP

- Single discipline (one week) scenarios
- Interdisciplinary challenges (over 5 weeks) and HtCtW.
- Approx. 40% of the curriculum in most departments is delivered through project-based experiences
- New, innovative, peer assessment tools for team/group work

See : Graham, R (2018) The global state of the art in engineering education, Massachusetts Institute of Technology (MIT)

https://jwel.mit.edu/sites/mit-jwel/files/assets/files/neet_global_state_of_eng_edu_180330.pdf

# Methodology

# Methodology

Collaborative, multi-disciplinary practitioner research.

Qualitative data collection through
- observations of PjBL activities and
- interviews with undergraduate students *in situ*

"unobtrusive observer" role (Robson, 2002:309)

Descriptive narrative of setting

Observers…

Project team members

Post Graduate Teaching Assistants (PGTAs) Faculty Engineering

PGCE students (full-time, FE route)

# Overview of Observations and Interviews

| Disciplinary Scenarios | Year |
|---|---|
| Bio Medical Engineering | Two |
| Bio Chemical Engineering | Two |
| Chemical Engineering | Two |
| Computer Science | Two |
| Civil Engineering | One |
| Electrical and Electronic Engineering (EEE) | One |
| Mechanical Engineering (Parts 1 & 2) | One |

| Inter-disciplinary Challenge |
|---|
| Year One<br>Electronic and Electrical Engineering paired with Computer Science |

| Focus Groups |
|---|
| Year One interdisciplinary group |
| PGTA Focus Group |
| PGCE Focus Group |

# PjBL Discipline focussed Initial Findings

**Focus: Bio Chemical and Bio Medical**

Enhance appreciation for and understanding of **non-technical aspects of engineering solutions** and innovation processes

Develop skills that will help students **turn their theoretical work into real solutions**

Ability to **start with the minimum**

Not just **problem-solvers**: Engineers are now crucial actors involved in identifying problems

# Non-technical aspects

“I think definitely communication, because it’s OK that everyone does anything but if they’re not communicating what they’re doing it’s hard for you to know what they’re doing […]. It’s also difficult to know what they’re thinking, if they’re confused, communication is like a key thing because if you don’t understand, if you wait until the last day to say it it’s incredibly difficult for everyone else.” [Bio Medical]

“We looked at what we were given [budget/resources] because we needed to do something that was viable. So we looked at the sensors we were given and what flex sensors and pressure sensors […] We’d used flex sensors and pressure sensors in previous labs so we…[…] knew how they worked…” [Bio Medical]

**Team working…..**

**Identified differences in disciplines/interdisciplinary [BioChem]**

"..I think that people would think differently especially if they are from different disciplines, but probably we think similarly because we are from the same discipline..[we get on better]"

"A: I didn't like the [interdisciplinary] challenges.

B: Because it was like two different disciplines as well, like you're with people you've never spoken to before and just be…they have a really different personality!

C: It was hard to co-operate.

Q: What do you mean they've got different personalities?

A: A bit more stubborn and like persistent in what they want!"

**Turning theoretical work into real solutions [Bio Chemical]**

"I guess it's familiarisation with the material that we learn in class. Because I guess in lectures you kind of absorb it but when you actually apply it and you kind of think of all the assumptions [....] and I think that's probably the most valuable input you kind of get from this particular scenario..

[...] Although it's like still theoretical, we haven't done [anything in] the real world! ...but it's better than like sitting in a room, a lecture room, listening to pure theory things. Because you work through it and you learn better..."

**Bio Medical:** "Yeah, we were inspired as well by a lecture we had on another course [anatomy and physiology] talking about wheelchair users and the [shoulder] problems that they often suffer as a result of [pushing chair]..."

# What's important..

"I think what [the lecturer] is interested in is more how we think [….], like how we present our information, how we express our information, and how we think. Not so much how everything is calculated. Because everything can be done by [computer]…" [Bio Chem]

"I'm actually really excited to tell people what we've done. Because we're getting questions like 'oh what are you guys working on' and you have to explain it every single time. And once you put it out there and everyone knows what you did during the week it's just pleasing, you've accomplished something." [BioMedical]

# Ability to start with the minimum

"I wish they'd given us a bit more of a brief though. They've given us a bit of stuff but it's still a bit unclear I feel like what exactly we have to do. But we're just doing the best of it that we can…." [Bio Chem : day 1]

Q: "So how has it gone since Monday?

B It's good. I actually feel better..[…] I did a lot more stuff than I expect[ed] I would do…

A Yeah we didn't expect that […] knowing that like because we've done quite a lot of the work and so we're halfway through the week only. So yeah it just feels like we've accomplished stuff…."

# Problem solving/solution-finding [Bio Med]

B “We worked out all of the electronics first, we thought that would be the most challenging phase, and so we had a working circuit, and after we knew that it was working and we tested it a few times ..we decided to go ahead and put it [together]”

D “We actually changed what we wanted to do. […]. So we were planning to give a response as soon as you were moving your arms, but we thought that [might] not be ideal, because it’s very hard for the LED to detect the movement of a sensor [….] because there can be a lot of delay. So we went onto something different, calculating an average. So the person sitting in the wheelchair is doing some pressures and then after a certain amount of time it recalls the data and then averages the data out […]. So it won’t give you an immediate response but after a certain amount of time has passed […]”

# Initial Analysis

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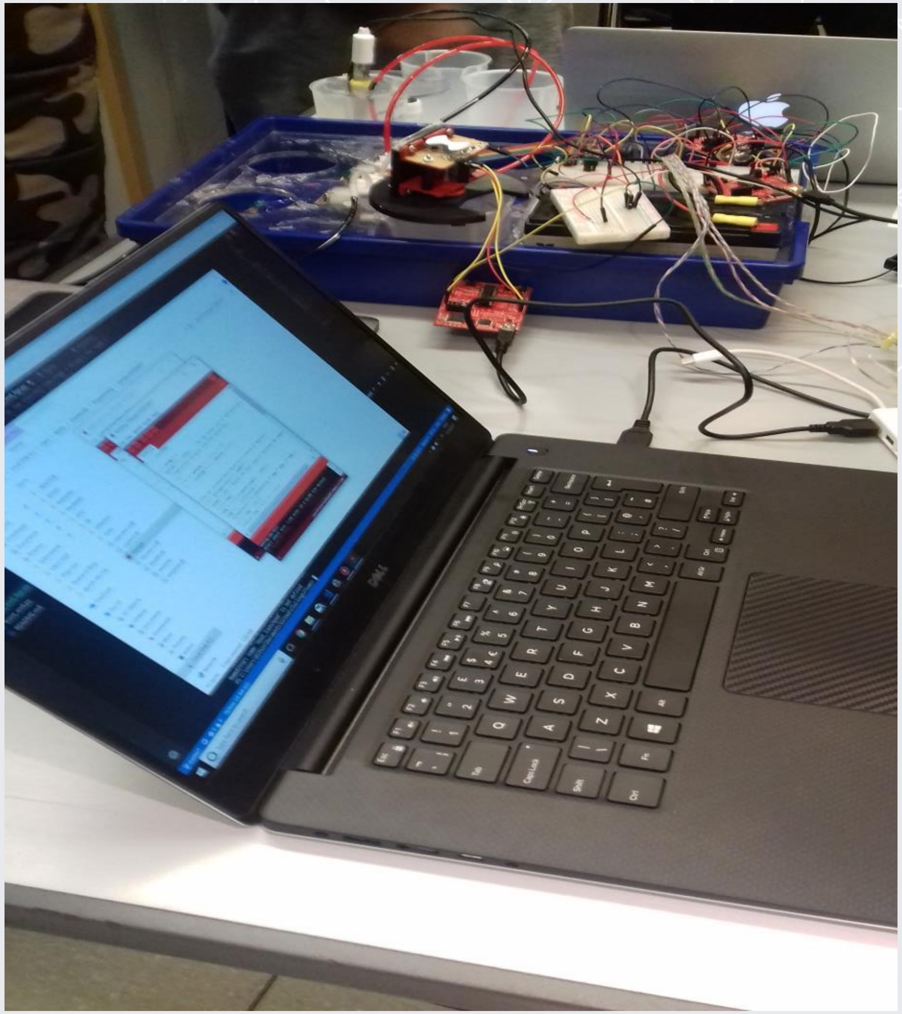

The ubiquitous presence of and interaction with technological objects … frames the learning process (Nerland, 2008)

In some; not others…

Project work demands communication; time-management; division of labour; negotiating etc….with disciplinary peers.

Projects (scenarios) enormously varied and reflect discipline

Applying and **developing** technical knowledge and understanding - singularly and collaboratively.

Learning: **actively mediated** through feedback and questioning (with peers, PGTAs, lecturers and external experts).

Most significantly, for the **discipline scenarios**:

Students learning to **operationalise a "set of investigative processes"** (Nerland and Jensen,2014). These are *distinctive* for the given *domain* enabling problem-solving and solution-finding.

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