

UNHE7006
TEACHING IN HIGHER EDUCATION 2

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1. Teaching intervention cycle

1.1. Abstract

The construction industry requires professionals due to a qualification shortage happening in the last years. The demand highlights the need for more practical capacities and skills, apart from construction knowledge. The aim of this report was to improve practical aspects in class where students could see practical application and be assessed upon this application. The solution was to investigate the implementation of Project Based Learning (PBL) in construction management studies as a tool that can enhance other required skills. A teaching intervention cycle was designed and implemented in a group of students at level 6, studying BSc Project Construction Management and BSc Civil Engineering and Environment Management at UWTSD.

Four student teams were created and different complex construction scenarios were distributed with various tasks to solve about planning and programming. During one semester, the teams worked about these scenarios, having 12 sessions which were distributed between lectures, mini-lectures and tutorials. The outcomes consisted of individual summary reports about their allocated tasks in the team and an oral presentation.

Additionally to technical skills and knowledge developed, other skills could be observed to evolve during time in the students, such as independent work, critical thinking, communication and collaborative work. Feedback from students showed a positive perception of the experience. Despite that, improvements should be considered. This study was a learning process for the tutor as well to understand PBL approach, procedures and issues happening in its implementation.

1.2. Introduction

This intervention cycle was designed and implemented in the module *Project Planning, Monitoring and Control*, inside the Level 6 courses for BSc Project and Construction Management and BSc Civil Engineering and Environment Management at UWTSD. This module worked about techniques for project planning and how they were implemented in construction projects. The complexity of the module came from the fact that there were many varied contents and it was difficult from the student's perspective to link them to the construction project if they did not have any experience in the sector. Besides, the coursework was assessed based on a theoretical report which did not help put in practice any of these techniques. This made it difficult for the students to find real application of their knowledge and little experience for their future careers in industry as construction or project managers.

There was a clear demand from last year students to make this module more practical, so that they could see the relationship between different techniques and the steps applied in a sequence to one real scenario. Therefore, the aim of this intervention cycle was to improve practical aspects in class where students could see practical application and be assessed upon this application. The method developed was a project-based learning (PBL) approach for their assignment where students could work collaboratively in most of the planning process for a construction project. The whole intervention cycle was covered including assessment, feedback and a list of improvements from lessons learned.

1.3. Literature review

1.3.1. Definition

Textbook Based Learning is not an engaging method for students as it does not achieve an effective learning environment. It is required that students get engaged and stimulate their own personal interests, this way achieving deeper learning (Bell, 2010). PBL was defined by Wurdinger et al (2007) as *'a teaching method where the teacher guide students through a problem solving process which includes identifying a problem, developing a plan, testing the plan against reality, and reflecting on the plan while in the process of designing and completing a project'*. This model is based on constructionism, where students can *'construct knowledge and new ideas when they engage in building tangible objects'* (Tangdhanakanond & Pitiyanuwat, 2006). This method supports the learning experience a great extent and is perfectly aligned with the aims and dimensions included in the UK Professional Standards Framework (Advance UK, 2011).

1.3.2. PBL implementation

Barret & Cashman (2010) presented PBL as a total approach with four interrelated dimensions:

1. Students are presented a challenging problem to solve at the beginning of their learning process.
2. They work on the problem in teams. A tutor facilitates the learning process.
3. Adequate assessment process is developed aligned with the learning outcomes.
4. The process is focused on students learning instead of teachers teaching.

The process can be split in six different steps, according to Genaro & Lyons (2015). On the other hand, Graeber (2012) described a seven-phase model. In the comparison made in Table 1, it can be observed that Genareo & Lyons worked from the teacher's perspective, whereas Graeber was more focused on the student's perspective.

Table 1. Comparison between Genareo & Lyons (2015) and Graeber (2012) models (Author, 2020).

(Genareo & Lyons, 2015)	(Graeber, 2012)
1. Identify outcomes and way of assessment.	
2. Design the scenario	1. Introducing the driving question
	2. Introducing the culminating challenge
3. Introduce the method of PBL	
4. Research	3. Developing subject matter expertise
	4. Doing the culminating challenge
	5. Debriefing the culminating challenge
5. Product performance	6. Responding to the Driving question
6. Assessment	7. Summative assessment

It is important to highlight the role of the tutor. In this guide presented by Barrett and Cashman (2010), this role was defined to:

- 'Facilitate the PBL process, not to give a mini-lecture;
- Listen very attentively to what students are saying and the learning that is taking place in the team;
- Encourage a welcoming and challenging learning climate;
- Ask questions that encourage critical thinking;
- Encourage student to link theory and practice;
- Encourage students to be responsible to complete high quality independent learning;
- Facilitate students to reflect on their learning, the development of key skills and the performance of the team;
- Facilitate the review section of the tutorial.'

Savin-Baden (2003) highlighted the differences between problem-based learning and project-based learning. Davies & Wilcock (2003) made a summary of them as shown in Table 2. Despite that, they suggested that, in practice, these two models are overlapped.

Table 2. Differences between problem-based learning and project-based learning (Davis & Wilcock, 2003).

Project-based Learning	Problem-Based Learning
Predominantly task orientated with activity often set by tutor	Problems usually provided by staff but what and how they learn defined by students
Tutor supervises	Tutor facilitates
Students are required to produce a solution or strategy to solve the problem	Solving the problem may be part of the process but the focus is on problemmanagement, not on a clear and bounded solution
May include supporting lectures which equip students to undertake activity, otherwise students expected to draw upon knowledge from previous lectures	Lectures not usually used on the basis that students are expected to define the required knowledge needed to solve the problem

1.3.3. Advantages and disadvantages

Grant (1997) emphasized the benefits of these techniques, allowing to move from teacher-centred to more student-centre activities. Raju & Sanker (1999) highlighted the relevance of using case studies as a valid technique for teaching in engineering as it exposes the students to real industrial matters. Davis & Wilcock (2003) affirmed that case study teaching can be well adapted to the discipline of Materials Science and Engineering as it offered a wide range of practical examples which can be contextualised to put in practice the theoretical concepts. It can also encourage active learning and allows the development of key skills (they identified improvements in communication, group working and problem solving). Additionally, it promotes student engagement with the topic and stimulates their interest to learn.

Kumari and Nandal (2016) affirmed that project based learning enhances the professional skills of students. In their research, they validated the results obtained in a sample of 100 students at measuring the effectiveness of project-based learning in professional education. Considering two different groups of students (control and experimental groups), different skills were assessed with project based learning process, showing a significant improvement in collaborative skills, technical skills, strategic thinking, problem solving, leadership, research attitude and self-learning.

Despite that, PBL is not always welcome by Lecturers. Davies and Wilcock identified several issues to introduce case studies in their courses. They mentioned lecturers with long teaching experience were reluctant to introduce changes in their classes. Timetabling issues were also identified, as background reading was needed and if lectures were just replaced by practical classes, students could fail to do it. Besides, the use of case studies should be increased gradually in the course as long as the resources, time and support needed were identified. Additionally, case studies had more difficulties to be introduced in accredited courses by chartered professional institutes. According to their experience, these accredited courses were well established, contents were fixed, students were more likely to have a physical science background and they tended to be more theory-based.

There is the need of mind-changing to accept new approaches to the learning process. Sahli (2017) gathered a series of complaints from a survey to teachers who were using textbook based teaching. This can be summarised into two main aspects:

- Textbook teaching is already structured and needs minimum preparation, whereas PBL always require additional planning time and continuous reading and update with new questions to solve.
- Textbook teaching is under the teacher's control, but PBL gives the student the capacity to work on their own and direct their learning by themselves. The teacher loses this control.

1.3.4. Some case studies

A complete example was shown by Nagle and Pecore (2018) of how project-based learning was applied to study the redevelopment of a site of a demolished shopping mall. A structured approach was developed going from initial compilation of information about the site to specific subject interest. Multidisciplinary groups of three students were formed, where they could offer creative approaches to the same problem from different perspectives. During this process, students could discover different problems to solve in this site and how to integrate other geological and topographic aspects working with parameters about social and environmental impacts, budgets, ground conditions, aesthetics, etc. Progress was assessed continuously as each group gave daily briefing, addressing challenges and solutions taken. Notes, sketches and diagrams produced were collected and feedback was produced from the lecturer. Mini-lessons were delivered to be implemented in their case study, and brief, open-ended questions were also given as formative assessments. Assessment was completed with a final presentation of the project and an exam covering concepts of land use and planning.

A very interesting experience was developed by Soetanto et al (2012), sponsored by Hewlett-Packard. International teams were created between students from two universities in the UK and Canada to work on a construction project brief. Every team was comprised by two local groups (one in the UK and one in Canada) of four civil/structural engineering students each. The project lasted for one academic year. The initial task was to identify technical and management skills required for this project as well as potential strengths and weaknesses of the team members. The teams carried out weekly virtual meetings and rotated the roles of the

company leader and secretary every month. Different submission deadlines were in place and the company leaders chaired the meetings, coordinated the work and ensured submission dates were achieved. On the other hand, the company secretary took the meeting minutes and deputised for the company leader in their absence. Every student was peer-assessed individually using Web-PA system. This assessment included several important aspects about communication skills, which data was obtained through interviews, questionnaire surveys, personal reflection, grades and tutor assessment feedback at different stages of the project, both individually and as a group. This helped develop a model for virtual collaborative learning using project based learning. The analysis of results showed clear differences in the learning experience in the students from both countries, which communication is more based on aural and read/write modes in the case of the UK students. It also suggested the need of addressing issues about collaboration and integration between different disciplines for multi-disciplinary collaborative working over distance.

1.5. Method

Following the steps defined by Genareo & Lyons (2015), the PBL technique was implemented in the first semester of the module Project Planning, Monitoring and Control. These steps were designed as follows:

Outcomes

According to the module descriptor, the learning outcomes to cover were as follows:

1. 'Evaluate alternative planning monitoring and control techniques and choose a suitable technique for a development;
2. apply various planning techniques to different complex construction scenarios;
3. Critically analyse various production techniques.'

The planning process of a construction project was defined so the outcomes of this work would be to cover several steps of this planning process using different techniques with different construction scenarios.

Scenario design

The class was comprised of 16 students, level 6, studying BSc Project Construction Management and BSc Civil Engineering and Environment Management. The class was divided in 4 groups with 4 students each. Each group was given a specific case study to solve (different scenarios showing different characteristics) in which they had to complete the planning and programming process specified for all projects. The scenarios were as follows:

Scenario 1. Construction of 6-story confined residential building block with party walls and constraint access in the city centre (group 1).

Scenario 2. Construction of 9-story residential building block with underground parking and private area for recreation (group 2).

Scenario 3. Construction of commercial development with two underground floors in the city centre (groups 3 and 4).

Plans and drawings were provided to define each scenario, as they were real cases but applied in other places. All students were advised to consider they were the project management team working for the main contractor preparing a bid at the tender process.

Four different tasks were identified to be completed. The tasks to cover were the following:

Task 1. Programming. Gantt chart

A schedule of works should be developed following these steps:

1. Define the construction method to use and make a list of activities for the project execution.
2. Calculate rates, labourers and cost for all activities.
3. Make a schedule of works using a Gantt chart and arrow diagrams if needed.
4. Identify float (if any) for each activity and critical path.

Scheduled activities should be overlapped whenever it is possible so that the total duration of works is as short as possible.

Task 2. Site layout

The site logistics should be planned for the execution of works. Discussion and decisions should be taken about the site layout for offices and facilities, services, plant, lifting (crane/s, hoist/s, etc.), storage and waste, and drawings and plans should be developed as required. Resources needed should be identified at every construction stage and how the site would change during time.

Task 3. Cash-flow forecast analysis

A cash-flow forecast analysis should be developed for the projected construction stage. For this, the next steps should be completed:

1. Calculate cost expenses per month, as well as monthly invoices and payments, considering 8% profit and 5% retention applied.
2. Calculate monthly cash-flow and locked-up capital, considering payments will be one month after valuation.
3. Draw a cash-flow diagram.
4. Calculate interest payable for this locked-up capital at 15% interest and profitability of this project.

Task 4. Resource optimization techniques

Optimisation of workforce distribution should be developed to avoid peaks and troughs. The steps to complete should be as follows:

1. Calculate average workforce per week.
2. Identify possible peaks and troughs in workforce distribution.
3. Analyse the implementation of resource levelling and resource smoothing.
4. Identify how other resources are affected and re-scheduled, such as cranes, earthworks plant, concreting works, and other specific material supplies.

Research

The whole teaching intervention cycle was explained in the first session, but no initial training about PBL was considered to be needed by the students. Teams were created and scenarios distributed.

The team distributed these tasks so that each student was responsible for the coordination of one task. Every student had to lead the group during the execution of their task and was responsible for the corresponding summary report submission regarding that task.

The work was scheduled to be developed during one semester, covering a total of twelve presentational sessions grouped in four blocks according to the tasks given to each group. Each block consisted of three sessions. The sessions were carried in a computer lab where students had access to computers, software and internet to work. The room was displayed with meeting tables, giving the opportunity for students to sit in front of each other and discuss.

Mini-lectures were planned in all sessions about the topic to work, giving guidance about techniques and references to use. After this, tutorial sessions were developed with all groups to follow track of their work and solve any questions.

Considering individual assessment requirements, the outcomes to produce by the students were as follows:

1. Each student should submit an individual summary report about the outcome of their specific task. The individual reports from each group should conform a harmonized solution for each scenario. Individual reports should be structured as follows:
 - Introduction. Explaining the work to do and aim of your report.
 - Background. Very short literature review (500-1000 words).
 - Case study. Explaining characteristics of case study and restrictions that could affect that task in the project.
 - Solutions. Solutions implemented to solve that task.
 - Discussion. Problems found, other alternatives, how the best choice was selected, as well as changes and improvements that could be added to the initial solution and how to implement them.
 - Conclusion.
 - Appendixes. Any relevant information such as calculations, drawings, graphs, etc. should be attached as appendixes at the end.
2. Additionally, each student would prepare a 5-minute oral presentation about the task they coordinated. This work was voluntary.

Assessment

Assessment was thought to be a reflection of the whole process, but due to different constraints in the module delivery and general assessment rules, it was adapted to UWTSD rules.

There was only one final submission, the summary report. There was only one project for each group, where the solutions applied should be discussed and developed collaboratively, but the assessment was individually, so each student was planned to submit their own summary report. Other skills were initially thought to be included in the assessment, such as communication, team work, capacity of self-learning, etc. All these skills were considered to be incorporated in the final assessment, but marking did not allow to include the assessment of these skills separately.

Considering these circumstances, each student had to complete a separate outcome for the case study, but linked to the rest of outcomes in the team. This individual outcome was a summary report according to the previous instructions. The assessment was linked to the five generic assessment criteria as defined in UWTSD for level 6:

1. Engagement with literature skills
2. Knowledge and understanding skills
3. Cognitive and intellectual skills
4. Practical skills
5. Transferable skills for life and professional practice

These assessment criteria comprised the final assessment feedback and marking, which the student would receive together.

Regarding oral presentations, they were not finally considered in the marking scheme due to restrictions of the UWTSD assessment policy, and they were only optional for the students. Additional feedback (but not marking) was provided for their presentations, considering the following criteria:

1. Content
2. Structure
3. Delivery
4. Use of visual aids
5. Managing questions and discussion

A final assessment sheet was completed by all students individually where they could explain the following:

- their involvement and participation in the team
- Work percentage developed by each team member in the task they were responsible
- Positive aspects during their learning process in this project
- Aspects to be improved

Additionally, a feedback session was developed in class the last day to discuss about this activity impact and performance.

1.6. Discussion

This discussion included the tutor experience with this activity and the discussion of the student comments from the various feedback received. It was structured in different sub-headings based on the literature review, and comparing other authors' experience.

Student engagement and participation

Students were initially reluctant to any type of collaboration or team work. Their expectations were more focused on an individual assignment with no other dependencies apart from their own capacities. It is important to highlight that most of the students were part-time, working in industry and with time constraints. This circumstances affected the implementation of this technique to a great extent.

One of the biggest issues students had was they were not used to this learning approach. The format of classes was not familiar to them and did not know how to manage at first. It was not possible to run any tutorial sessions during the initial weeks because they did not prepare any materials and independent work was practically non-existent. As a consequence, the start of this exercise was delayed for three weeks. This problem was also identified by Davis and Wilcock (2003) in their report. Sahli (2017) also identified similar problems when the previous commonly used format was textbook based, but in that case the complaints came from the teacher's perspective. As this activity being the author's first approach to PBL, it was surprising to find this initial strong reluctance from the students to this learning technique.

On the other hand, the author did not have any previous experience in PBL. Despite the complete initial planning developed, the design of the intervention cycle had to be reviewed and adapted to the group capacity, which was previously unknown. Hung (2016) discussed about issues occurring when defining the scenario and how to avoid them. Following some of his recommendations, and considering the characteristics of this student group, some actions were put in place. For example, it was needed to prepare and deliver some full lecture sessions at the beginning so that the students could feel confident to start working on their projects. Besides, further detailed instructions were developed to help understand the steps of each task, and further guidance on literature and supervision was also carried out.

After this initial period, which took three weeks, the teams were more settled and started working more fluently. This way, tutorial sessions could be started, but with the aid of weekly mini-lectures which supported their work for the next week, following the experience from Nagle and Pecore (2018). These mini-lectures gave advice on the topics to deal with and proposed different techniques and procedures, as well as suggested references for further reading. This helped the students manage independent work better. Nevertheless, their final contribution was reduced and focused on one direction only, and as a consequence, it also reduced creativity which, although developed at some point, it was more constraint than expected.

In the student feedback, it could be observed that, despite these initial difficulties, they recognised the value of this exercise and the benefits they had. The fact of being involved in this process and having the capacity to take their own decisions was very well considered and also an engaging element that impacted later in their final results.

As long as work progressed, issues arose about participation and engagement with specific students in the team dynamics. This brought some internal conflicts that had to be solved with the agreement of the whole team. Similar situations were described by Soetanto et al (2012) in their case study. These issues were informed to the tutor conveniently and he suggested some solutions, which were later discussed and agreed by the team.

Scenario design

The scenarios proposed were linked to construction, and complexity was conveniently adapted to the level expectations. Despite that, civil engineering students complained about the lack of civil infrastructures, as all projects were buildings, and very much focused on construction management. Notwithstanding, it is important to highlight that the civil engineering role is also linked to soil excavation, basement construction and superstructures, which were the main aspects to solve in these scenarios. On the other hand, the outcomes to cover in this module were focused on construction management and planning techniques, so it was one unavoidable requirement of this module.

The tasks were linked between them, not independent. Students did not like to be interdependent and some teams had problems with coordination. A more detailed description of tasks, as well as the support with some additional lectures contributed to a better understanding of the exercise.

Time allocation

Time was a constrain element: firstly, considering there were only twelve sessions; secondly, students availability for self-learning and progress was limited. Due to initial problems with the assignment definition and understanding of tasks, the start of the exercise was delayed for three weeks. Despite that, during that time some lectures were carried out which could reinforce the student knowledge for the tasks to develop. On the other hand, as the tasks were linked, the last one was reduced and the coordinating students did not have as much time as expected.

Time was re-scheduled and agreed in class with the teams. Final submission was delayed for one week and time for the different tasks was redistributed.

Each session was planned with time distribution between lecturing and tutorial. In a two-hour time slot, an initial mini-lecture was programmed of about 30-40 minutes, and the rest of the time was allocated for tutorial. During that time, each team had individual meetings where they presented their work to the tutor. They received feedback and planned for next week. This task was coordinated by one student in each team, and this role rotated every three weeks.

Outcomes

Students achieved a good level with their outcomes, showing the application of different techniques of construction planning and programming to the different scenarios they solved. Although they only worked on one specific scenario as distributed at the beginning, they could see other solutions and techniques with the other scenarios solved by the rest of the groups.

The four tasks to develop had a similar level of complexity. Despite that, task four was less developed in general, probably due to a more reduced time to develop it. The impact in the team work, though, was not affected by it and the students who coordinated that task were conscious of that matter. Despite that, it was one element highlighted by the students in the final review.

Collaborative work was an initial handicap, but it was accepted progressively. Participation and collaboration was considered acceptable for most students, and exceptional in some cases. This was reflected in the individual final summary reports, which results were positive in most cases.

It is important to mention that students performed in a supportive way and the teams backed their members. The team dynamic reinforced the idea of a collaborative work and they could discuss and learn from each other. It is worth to highlight the experience with an international student in the group. He started with many problems of understanding due to lack of practice with English language, but also his background was slightly different and had not worked about construction management before. He was integrated in one of the teams as well. Progressively, he engaged with the topic and the support of his team members. His final report and presentation was outstanding. This could be as a result of the team support which helped him, but his different background from another country, cultural and education differences (perhaps more used to PBL), different dynamic experience to this group, and personal situation could have also influenced his good performance.

On the other hand, there was one student who disengaged completely from his group due to health problems. He could not attend many classes. The team had problems to complete his task and he was not successful at the end. Another student in a different team participated in his team activity, but his final report was with very poor quality. In a later personal discussion, he admitted work problems which affected his performance.

Regarding oral presentations, as explained before, they were voluntary. Almost 100% of students presented their work, though. Generally, these presentations were at a good level of quality and helped understand all scenarios and management solutions implemented. In some cases, they opened a small discussion in class about techniques and other possible solutions, which enriched the debate and showed a good understanding of planning and programming techniques in the class, which also showed the achievement of the learning outcomes of this module.

Assessment

Feedback and assessment were two differentiated elements and they were programmed at different stages. Regarding feedback, students received feedback continuously, which was developed as follows:

- During tutorials. Every week, the teams showed their work progress to the tutor. Then, the tutor made considerations about the quality of it and suggested different paths so that they could develop their independent work and improve it.
- Summary report feedback. Each student received individual feedback about their performance with this final report, evaluating the five generic assessment criteria.
- Oral presentation feedback. General feedback was given once all presentations were concluded, explaining aspects about how to improve communication skills. Personal feedback was also given to the students individually.

Regarding marking, marks were only given with the submission of the summary report as it was considered the main outcome for this exercise. UWTSD Assessment policy restricted the assessment to only one element each semester. These marks, though, tried to gather all the student work and performance during this semester.

Additionally, the students provided feedback for this module, answering individually to the feedback sheet provided in the assignment, but also in a feedback session at the end of this activity. Some positive comments were as follows:

- In general, they recognized they progressed with their learning. Some comments were like “I found it challenging but have learnt practical stuff for my work” or “the classes were helpful and I learned much from them”.
- Most of the students referred to this learning method as more practical, not theoretical, more engaging, and applied to industry problems.
- Some students mentioned that they could organize their time by themselves.

On the other hand, the following aspects to improve were identified:

- Time for tasks was not equally distributed. There were tasks which lasted longer than others. Preparation of Gantt chart (task 1) took longer, whereas resource smoothing (task 4) took only one week. This perception could be due to the initial time taken to start this activity. But it was obvious that time constraints and initial problems affected the correct development of tasks.
- Initial literature review for the summary was not considered as relevant. The purpose of it was that each student could make a summary of their independent work. But students only understood it as additional work.
- The tasks were chained, and some students had to wait until the previous one/s were completed. This was part of the team coordination work, but students understood it as a handicap to achieve their individual outcomes, probably because they did not fully understand this exercise as a full activity, and it could be due to the way it was planned (individual outcomes instead of one team outcome).
- There was disengagement with others’ work in the team. They felt they did not engage much with the four tasks apart from their own. It was as a consequence of splitting the work individually as mentioned before.
- Presentations should have been marked. This arose after the oral presentations, as they found them useful and engaged very well. Considerations should be taken about it when reviewing this activity and the way to adapt it to the UWTSD assessment policy.
- The assignment descriptor was not understood properly. It needed further clarification later. This was also due to the novelty of this learning method for this student group. Planning should have been improved and the teaching intervention cycle should have been introduced and explained in a better way so that initial misunderstandings would have been avoided.

1.7. Conclusion

The use of PBL was a valid learning approach for construction management students. With this case study, it could be observed that knowledge could be developed by these students properly, and they could work and improve other skills, such as independent work, critical thinking, communication and collaborative work.

The lack of experience in using PBL, as well as the common learning model for students being textbook based, caused the implementation of PBL to be challenging. Students were initially reluctant to this learning approach, although they recognized at the end it was a practical way of learning, engaging and more linked to their future work in industry.

It is essential to plan a good strategy for PBL, which should cover planning, implementation, monitoring and assessment. Planning should include a complete and correct design of the activity, as well as time schedule. Implementation will require an initial introduction to PBL approach and application to the designed problem/scenario. Monitoring will help follow continuous progress and review. This process should be completed with a continuous, complete assessment, which will evaluate performance of students, but also review the achievement in completion of the initial learning outcomes.

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2. Teaching intervention cycle poster

STRUCTURAL DESIGN LEARNING BY SUMMARIES AND SOLVED PROBLEMS

UWTSD. School of Architecture, Built and Natural Environments

Abstract

A case study is developed about the use of summaries and solved problems in one module about structural design. The complexity of this subject was synthesized in methodologies to solve specific problems, which was repeated introducing small variations each time. The student final results were outstanding. This module worked as an introduction to structural analysis.

Background

The case study was a L4 module, for HNC Civil Engineering studies. Structural design is one of the core knowledge for Civil Engineering according to the Institute of Civil Engineering (ICE). Students in this module (7 in total) were all part-time, linked to the construction industry. Their knowledge about Mathematics was poor and had had no approach to structural design before. The difficulties for the students to learn this subject were evident.

Literature review

Many authors have developed textbooks and manuals for structural analysis and design (Draycott, 2011) (Hibbeler, 2015). But this subject is of big complexity. Convergent thinking can help learning of basic concepts from where the subject can expand to more complex models (Zhang, Sjoerds, & Hommel, 2020). Summary notes and solved problems can support learning in this initial process and help later further development of knowledge.

Method

Contents

- Performance of basic structural elements
- Moments of inertia
- Simple bending theory
- Basic design of timber and steel beams
- Basic design of concrete beams

Resources developed by the tutor

Summary notes about all contents

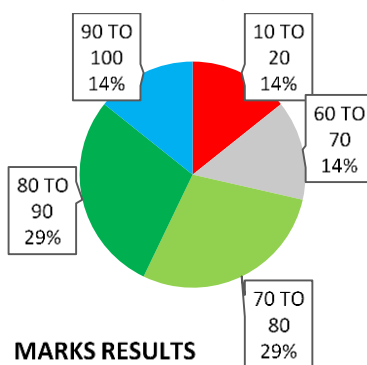
Solved problems about:

- Simple supported beams with point and distributed loads
- Moment of inertia of different cross sections with increasing complexity
- Design of timber joists and beams
- Design of concrete beams and columns

Sources used

Eurocodes 1, 2 and 3
BS 8500-1 and 2
BS EN 206-1
BS 4449
BS 8666
BS 8110
(Bond, et al., 2006)
(Draycott, 2011)
(Hibbeler, 2015)
Author's previous knowledge and experience

Results and Analysis



MARKS RESULTS

STUDENT FEEDBACK QUESTIONNAIRE (1 TO 5)

The contents explained have been interesting.	4.0
I have understood all the explanations.	4.3
I have been able to see a real application of the new knowledge.	3.3
The lecturer has been close to the matters of the students.	4.7
The lectures have been dynamic and participative.	4.7
The lecturer has accomplished with the right time of lecturing.	4.7
I have been able to attend tutorial hours.	3.5
The resumes issued by the lecturer have been interesting.	4.7
I know the assignments and/or exams to develop.	4.3
We have developed practical exercises in class.	5
The organization of classes has been right.	5
Average:	4.4

Conclusions

Summary notes and solved problems supported learning of these students very much. From an initial uncertain scenario, students could get confident as long as they could solve structural design problems by themselves. The final results in the assessment were outstanding. This learning worked as an introduction for structural design, which can be helpful for any further studies they would like to start in future. Suggestions were made about working more problems applied in the construction laboratory.

List of References

- Bond, A., Harrison, T., Narayanan, R., Brooker, O., Moss, R., Webster, R., & Harris, A. (2006). *How to design concrete structures using Eurocode 2*. Surrey: The Concrete Centre.
- Draycott, T. (2011). *Structural Elements Design Manual*. London and New York: Routledge.
- Hibbeler, R. (2015). *Structural Analysis (9th Edition)*. Singapore: Pearson.
- Zhang, W., Sjoerds, Z., & Hommel, B. (2020). Metacontrol of human creativity: The neurocognitive mechanisms of convergent and divergent thinking. *Neuroimage*, 210. doi:doi.org/10.1016/j.neuroimage.2020.116572

3. Teaching observations

3.1. Teaching Observation 1

PGCert tHE STAFF OBSERVATION FORM

Name of Staff member: *Juan Ferriz-Papi* Date: *24th October 2018*

Name of Observer: *Allan Nantel*

Number in class: 32

Student level: 6

Location: *FF004*

Topic: *Dissertation Presentations*

Start Time: 9.00 Finish Time: 10.00

Teaching Characteristics:

Juan had planned well for this session, reflecting on the preparation and effective delivery of dissertation Viva, a key element of the module in situ. The dominant focus of this lesson was to activate creative and innovative approaches to delivery, and bring sound communication and presentation skills in application of this knowledge to current practice in professional delivery to peers. This session was predominantly delivered with a lecture style approach, with an encouragement from Juan to engage the students in question and answer sessions.

Presentation:

Juan presented to a large group of students, who worked comfortably together. The presence of an observer did not impact on their willingness to engage and volunteer responses when questioned. There were no problems with class management, but there were challenges with establishing full class attention at first, which proved to be a deliberate approach by Juan and within the lesson plan.

The beginning of the lecture was thought provoking, even for the observer! A very original approach of presenting a terribly poor viva presentation to the group, without initiating an introduction or explanation of the content for the lecture. This surprised the entire room and would have had a very positive impact for memory call on the whole point of the delivery. A very clever approach! There was evidently an expectation by the students that they would have engaged in a professionally presented lecture start. Once it became evident that the utilised process was deliberate, students reacted positively, confirming the valid approach that Juan utilised. They should well remember this lecture when preparing their end of year presentation. The lecture enabled a fruitful and interesting discussion, comparing and contrasting the poor delivery to what they believed was a good one. Students were allowed time to discuss, via group work, the positives and negatives of the typically poor, and then professional delivered viva as demonstrated, and to formulate questions and use these as a catalyst for discussion.

The strength of subject knowledge was clearly appreciated by the students in the concluding section of the session, where they were able to ask questions. It is evident that Juan is keen to establish an environment where students are able to think about their ideas by asking provocative questions. He was eager to demonstrate that there is an opportunity for creative solutions to the challenges of the viva presentation and design.

Technique and Aids: *Juan made effective use of his Powerpoint, which was visually stimulating and used to encourage good discussion. Group analysis and discussion with open response was well utilised.*

Student Responses: *Following the initial students surprise of the deliberately poor viva presentation, the students relaxed and began to engage in lively discussion about the challenges of good delivery and design for their Viva presentations. The conclusion of the session was in stark contrast to the deliberately poor introduction, with students fully engaged. Open discussion and supported analysis helped to encourage their engagement in the session.*

General:

Juan's is developing a range of strategies to ensure valid and impactful learning is occurring during his sessions. He has a positive rapport with his students, who recognise his expertise and are keen to ask questions. Juan delivers clearly and at a very good pace. His students are engaged when he is speaking, and are constantly note taking.

Examples of good practice:

- *Visual stimulus – Powerpoint.*
- *Questions – to challenge and promote thinking.*
- *Subject expertise.*
- *Innovative approaches to teaching*
- *Group discussion and analysis*

Action points:

- *Explore the use of emergent technologies to APK.*
- *Provide lesson plan and slide copies for observer.*

Thank you for letting me observe the lesson. I found this an excellent presentation and a thought provoking approach to the learning process.

Observer *Allan Nantel*

Date *24th October 2018*

Oberservee *Juan A Ferriz-Papi*

Date *24th October 2018*

On completion of the peer observation reports for each module, compose a short reflective paragraph on your observation experiences.

3.2. Teaching Observation 2

PGCert tHE STAFF OBSERVATION FORM

Name of Staff member: *Juan Ferriz-Papi*

Date: *13th March 2019*

Name of Observer: *Sue James*

Number in class: *3*

Student level: *6*

Location: *IQ 107*

Topic: *Architecture*

Start Time: *9.15* Finish Time: *12.00*

Teaching Characteristics:

Juan had clearly planned for this session, reflecting on the previous learning and preparing for a trip to identify the key elements of the module in situ. The dominant focus of this lesson was to activate prior knowledge and make application of this knowledge to current practice in architectural design with sustainability at its core. This session was predominantly delivered with a lecture style approach, with an encouragement from Juan to engage the students in question and answer sessions.

Presentation:

Juan presented to a small group of students, who worked comfortably together. However, the presence of an observer in the group impacted on their willingness to engage and volunteer responses when questioned. There were no problems with class management, but there were challenges with establishing a lively rapport with the students initially. Towards the end of the session they became less intimidated by the observer's presence and they began to engage more readily in discussion.

Activating priory knowledge (APK) was a key element of this lesson and the questions presented in the beginning of the lecture were thought provoking, but met with a little reluctance to engage. There was evidently an expectation that the students would have engaged in the module reading for the session, but the students had clearly forgotten the content. Once this became evident that the students had not completed the reading tasks it was good to see that you provided reasonable time during the session for them to read and reflect on the documents. This enabled a more fruitful and interesting discussion.

The strength of your subject knowledge, which was clearly appreciated by the students in the concluding section of the session, where they were able to ask questions. It would be a positive idea to allow time for students to formulate questions and use these as a catalyst for discussion. Although, your questions were pertinent, however, where the students struggled to respond you needed to give them more thinking time before you respond with an answer.

It is evident that Juan is keen to establish an environment where students are able to think about their ideas by asking provocative questions. He is eager to ensure there is an opportunity for creative solutions to the challenges of design too. This aspiration can be more fully realised if there is time factored into the session for the students to engage with a problem solving activity, to endorse the active learning aims of the session.

Technique and Aids: *Juan made effective use of his Powerpoint, which was visually stimulating and used to stimulate discussion at times. However, there was a missed opportunity to use a broader range of enhanced technologies, which could have provided a more engaging APK stimulus for the students, (as discussed).*

Student Responses: *Juan struggled to illicit any discussion initially; despite the presenting stimulating questioning. However, the responses from the students was definitely affected by the presence of the observer. Following a break, the students relaxed and began to engage in lively discussion about the challenges of creating designs which fully addressed conservation issues. The conclusion of the session was in stark contrast to the introduction with students fully engaged. Offering the students' time to review the texts provided also, helped to support their engagement in the session.*

General:

Juan's is developing a range of strategies to ensure learning is occurring during his sessions. He has a positive rapport with his students, who recognise his expertise and are keen to ask questions; when given the opportunity. Given the size of the group the lecture style approach was less successful and when you were working alongside the students there was greater willingness to contribute, (investment in a clicker would enable you to work with the group at the table and remove the need for the need to be more fixed to the lectern, as discussed).

Examples of good practice:

- *Visual stimulus – Powerpoint.*
- *Questions – to challenge and promote thinking.*
- *Subject expertise.*

Action points:

- *Explore the use of emergent technologies to APK.*
- *Establish clear points in your session for student thinking time.*
- *Investigate using Problem-based learning strategies in your sessions.*

Thank you for letting me observe the lesson, I thoroughly enjoyed it and you should gain confidence from this observation.

Observer Sue James

Date 15th March 2019

Oberservee Juan A Ferriz-Papi

Date 15th March 2019

On completion of the peer observation reports for each module, compose a short reflective paragraph on your observation experiences.

3.3. Teaching Observation 3

PGCert tHE STAFF OBSERVATION FORM

Name of Staff member: Juan Ferriz-Papi

Date: 13th May 2019

Name of Observer: Chris House

Number in class: 8

Student level: 7

Location: IQ 206

Topic: Architecture

Start Time: 14.00 Finish Time: 15.00

Teaching Characteristics:

Juan's ex-ante planning and preparation were precise and well-considered. A logical and well-constructed lesson plan which acknowledged the level and differentiation of the student group. Learning objectives engaged with the knowledge/skill level of the student group although some misconceptions were identified during and post-delivery.

Presentation:

A varied and valid set of pedagogical strategies used to engage the group in the subject matter. The student group remained focused on the tasks and lecture due to the sound management of the class environment. Perhaps consider using an appropriate 'ice breaker' to form a relationship with the group. I discussed possible methods with Juan after the lecture. Some excellent use of contemporary resources that provided a forum for intellectual debate and practical applications. The use of powerpoint was generally accomplished and appropriate. Some minor issues were discussed. The lecture and exercises gave the students the opportunity to develop and refine their skills and knowledge.

Within the short timeframe of this lecture Juan was able to develop a competent and credible group dynamic which was based on his natural ability to engage with the class. Perhaps he could have used the different experiences of the students to enhance the contextualisation of the learning experience.

Technique and Aids:

A mature and well-informed style of questioning that allowed students to answer and ask questions to promote their comprehension of the subject. The style of dealing with questions gave students the confidence to become more involved in the class. However, the misconception noted earlier is an essential lesson in pedagogical development

Student Responses:

The student group clearly liked the style and pace of Juan's lecture, and a variety of appropriate methods were used. His considerate and infectious personality was evident and is a critical teaching trait which deserves considerable credit.

General:

Juan's knowledge and experience in the subject meant the lecture had good pedagogical attributes that highlighted the links between practice and theory. Also, his natural style and personable manner mean he has the skills to be an exceptional educator within HE.

Examples of good practice:

- developing a positive and productive group dynamic
- managing and developing diverse levels of motivation and skill

Action points:

- Learning to deal with mistakes within the conceptual agenda

Observer Chris House

Date 20th May 2019

Observed Juan A Ferriz-Papi

Date 20th May 2019

On completion of the peer observation reports for each module, compose a short reflective paragraph on your observation experiences.

4. Reflective evaluation of CPD events

4.1. CPD event 1

Kick-off Meeting for PG Cert tHE Team at ABNE

School of Architecture, Built and Natural Environments

Room 203. Mount Pleasant Campus. University of Wales Trinity Saint David

3rd July, 2018

Overview and content

There was the requirement from the Faculty of Architecture, Computing and Engineering to increase the number of HEA (Higher Education Academy) members among the Lecturing staff. ABNE (School of Architecture, Built and Natural Environments) is involved in this process. The aim of this meeting was to agree about the process to achieve HEA fellowship and PG Cert tHE certificate for six members from ABNE.

After a brief presentation of each other, the discussion was focused on the work to do for the achievement of 60 credits in level 7 for the PG Cert tHE certificate and the organisation of work as a team to improve our teaching as well as to support each other in this process.

Mr Mark Flagg was invited to this meeting. He gave instructions about how to complete the different tasks for these modules and how to apply for RPL recognition in case it is applicable. During the discussion, three main aspects were highlighted to work as a team for next year: Induction, Dissertations and a Poster mini-conference with our individual work.

Induction. It was programmed to start next 22nd September with the student welcome and developed during the following week. We agreed to work about the activities to prepare during the 22nd of September, together with one open day programmed for the same date. Some suggestions were proposed such as the organisation of this mini-conference and to use it as CPD and peer teaching observations.

Dissertations. The interest was to improve the student learning experience during this period. Suggestions were developed as brain-storming. A group of workshops would be arranged to be developed with students to help their performance. This was also suggested to be used as peer teaching observations.

The submission of this work would be decided individually according to their possibilities. The final decision was to programme other progress meetings so as to get feedback from each other. For the ones who applied, the RPL recognition application was agreed to be submitted during the summer.

Reflection

The running of this meeting helped show the capacity of the group to organise themselves for planning learning activities (A1) with a vision towards the completion of a full teaching-learning cycle (A2, A3), in this case linked to the achievement of the PG Cert tHE. It also demonstrated the capacity of programming and developing continuous professional development about teaching skills (A5) creating a collaborative environment (A4).

The experience of the participants helped the flow of the meeting contributing with ideas and proposals to be introduced in this learning process (K1, K2). Collaborative work was identified as crucial to learn about construction learning and teaching, as the participants' experiences were considered very valuable to learn about new approaches (K3). The main purpose of this meeting was to work on planning, although some techniques were also suggested to be implemented in the process for feedback as a group, such as the organisation of a mini-conference or peer-teaching observations (K5, K6).

The participants in the group were at different stages with this course. Some were starting whereas others had already worked some parts of the modules. The group integrated all participants with the vision of helping the last ones and pushing all at the same pace (V1, V2). Besides, it was a very good exercise of participation as creativity for proposals and implementation were also improved. Furthermore, it strengthened the relationship of the group members for collaboration because of the supportive environment (A4).

4.2. CPD event 2

Teaching and Learning Sharing Good Practice Forum

Faculty of Architecture, Computing and Engineering

Room 002. IQ Building SA1 Waterfront Campus

21st November, 2018

Overview and Content

Working on comments and proposals gathered from one survey about staff training demands for this academic year in FACE, Greg Owen organised this forum with the following purposes:

- Work on T&L staff development
- Show how teaching evolves and can be enhanced in class for student engagement
- Demonstrate some techniques that other lecturers are using in class
- Show a variety of teaching styles depending on different contents and approaches

There were five lecturers presenting their experiences in the use of applications for teaching and learning. They were as follows:

- Greg Owen. Using Panopto for feedback and support.
- Abigail Summerfield. Using a surface and Onenote for teaching
- Tim Tudor. Supervision of Group Project through Notebook and Onedrive. Shared spaces
- Owen Williams. Using Ipad for Whiteboards apps. Equations, drawing and notes
- Kelvin Lake. Use of Penultimate Notebook

The presentations were brief, not occupying more than 20 minutes each. They were practical experiences linked to the Lecturer's daily challenges for different subjects, solutions implemented and feedback from students.

Reflection

The presentations could show the application of different software and apps in class for different purposes, from the use of the screen as a whiteboard to collaborative work and shared spaces online (K4). It was useful to see how actual problems with traditional whiteboards, for example, can be sorted in a digital environment. Complex contents of teaching, such as Mathematics or Science, were shown how they were taught with different case studies and solutions (K2, K3, A4). Student engagement was shown to be at a high level compared to other traditional techniques in class (K4, K5).

It was relevant to notice the large number of students in class where these techniques were applied. Some of these groups have more than 50 students. It is even more difficult to manage a class with such a big number of students, and some of these tools showed a big improvement to be able to manage the group in an adequate manner and, at the same time, engage them (A2, A4, K3, K4, V3). This is the case of Greg Owen's experience. The use of Panopto has given the opportunity to prepare multiple assessments for big groups of students that can be marked easily and students can get feedback properly (A1, A3, K2). In this case, a full

explanation of the assessment solutions is recorded and given access to students to this video so that they can watch it as much as they need (A3).

The experience from Tim Tudor was also very interesting. In this case, he was working Group Project with students, where they worked collaboratively on one project during the whole year. The lecturer created virtual shared spaces for each group of students so that they could share their work and the lecturer could monitor progress. This showed a useful solution for team working in an online shared space (K3, K4, V3), and the corresponding monitoring of the Lecturer (A2, A3).

The use of digital technologies showed to be very helpful. Despite that, it was agreed that these tools should be used according to the needs in class. Furthermore, it does not replace personal contact with the student, which is crucial to understand the student needs and actual engagement with the learning process (V1, V2, V4). for specific environments in concrete situations

This workshop could help enhance lecturers' performance and student engagement as well, what can contribute to create a more improved learning environment that will benefit our students in FACE (A4, A5, V4).

4.3. CPD event 3

Circular Economy Research and Innovation Group Meeting

Swansea University

Room 12.10. Tower Building. Cardiff University (Cardiff)

19th June, 2019

Overview and Content

The Circular Economy Research and Innovation Group (CERIG) in Wales is working since last year, and the main purpose is to create collaborative work between research institutions in Wales so that they can create knowledge and innovation, support industry to introduce circular economy in their activity, create consciousness in society, and support the Welsh Government with policies around circular economy. Last 19th June, one meeting was developed at Cardiff University facilities with the intention to continue working on different matters arising.

Discussions developed were around different aspects, such as the following:

- Information was provided about different events occurring about Circular Economy in Wales, UK and European Union. Main concerns were highlighted about plastics, microplastics and fibres, resource efficiency, procurement, etc. Feedback was provided by CERIG to Welsh Government policies about Circular Economy about Extended Producer Responsibility, and there will be a review of the Zero Waste Strategy soon in which CERIG can also participate.
- Funding opportunities were identified and potential research projects were proposed where teams can be created in CERIG to work about them. Besides, the CERIG web-site is updated with different contributions from its members about case studies applying circular economy principles.
- A presentation was carried out about the Centre for Climate Change and Social Transformation (CAST). It was presented by Prof. Lorraine Whitmarsh from Cardiff University, and she showed the opportunities it can offer for CERIG members.
- Samantha Williams, from the Welsh Government Innovation team, presented the Futureproofing Toolkit. This intends to be a tool of circular economy assessment for business, and will be implemented in future as a requirement for any funding from the Government. The CERIG group put in practice this tool and provided feedback about its performance and improvement.

Reflection

Since this event was more related to research perspective, the main contribution was linked directly to the acquisition of the subject knowledge (K1) and continuous professional development (V3, A5). Despite that, indirect links can be also identified as follows:

- Research and innovation is core to obtain high levels of student learning and professional practice, increasing the quality of teaching (K6, A5). It gives a vision of the wider context in which high education operates and the contribution to industry (V4)

- It helps to design learning activities and support the learning/teaching process with different approaches to the way students can learn (A1, A2, K2, K3). It also helps use appropriate resources and technologies for teaching (K4)
- The implementation of research outcomes in class (in the form of papers, experiments, case studies or similar) can help improve professional development and the capacity of students for self-learning and creativity, also linked to equality of opportunity for learners (V2, V3, A5)

In particular, the activities in this meeting were also linked to the learning process. For example, the use of feedback in different situations to learn from others (e.g. consultation process from Welsh Government, or feedback given about Futureproofing Toolkit) (A3, A4, K4, K5). In both cases, procedures were developed so that feedback could be gathered and analysed properly. Full learning cycles can be identified in these two examples, in which we intervened at some point to give feedback about their performance (A1).

5. Reflective assessment of development

The period undertaking this programme has been a permanent review of the teaching methodologies and approaches I have used during the last seventeen years working at Higher Education. My practice as a Lecturer has always considered my experience when I was a student, and has made me think about what worked and what did not. Innovation and new practices in teaching in Higher Education has challenged my interest and creativity to develop good learning environments in class and support the student experience.

I consider practice and experiential learning as an essential element to improve understanding and engage students in class. Even more, this is a requirement that industry is demanding. New courses introduced at Higher Education, such as apprenticeships, are mainly focused on covering this demand with an important range of practical aspects incorporated. Despite that, if we focus only on practice, Higher Education is at risk of becoming vocational training. There should be other skills develop which can make industry evolve and develop new innovative solutions. Such skills are, for example, decision making and critical thinking. Besides, a more connected, complex society brings to other necessities to develop, such as communication or collaborative work. As it is observed, not only knowledge or practice, but a holistic approach is what is required to develop a wide range of skills for future professionals.

The teaching interventions I have completed for this report were based on the development of practical skills, but also other skills mentioned before. Constructivism is one of the paradigms in modern Higher Education. The use of textbooks in class is being set aside and a series of more dynamic and practical techniques are being introduced more often, where the Lecturer's role is also being transformed to become a tutor for the student's guidance. This is where I would like to tend in the following years, and the case studies explained will form part of my own learning process to that goal.

I have been able to learn many things during the development and completion of these teaching intervention circles. I think I am capable now of implementing project-based learning properly, following the steps for planning, implementation, monitoring and review. At the same time, the experience with summaries and solved problems in structural design helped understand students' thinking process and improve it using convergent thinking. There were things to improve, though, as discussed in this report. The whole process of PBL should correctly designed and programmed to avoid potential misunderstandings and problems. On the other hand, the reduction of knowledge to solve specific problems can work as an introduction in the subject but limits the student capacity unless there is further improvement later.

I am very thankful to the colleagues that have supported me during this journey. But this is just continuous development. It does not end here. There is a long path to walk in Higher Education where you never stop learning. The construction industry is evolving to a more engineered process and universities have a lot of changes and innovative improvements to contribute. The type of learning our students have now will shape the future we will have next.