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Are our teaching approaches suited to the current generation of engineering students?

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ABSTRACT

Engineering lecturers often find fault with students' basic engineering skills yet are concerned about providing courses that appeal to 'generation Z'. In this study we asked students of civil engineering at the University of Plymouth, via group interviews, to identify matches and mismatches between the teaching on the course and their learning preferences, in order to determine whether the teaching approaches are suited to the current generation. Complete openness of access to all course material was identified as being at the core of their learning preferences. This includes course material and lecture content, accessed from the VLE as needed, and video capture. But students were clear that they enjoyed engaging in class activities, and identified working with examples in class, especially real-world examples, as a favoured method of learning. In effect, the students are seeking for their lecturers to control the class *experience*, but not to control, or to limit in any way, access to the *content* of the course. Most students had appreciation of the importance of basic engineering skills like sketching and hand calculations, but this came from industrial experience and not necessarily from their natural preferences or from course content.

INTRODUCTION

We were motivated to carry out this study while attending a staff away day for the School of Engineering at the University of Plymouth in July 2018. At one point in the day there was discussion of aspects that impacted negatively on students' performance on the courses

(primarily civil engineering and mechanical engineering). The comments were predictable, some obviously important and some rather dreary, including: 'poor note-taking skills', 'poor attention span', 'poor skills in the use of sketching to present ideas', 'poor use of log books'. Certainly some of these comments seemed ironic in the light of a later discussion, which was about 'how do we ensure our teaching is connecting with generation Z'. We decided then and there to ask our students directly what they felt about the match or mismatch between the staff's teaching approaches and their own learning preferences.

SUMMARY LITERATURE REVIEW

Many published papers speculate on the characteristics and educational preferences of generation Z. One that is specific to engineering is by Moore et al. (2017), from the USA, which presents an extensive analysis of the differences between generations, and a discussion of developments in engineering education. They propose particular approaches that they feel will suit generation Z, including problem-based learning and a focus on information skills. A study by Barreiro and Bozutti (2017), in Brazil, directly considers the 'challenges and difficulties to teaching engineering to generation Z'. The study, based on a survey of teachers' perceptions and knowledge, identified 'a major problem ... in linking theory with practice', revealing at least as much about the emphasis within course delivery as about the learning preferences of the students. Boles et al. (2009), in Australia, consider 'synergies between learning and teaching in engineering'. They make the point that 'the interaction between the students' learning styles, lecturers' learning styles, teaching styles and philosophies ... holds a great potential for enhancing students' learning environments and outcomes'. The paper places emphasis on classification of learning styles, and a systematic matching between staff and students. Also in Australia, Grysbers et al. (2011) ask a question relevant to the current study, 'why do students still bother coming to lectures, when everything is available online?' They found that the great majority of science students surveyed valued the experience of lecture attendance even when there was full online availability.

AIM / RESEARCH QUESTION

The aim of this small-scale case study involving civil engineering students at the University of Plymouth was to ask the question, 'are our teaching approaches suited to the current generation of engineering students?' The main reason was to determine whether changes should be made to course delivery of the course or to the assumptions of lecturing staff.

We didn't want to start with assumptions based on other people's characterisation of 'generation Z', not least because there was no reason to assume that engineering students, and specifically civil engineering students at Plymouth, would comply with any stereotype. We just wanted to ask the question.

METHODOLOGICAL APPROACH

This survey consisted of six semi-structured group interviews held with a total of 35 year 3 students of Civil Engineering at the University of Plymouth (24 male, 11 female; from two cohorts: 2018/19 and 2019/20), as shown on Table I. Most had placement experience. The group interviews were facilitated by the two authors, both of whom had experience of running similar groups with students.

Group	Date	Number	Male	Female	With placement experience
1	5 March 2019	3	2	1	3
2	5 March 2019	4	2	2	4
3	25 March 2019	7	5	2	5
4	25 March 2019	4	4	0	2
5	15 October 2019	10	6	4	8
6	15 October 2019	7	5	2	3
Total		35	24 (69%)	11 (31%)	25 (71%)

Table I Interview group details

After completion of consent forms and confirmation about anonymity, the following statement was made.

'This is not a course feedback meeting. It is not about who's a good teacher or a bad teacher. However if there are specific examples of 'good' or 'bad' approaches that help you make a point, please use them. This is definitely not about who might be a good student or a bad student.

'Teaching in higher education typically takes place across a gap of a generation. Students today almost certainly want to learn in ways that are different from how their lecturers wanted to, or were forced to, learn when they were students.

‘There’s actually just one question we want to ask you. We’re looking at the match or mismatch between our teaching approaches and your learning preferences. In that context, what do you like, and what do you not like, about civil engineering course delivery at Plymouth?’

The main question was deliberately open. Prompts were used to direct the students’ focus to different aspects of the course.

The responses that relate directly to the aim are reported here. Other issues that emerged in the discussion about the course more generally have been reported back to the staff group.

KEY FINDINGS

One of the first points always raised was a preference for learning from worked examples, especially real-life examples, and for solving examples in class.

I think most people ... learn best when you’re hands-on, so with worked examples we’re doing it ourselves.

If I look at the lecturers or the modules that get the best attendance, that I enjoy the most, the ones that I do best at, are the ones where lecturers go through and do worked examples, because you can see how you’d use it in real life as well ... I’d follow that same process so I can see how I’d use it, in a job.

The other key preference was for teaching that is supported by open and comprehensive access to all material and lecture content. This includes course material, lecture presentation content, video capture and annotated notes.

In spite of the benefits of complete openness of access to material, students also seek to benefit from attending and engaging in classes.

The digital content and the lectures have to work hand in hand – each has to add something.

I think a mixture of the two is probably the ideal place to be because they complement each other ... [with] the Open University, you can sit at home and do it all yourself, but that's not what we signed up for here.

Reasons for attending include giving their studies a framework and discipline, the learning 'atmosphere' of a class, and the opportunity to collaborate with fellow students.

Did complete access to material make students less inclined to attend classes? The consensus was that it did not reduce their attendance, and that access to the material was most effective when supporting the experience in class.

If you're not going to attend, you're not going to attend, whether the material is there [on the VLE] or not.

In some discussions, a style of teaching which was effective in many ways but which did not include complete openness of access to all content (as a teaching strategy) was identified as 'old school'. This limit to access to course material outside the class did not suit the learning preferences of many students, and some found it frustrating.

What about 'traditional' engineering skills: for example, good sketching skills v. a preference for using CAD, or the use of hand, 'back of envelope', calcs v. using a spreadsheet? From discussion of these aspects it emerged that the students generally understood the usefulness of sketching and hand calcs, but this awareness had come from their industrial experience. They conceded that their own preference might otherwise have been for computer-based approaches, and it was clear that it was their industrial experience, not even their experience of the course itself, that had changed their attitudes.

I think everyone likes to think that they're going to using CAD a lot more and won't have to be doing sketching or hand calcs, that's why everyone is attracted to CAD and Excel ... In reality the moment you stand on a site and you're soaking wet covered in mud, you've got to draw it by hand because you're not going to have access to a laptop, and even if you did it wouldn't work because it's pouring down with rain.

People on site wouldn't look at CAD ... why are you giving me that, just sketch it for me? I think it's us not wanting to believe that we have to do it, we all think it's just technology technology.

They did indicate that their experience on the course had persuaded them of the importance of simplified calculations in one context: to validate output from software. And they appreciated the importance of developing the knowledge needed to understand that output.

Yes we know it's going to go into software but it's the fundamental knowledge behind it that makes you an engineer.

However, they made the convincing point that since much of the course put a focus on detailed analysis, the importance of simplified calculations was hardly likely to have prominence.

DISCUSSION

We realise that we were talking to the more engaged of our students. Participants were invited by email. The only incentives we were able to offer were coffee/tea and biscuits. Those attending were approximately one third of those invited. The other important (and related) characteristic is that most had been on placement, and this experience seemed to genuinely affect their attitudes to their experience at university.

In seeking to identify the match or mismatch between teaching approaches and learning preferences, our groups involved a deliberately wide-ranging discussion of what our students liked, and did not like, about their course. Emphasis has been given in this paper to aspects that point specifically to teaching approaches that are suited (or not suited) to the current generation of engineering students.

Two main favoured characteristics were identified. One was significant use of examples: worked examples, examples solved by students in class, especially where there was obvious real-world application. The other was complete openness of access to all material, including lecture content, video capture and annotated notes.

This desire for access to material does not equate to a 'take it or leave it' attitude to class attendance. The students wanted to engage in class activities; they would not have been satisfied just working with the material independently.

Industry experience greatly affects students' perceptions. In judging the value of good sketching skills (as opposed to always favouring CAD) or the use of hand calcs (as opposed to using Excel), experience of industry has persuaded the students to go against what might have been their natural preferences. Another impact of industry experience is that it enhances students' frustration when there is not open and comprehensive access to material and lecture content. Their experience of industry reinforces this.

When I was on placement, if I missed something or I didn't hear something, I'd ask again or I could always look it up again.

This is part of an interesting tension between the learning preferences of the current generation of engineering students and the effect of any experience they have had of working in industry. In the case of sketching or the use of hand calcs, experience of industry has convinced the students that 'old-fashioned skills' have value in spite of their generation's supposed preference for computers. Whereas in cases where 'old-fashioned teaching' limits open access to material, what might be seen as their generational dissatisfaction with not being able to access all the material themselves is reinforced by their experience in industry.

CONCLUSIONS & RECOMMENDATIONS

Our overall interpretation is that the current generation of engineering students are seeking for their lecturers to control the class *experience* (for example, effective use of examples, engagement in class activities), but not for them to control, or to limit in any way, access to the *content* of the course. While the current generation want complete openness of access to course material, that doesn't mean that the importance of effective teaching in the classroom is lessened.

This small-scale case study has particular relevance to the delivery of civil engineering courses at Plymouth, but we hope that the findings are of interest more widely, to guide practice and course development and as an endorsement for industrial placements.

REFERENCES

Barreiro S C and Bozutti D F (2017) Challenges and difficulties to teaching engineering to generation Z: a case research. *Propósitos y Representaciones*, **5** (2), 127-183. <http://dx.doi.org/10.20511/pyr2017.v5n2.163> [accessed September 2019]

Boles W, Hadgraft R and Howard P (2009) Exploring synergies between learning and teaching in engineering: a case study approach. *Australasian Journal of Engineering Education*, **15** (1), 19-26. <https://doi.org/10.1080/22054952.2009.11464020> [accessed May 2019]

Gysbers V, Johnston J, Hancock D and Denyer G (2011) Why do students still bother coming to lectures, when everything is available online? *International Journal of Innovation in Science and Mathematics Education*, **19** (2), 20-36. <https://openjournals.library.sydney.edu.au/index.php/CAL/article/view/4887> [accessed September 2019]

Moore K, Jones C and Frazier R S (2017) Engineering education for generation Z. *American Journal of Engineering Education*, **8** (3), 111-126. <https://files.eric.ed.gov/fulltext/EJ1162924.pdf> [accessed September 2019]